Investment opportunities at the intersection of environment and nutrition

October 2025



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Executive summary (1/4): Context and objectives of this study

With SDG 2 off track and climate change accelerating, investments in selected food value chains can address both nutrition and environment objectives. Development Finance Institutions (DFIs) are already paving the way

- Across the world, there is a deficit in both supply and consumption of healthy and diverse foods, with a wider gap observed in Latam, S&SE Asia (South and Southeast Asia) and SSA (Sub-Saharan Africa).
- While a third of all greenhouse gas emissions caused by humans is linked to the production, processing, packaging, and transport of food, climate change is, in turn, increasing yield variability and reducing overall production, thus harming our ability to ensure access to nutritious food for all.
- DFIs are already identifying investment opportunities that can help increase nutritious food supply while lowering its environmental impact. The seven DFIs studied in this report[1] have all actively invested in nutrition, with nearly half of their food investments in *nutritious* value chains, of which more than half serves (at least partly) local markets. These DFIs also all set net zero goals for GHG emissions by 2050, along with other environmental commitments, and support their investees in improving their environmental practices, especially when they operate in food value chains with high environmental impact (e.g., animal-based foods).

This report highlights existing and potential investment opportunities, as well as environmental and social best practices, in value chains at the nexus of nutrition and environment, that could help further accelerate this transition toward healthier, more sustainable food systems. It hopes to serve as inspiration for investors looking to maximize their nutrition and environmental impact while achieving their RoI (Return on Investment) targets.

Notes: (1) This report includes information on investment portfolios of a subset of 7 DFIs: IFC, BII, FMO, Norfund, DEG, Proparco, BIO - which should not be considered as an accurate representation of all DFIs globally.; Source: Global diet quality project, Global Nutrition Report 2022, GAIN article, UN FAO, Costlow et al., 2025, UN, Food systems account for over one-third of global greenhouse gas emissions (2021), Our World in Data, CGIAR.

Executive summary (2/4): Methodology

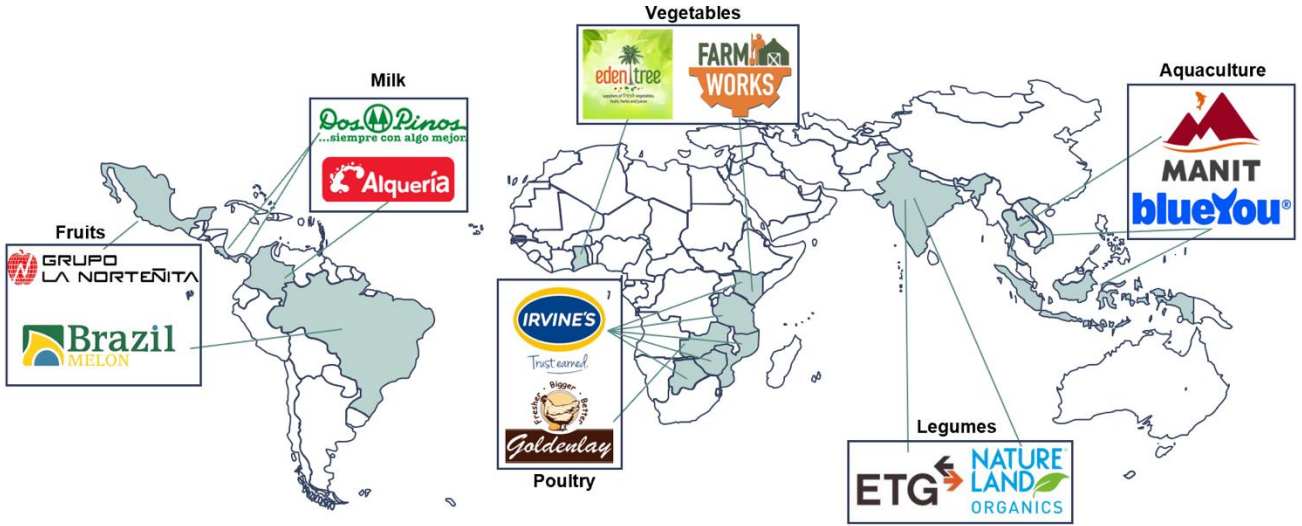
Analysis along 3 selection criteria to prioritise 6 food value chains…

1. Nutritional impact, with a focus on food with inherent nutritional value.

2. Environmental impact across four indicators: GHG emissions, terrestrial acidification, water use and land use.

3. Investability, with global market size and number/ amount of DFI investments used as proxies.

… across SSA, S&SE Asia, and Latam with two case studies per value chain



Executive summary (3/4): Findings on plant-based value chains

Market outlook

- Fruits, vegetables and legumes have **high inherent nutritional value and low environmental impact.** These foods are well anchored in the **diets of Latam, S&SE Asia and SSA, yet consumption per capita remains lower than recommended.**
- **Market sizes are relatively small but growing**
  - Legume production in S&SE Asia is a $49bn market (compared to $197bn for aquaculture), and vegetables production in SSA is valued at $18.5bn.
  - Growth is steady: 4.2% CAGR for fruits in Latam, 10% for vegetables in SSA, with organic segments surging (e.g., 20% CAGR in India's organic sector).
- Investors cite **market fragmentation as the biggest hurdle**: a mix of smallholder farmers with low productivity and a few large distributors, all struggling with quality and ESG standards.

Opportunities

Wholesalers could play an aggregation role and strengthen local market access, as well as reduce post-harvest losses through operational optimization and tech integration

- Market access is the key driver of improved farmer productivity—far beyond input subsidies or training according to entrepreneurs interviewed. Wholesalers aggregating supply from smallholder farmers and distributing locally are therefore key levers for greater local consumption, that investors can support in optimizing operations for greater efficiency—especially with IT systems for smarter sales forecasting and route planning.
- More than 40% of total production for fruits and vegetables in SSA and Latam are lost post-harvest: improving logistics efficiency, grading and sorting products as well as cold and/or drying technologies can reduce waste, improve farmer's and distributors' revenues while increasing the availability of affordable products.

Investors' possible roles

Wholesalers remain high-volume, low-margin businesses, requiring patient capital and technical expertise to maximize their and their farmers' productivity

- Today, despite strong (reported) revenue growth and financials, these companies struggle to attract private investment.
- This is a clear impact and economic opportunity for investors—which will require small tickets ($5m) for early stages of growth and targeted support in agronomy, nutrition, and operations.

Executive summary (4/4): Findings on animal-based value chains

Market outlook

- **Poultry in SSA, aquaculture in S&SE Asia and milk in Latam are well anchored in local diets** and are important food sources to cover protein intakes and micronutrient deficiencies – provided that they are not heavily processed.
- While they have a higher environmental impact than plant-based foods, this report focuses on the **least environmentally impactful animal-based products and identifies ways to reduce their footprint further**.
- **These markets are large and have already seen substantial investment and DFI support, which has helped improve environmental practices.** The large size of global dairy, poultry and aquaculture markets translates into higher investment amounts and focus from the seven DFIs sampled in this report.
- Yet, as more mature value chains, **their projected growth is relatively modest**: just 0.7% annual value growth for milk in Latam and 1.9% for poultry in SSA, with aquaculture in S&SE Asia as the exception (5.4% CAGR).

Opportunities

There is still room to further scale successful models, as well as to increase productivity and reduce environmental impact

- Selected breeds for poultry and aquaculture can reduce feed conversion ratios, improving productivity while cutting environmental impact.
- Some of the best practices identified to lower fish and poultry's environmental impact can also generate additional revenue streams (e.g., getting blue carbon finance for mangrove restoration, commercialising manure as organic fertilizer).
- In the milk value chain, large companies have shown that providing their suppliers with training and equipment (like solar panels or biodigester) can significantly improve productivity and reduce environmental impact.

Investors' possible roles

Impact investors' support is still required to expand established players' operations and improve their nutritional and environmental impact

- Established players would still benefit from DFI's attractive financing terms for their capex and equipment. For DFIs, these companies are also worth investing in to reach livelihood objectives, as smallholder farmers are often their main suppliers.
- Innovative models that generate revenues from environmental best practices (e.g., carbon credits, blue finance) may require blended finance to scale, and DFIs are well placed to offer it.
- Partnering with experts, investors can help companies reformulate products for better nutrition (e.g., lowering sugar in dairy products) and adopt greener practices.

Notes: Additional issues and opportunities related to animal welfare are not covered.

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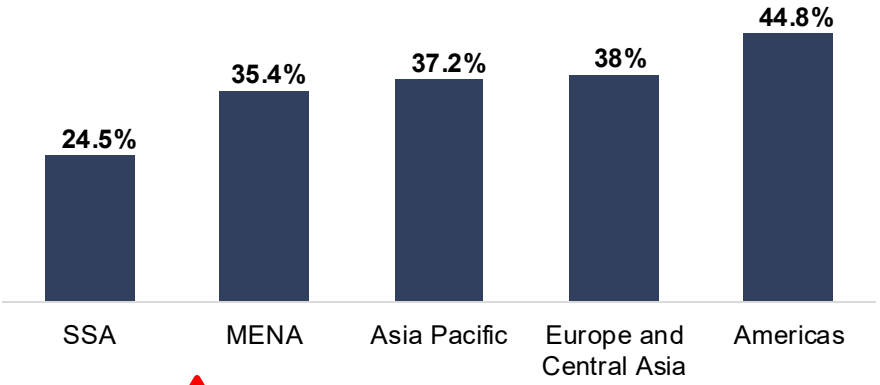
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With a deficit in both supply and consumption of healthy and diverse foods, we are not on track to meet SDG objectives

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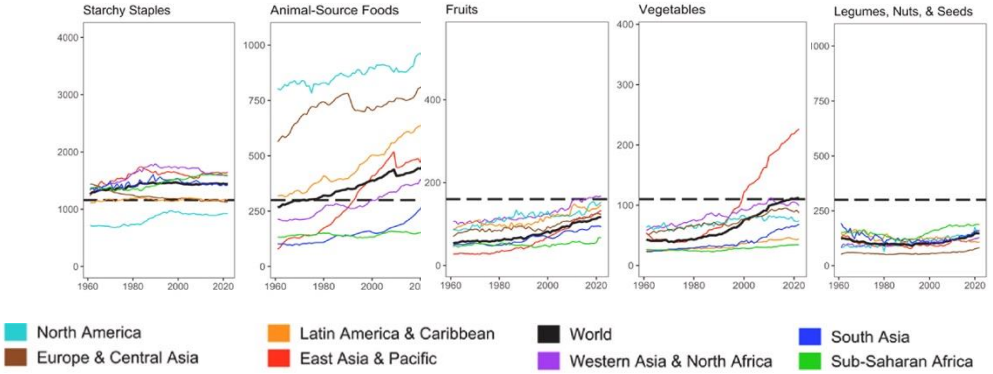
In most countries, <50% of population[1] is consuming[2] the five recommended food groups for a healthy diet

Proportion of population consuming diets with all five recommended food groups (in %)



Insufficient supply except in starchy staples across Africa, Asia and Latam contributes to the inability to meet healthy diet recommendations

Regional food supplies relative to 'Healthy Diet Basket' targets[3], 1961-2022 (in kcal/ capita/ day)





With only five years remaining until the 2030 SDG deadline for achieving zero hunger, projections indicate that **582 million people will still be chronically undernourished by the end of the decade — more than half of them living in Africa.**

Notes: (1) 41 countries surveyed in 2021 represent two-thirds of the world's population., (2) This may be due to unavailabilityof food and/ or lack of resources to obtain food., (3) Black dashed lines indicate Healthy Diet Basket targets used to measure access to a healthy diet as recommended in FAOSTAT national dietary guidelines.;
Source: Global diet quality project, Global Nutrition Report 2022, GAIN article, UN FAO, Costlow et al., 2025.

Climate change is increasing risks related to food security and healthy diets...

Climate change impacts food production... → **...Increasing nutritional challenges**

Reduced productivity

- **Lower agricultural production**
  1-5% reduction in agricultural production per decade with climate change compared to scenario with no climate change.
- **Lower fish stocks**
  5-10% decline in fish catch in tropical marine ecosystems by 2050.
- **Non-viability of rainfed crops**
  For instance, on a +4°C emissions path, rainfed crops like common beans in much of southern Africa will become unviable.
- **Nutrition dilution** decreases in the concentration of essential micronutrients like iron, zinc, and protein in crops.

+

Variability due to extreme events

18-43% of variance of yield anomalies attributable to climate extremes during growing season (droughts, floods and heatwaves), depending on crop type.

+

Increased stress from displaced population

Up to **200 million** people could be displaced by climate change by 2050, placing additional pressure on regions that remain agriculturally productive or have untapped farming potential.

=

Increased nutritional deficiencies

- **175m** more people will be zinc deficient by 2050.
- **122m** more people will be protein deficient by 2050, mostly in Asia and Africa.
- There is also a strong link between **drought and stunting** in children.

Source: Our World in Data, CGIAR, GAIN.

...And food systems are partly responsible for this climate change

Food production contributes to environmental degradation...

1. Greenhouse gas emissions

26% of global greenhouse gas emissions come from food production.

2. Land use

50% of the world's habitable land is used for agriculture[1].

3. Freshwater withdrawals

70% of global freshwater withdrawals are used for agriculture.

4. Eutrophication

78% of global ocean and freshwater eutrophication[2] is caused by agriculture.

...Exacerbating climate change and other environmental challenges

- Climate change
- Water stress and scarcity
- Biodiversity loss

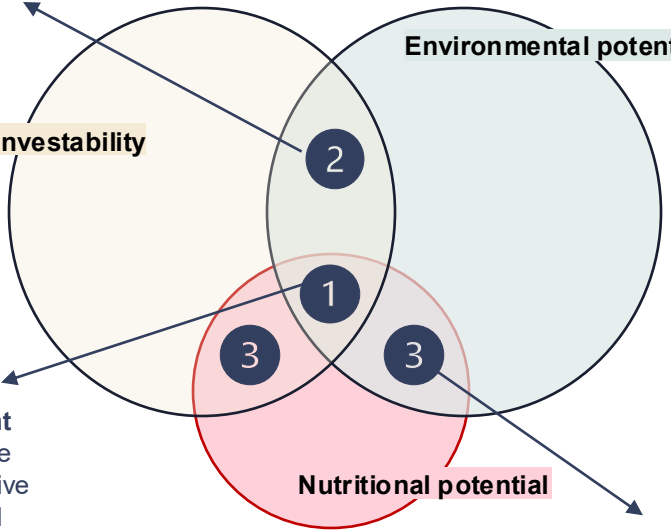
Notes: (1) Habitable land is land that is ice-and-desert-free., (2) Eutrophication is the pollution of waterways with nutrient-rich water.; Source: Our World in Data, CGIAR.

Strategic investments in nutrition and environmental sustainability can transform a vicious cycle into a virtuous one of growth and resilience

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Scope of this report: Finding investment opportunities at the nexus of nutrition, environment and investability

2nd priority: Can we improve the nutritional impact of other value chains where DFIs are already active:
- At a negligible additional cost, and/ or
- Delivering significant nutritional benefits?



1st priority: Can we increase investment in value chains where DFIs are already active and where nutritional potential is high?

3rd priority: Are there value chains with high nutritional potential where **we can improve environmental impact or uncover more viable investment opportunities?**

Why are DFIs ideally placed to invest in nutritious food companies?

- **Capital investment:** The seven DFIs studied for this report have already invested $4bn+ in nutritious value chains.
- **Mandate to invest in line with SDGs:** To enhance climate action, promote good health and achieve zero hunger.
- **Higher risk tolerance**: In frontier markets and invest patient capital for longer durations.
- **Catalyst**: By de-risking and mobilizing additional private capital.
- Beyond capital, they can provide **advocacy and technical support.**

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This report leverages DFIs' and sectorial experts' insights to identify promising value chains and showcase 12 case studies

Selection of six most promising value chains at the nexus of nutrition and environment | **Selection of 12 cases studies** | **Final report**

Three selection criteria

1. Nutritional impact, with a focus on food with inherent nutritional value.
Source: GAIN's definition of nutritious and safe foods

2. Environmental impact across four indicators: GHG emissions, terrestrial acidification, water use and land use.
Source: Poore and Nemecek global database, Quantis regional, crop-specific database and interview with environmental experts[1]

3. Investability, with global market size and number/ amount of DFI investments used as proxies.
Source: analysis of seven DFI's portfolios, interview with four DFIs and investors[1], global market size

Six prioritised value chains across SSA, S&SE Asia, and Latam

Two case studies per value chain identified via desk research, interviews with partner DFIs and value chain experts[1]

Public report synthesising findings on best practices and investable opportunities

Notes: (1) See appendix for full list of interviewees and for the environmental impact assessment methodology used in this report.

This report selected value chains representing opportunities for investment at the nexus of nutrition and environmental impacts

	Invested food value chain	Nutritional value[1]	Average environmental footprint*	10th percentile environmental footprint*	Gross production value(**)[2] ($bn '25, estimate)	Interest from DFI stakeholders[3]
'Must-haves' selected Scoring high on all criteria.	**1. Vegetables**	**High**	Low	Low	**179**	4 DFIs
	2. Fruits	**High**	Low	Low	**171**	
Selected Large markets, high interest from DFIs, and lowest environmental impact for animal protein food.	**3. Milk**	**High/ Medium** (unsweetened/ minimally sweetened)	Medium	Low	**420**	2 DFIs
	4. Poultry – chicken and eggs	**High/ Medium** (eggs/ minimally processed chicken)	Medium	Medium	**174**	3 DFIs
Selected Strong DFI interest and market size. Region with lowest environmental impact to be chosen for cases.	**5. Aquaculture**	**High** (minimally processed)	High but highly variable per fish	High but highly variable per fish	**293**	3 DFIs
Decision to choose legumes and exclude nuts based on investability and stronger legume local consumption.	**6. Legumes**	**High**	Medium	Low	**71**	2 DFIs
	Nuts	**High**	High	Low	**23**	2 DFIs
Clear eliminations **Cereals**: Lower nutritional value and productivity/ investability challenges for more nutritious crops. **Red meat**: High environmental impact and lower DFI interest.	Cereals	**Medium/ Neutral food** (nutrient-dense wholegrain/ not fortified)	Medium	Low	**406**	1 DFI
	Red Meat	**Neutral food** (minimally processed)	High	High	**170**	

Notes: (*) *See slide appendix for explanation on the environmental ranking methodology;* (**) Cumulative figures representing sum values for SSA, Latam, and South and SE Asia.; Source: (1) GAIN - N3F Eligible Foods Spotlight table, (2) Statista Market Insights 2025, (3) Interviews with DFIs, FMO article on Blue Finance, (2024), BII Food and Agriculture strategy, IFC's practices for sustainable investment in the livestock operations.

12 case studies exemplify opportunities for dual impact, in three plant-based and three animal-based value chains across emerging markets

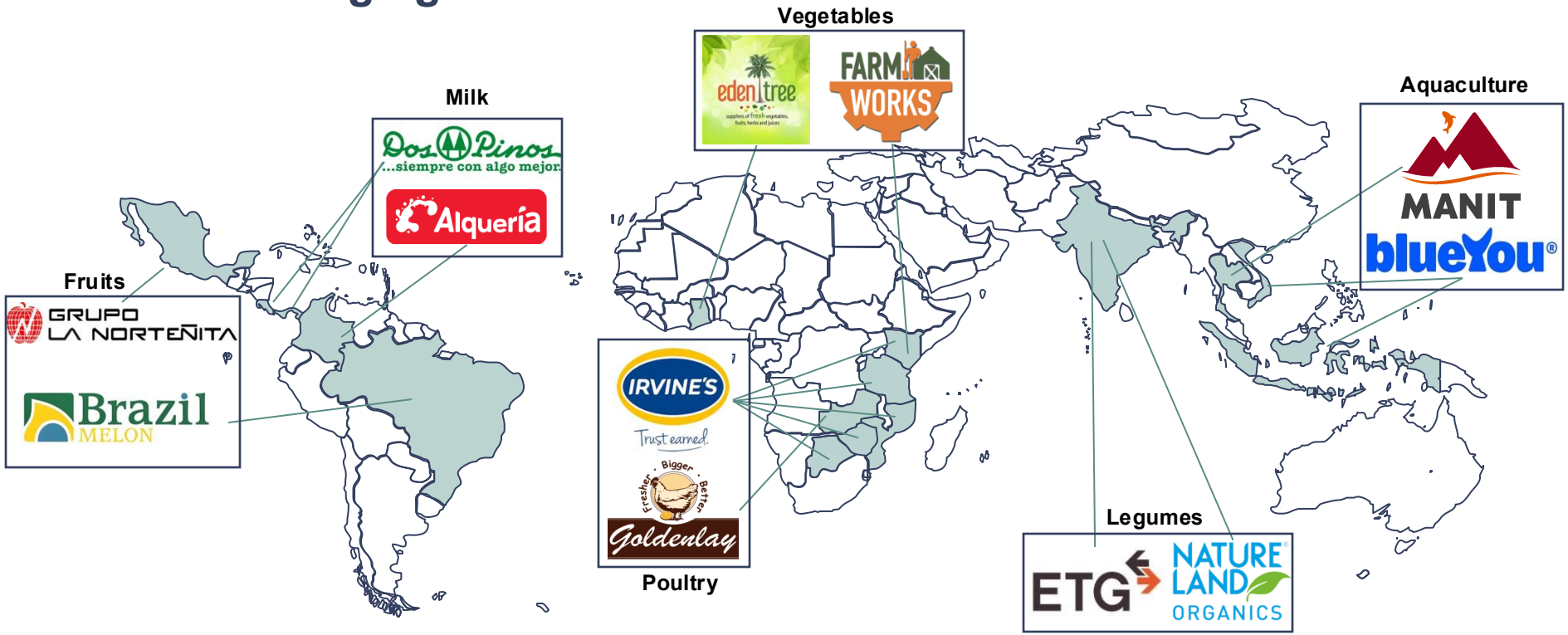


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The seven DFIs analysed have a formal commitment to reducing environmental impact…

All DFIs included in this study have publicly set a net zero goal for GHG emissions[1]…



…as well as additional environmental targets

"We aim to support our customers (…) to improve their sustainable use of natural resources, such as water."

"Avoid or minimize pollution to air, water and land, and promote the sustainable use of resources, including raw materials, energy and water."

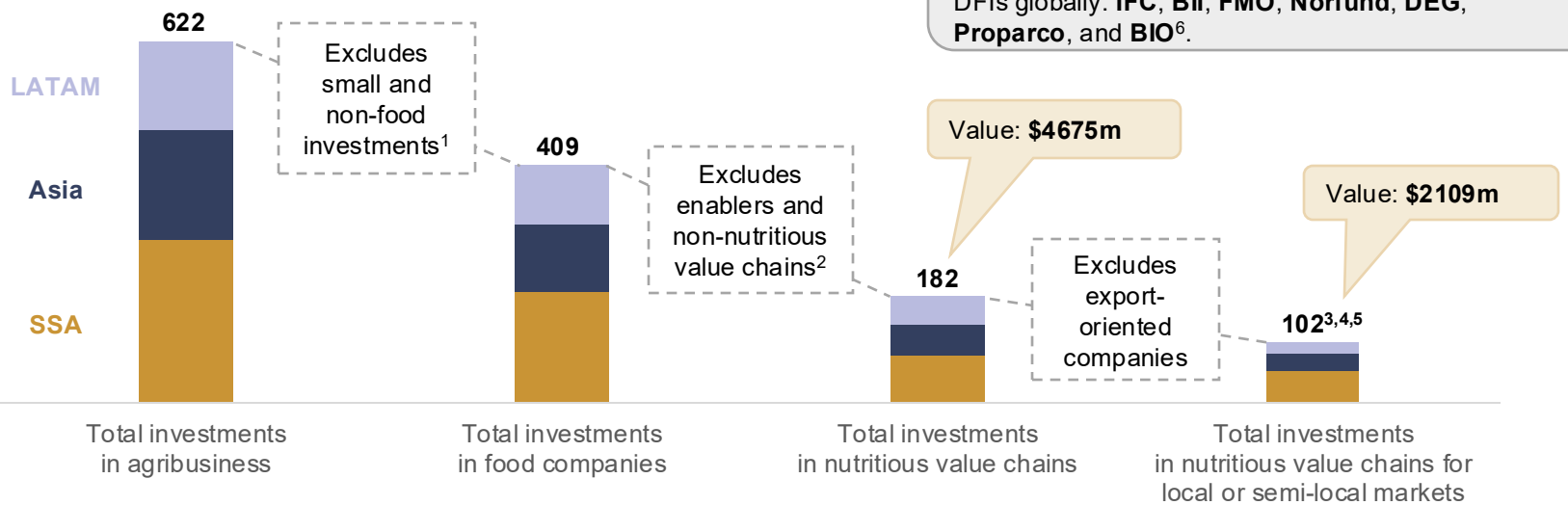
"Investing in biodiversity."

"No net loss of natural habitat."

Notes: (1) Greenhouse Gas, Proparco's contributes to AFD's commitment of becoming "100% compatible with the Paris Agreement." BIO does not explicitly mention net zero emission but claims to "Support its clients to steer capital towards the low-carbon, resilient and ecological transition as defined in the Paris and Kunming-Montreal Agreements on climate and biodiversity;
Source: FMO's climate action plan, Norfund's Policy for Environmental and Social Sustainability, Proparco's 2023-2027 strategy, BII Climate change strategy, IFC's alignment with SDGs, sustainable crop production and practices for sustainable investment in the livestock operations, DEG Impact Climate Commitment 2024, BIO Development & Sustainability Report 2024.

…And while not always formally stated, DFIs also invest in nutrition: Nearly half of their food investments are in nutritious value chains, of which the majority serve local markets

Repartition of DFI investments by region (number of investments)



The database includes information on investment portfolios of a subset of seven DFIs, which should not be considered as an accurate representation of all DFIs globally: **IFC**, **BII**, **FMO**, **Norfund**, **DEG**, **Proparco**, and **BIO**[6].

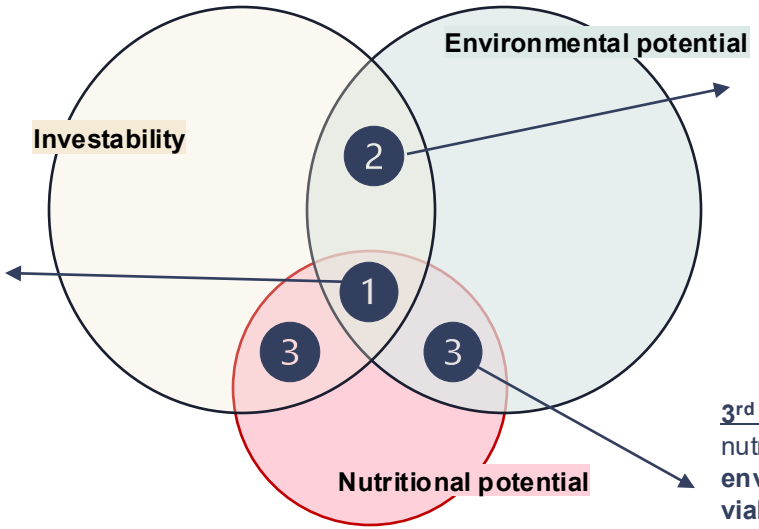
Notes: (1) Excluding small investments (<$0.5m) that are technical advisory investments, (2) Excluding non-nutritious value chains such as cacao, heavily-transformed products, and foods that do not achieve at least a neutral score in the N3F nutritional value rating; (3) There has been 102 investments in 97 companies (DFIs co-invested in four companies); (4) 10 companies did exclusively rice and/ or wheat and/ or soy and have been excluded following discussions with GAIN; (5) Local and semi-local markets excludes exports that are not regional; (6) These 7 DFIs were selected in partnership with GAIN based on the availability of data on agro investments; Source: Hystra analysis based on DFI's investment database, 2025.

The six value chains studied present various types of opportunities for impact investors looking to combine both nutritional and environmental objectives

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1st priority: **Can we increase investment** in value chains where DFIs are already active and where nutritional potential is high?

- *Fruits in Latam and aquaculture in S&SE Asia: Opportunity to leverage strong growth perspective (4.2% projected CAGR for fruits, 5.3% for aquaculture) to further encourage invested companies in developing local markets and further reduce environmental impact (post-harvest losses, aquaculture feed).*
- *Poultry in SSA: Opportunity to support established players growth, including in the table eggs business.*



2nd priority: Can we improve the nutritional impact of other value chains where DFIs are already active?

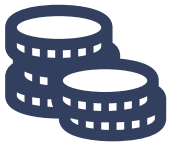
- *Milk in Latam: In a market already well invested and consolidated, opportunities lie in replicating best environmental practices observed among top players, as well as steering portfolio development toward more nutritious options (e.g., less sweet).*

3rd priority: Are there value chains with high nutritional potential where **we can improve environmental impact or uncover more viable investment opportunities?**

- Vegetables in SSA and legumes in S&SE Asia: Opportunities to support wholesalers in increasing market access for local farmers, which will increase local consumption while improving livelihoods.

Fruits in Latam: A large, growing market with opportunities to increase local consumption and reduce post-harvest losses

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$140Bn production market

4.2% projected annual revenue growth through 2030



High inherent nutritional value, with essential nutrients including vitamins A and C, fibre, and antioxidants

Consumption at **55%** of WHO-recommended intake (above the 40% global average)



Low average negative impact across all environmental indicators

Main impact drivers include land use change, fertiliser use and irrigation

Opportunity 1: Localising consumption

While Latam is the second-largest fruit producer, a sizeable share of production is exported. Exports will continue to rise thanks to a dynamic market, but there are also economic opportunities to increase local consumption.

- La Norteñita, a Mexican fruit company, has managed to earn 40% share of fresh apples' market in Mexico, with ~$100m in revenues in 2024. Strategies include promoting local retail, public procurement (e.g., school meal programs), and product formats tailored to affordability and increased shelf life.

Opportunity 2: Reducing post-harvest losses

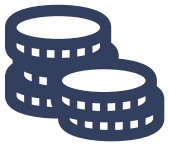
In Latam, around 30%* of fruits are lost post-harvest, representing a missed opportunity to increase availability at a lower price while also reducing fruits' environmental impact.

- Expanding low-energy preservation methods (e.g., drying) and modern technologies (e.g., cold storage or controlled atmosphere chambers like those used by La Norteñita) can reduce losses and enable year-round supply of nutritious products.
- Additionally, regenerative practices such as mulching and moisture monitoring implemented by Brazil Melon, a Brazilian fruit grower, can help maintain product quality and reduce losses at the farm level, while also reducing water consumption/costs.

Source: (*) Global food losses and food waste (FAO,2011) – Figure 6 excluding agriculture and consumption stages.

Vegetables in SSA: A small market with strong growth potential and opportunity to strengthen market access, reduce post-harvest losses and expand reach locally

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$18.5Bn production market, the region with the lowest production of vegetables (5% of global production)

10% projected annual revenue growth through 2030



High inherent nutritional value and provides essential vitamins, dietary fibre, water, and antioxidants

Consumption represents **46%** of WHO recommendations – lower than the 60% global average



Low average negative impact across all environmental indicators

Main impact drivers include land use change, fertiliser use and irrigation

Opportunity 1: Supporting aggregators and distributors to improve market access

In a fragmented market made of smallholder farmers, the key lever for increasing productivity and local consumption lies with distributors:

- FarmWorks, a Kenyan agro distribution company, is on average, increasing the productivity of its 3,000 partner farmers by over 30% - mainly due to guaranteed offtake. It uses software to track the entire supply chain – from farm gate collection to delivery to final sale – minimizing theft, delays and post-harvest losses (see below).

Opportunity 2: Segmented offer to reduce post-harvest loss and increase affordability

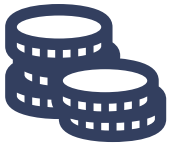
In SSA, up to 40% of vegetables are lost post-harvest:

- FarmWorks has cut post-harvest losses to just 3% through (i) efficient logistics and (ii) graded sorting of products.
- Eden Tree, a Ghanian processor and distributor of vegetables, plans to install dryers to valorise lower-grade/ damaged produce.

Opportunity 3: Expanding reach to increase customers' access to nutritious food

- Eden Tree's retail expansion from high-end supermarkets and hotel, restaurant and catering clients to local shops, street vendors and e-commerce, helped the company increase output and revenue by 15%.

Legumes in S&SE Asia: A small market with opportunities to further localize production and increase value addition



$49Bn production market, accounting for 50% of global production

2.3% projected annual revenue growth through 2035



High inherent nutritional value, among the most affordable sources of protein

Consumption represents **36%** of WHO recommendations – higher than the 26% global average



MEDIUM average negative environmental impact, with low GHG emissions but high water use

Regenerative agriculture practices and deforestation-free cultivation can help reduce impact

Opportunity 1: Increased productivity coupled with market access

While S&SE Asia is the largest producer of legumes, it still imports several millions of tons per year, with high volatility across the years. Additional challenges include varying quality and low productivity; training, input provision and guaranteed offtake could help address these.

- Natureland Organics, an Indian company offering >175 organic food products, establishes long-term partnerships with 10,000 farmers, offering them seeds, agronomic advice and product off-take, enabling them to boost incomes while ensuring a diverse, reliable supply.
- ETG, India's largest legume processor, currently imports a large share of its legumes to ensure a constant supply of high-quality legumes to the market but aims to grow local sourcing beyond 30%.

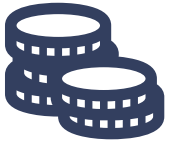
Opportunity 2: Addressing the organic segment

While the legume market is still niche and low-margin, some segments have strong growth potential (e.g., 20% CAGR in India's organic market) and the ability to generate carbon credits.

- Natureland Organics has been growing at a fast pace over the recent years, with current revenues of $20m – 90% of which comes from India. It pays for supplying farmers' organic certificates – remaining proprietor of those, limiting side sales to competitors – and facilitates generation of carbon credits for their organic cultivation.

Milk in Latam: A mature market with opportunities to improve nutritional and environmental impact

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$85.5Bn production market, mainly for local production

0.7% projected annual revenue growth through 2035 (1.7% for yoghurt in 2026)



High inherent nutritional value, key source of calcium, vitamin D, and other essential nutrients

132kg consumed per person per year, below levels in Europe and North America. 80% of adults in Latin America still consume too little calcium



MEDIUM average negative environmental impact, with low GHG emissions compared to other animal-based foods but high relative to most plant-based foods

Enteric emissions, feed and manure are the main drivers of impact – with proven solutions to reduce these impacts

Opportunity 1: Improving access to low-sugar dairy products

Shifting consumer habits towards healthier dairy options is a commitment that some leading companies in the region have started to make:

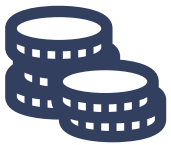
- Alquería, a leading Colombian dairy company, improved the nutritional profile of 79 of its products, adding micronutrients or probiotics to 21 of them.
- Dos Pinos, a Costa Rican cooperative, gradually reduced sugar quantities in its products to allow consumers to adjust. Between 2021 and 2023, it cut yogurt sugar by up to 83%.
- Alquería's network of 140,000 small shops and affordable packaging (e.g. UHT milk bags) ensures access for low-income households, especially in remote areas without cold chains.

Opportunity 2: Scaling proven environmental best practices

Milk environmental footprint can be significantly improved by adapting farming practices – large processors have a role to play in helping small-scale farmers in their supply chains adopt these practices:

- Alquería supports 5,500 farmers with training, solar-powered cooling, and manure-to-biogas systems. It also monitors deforestation using geo-referencing and has developed partnerships for regenerative grazing over 130,000 acres.
- Dos Pinos supports its farmers using a point-based system covering environmental, social, and animal welfare performance to assess farmers' current impact and their most pressing needs. Dos Pinos also implements circular practices in its processing operations, for instance reusing 200,000 m^3 of water (10% of total consumption) and converting 100% organic sludge into biofertilizer.

Poultry in SSA: A small market with rising demand and opportunity to improve productivity, scale egg production and valorise eco-friendly by-products



$27Bn production market for poultry meat (3% of global production)

$6.8Bn production market for eggs

1.9% projected annual volume growth through 2035



Eggs, organ meats and minimally processed poultry are densely packed with essential macro- and micronutrients

3.8kg consumed per person per year, below the 14kg global average despite per capita consumption doubling over the past 20 years (2.2kg of eggs per year vs. 10.2kg globally)



Medium average negative environmental impact, with eggs scoring better than meat

Deforestation-free feed cultivated through regenerative agriculture practices and manure reuse are the main drivers to reduce environmental impact

Opportunity 1: Increased productivity (weight per head/ kg of feed)

Improved breeds offer cost-effective, lower environmental impact opportunities to address low poultry productivity in SSA and meet rising demand.

- Irvine's Group, a vertically integrated poultry company, commercialises cobb Day Old Chicks that offer lower feed conversion ratio, higher egg output and better disease resilience. Dual-purpose poultry breeds can produce 4x more eggs, increase chicken weight by 50%, mature faster, and significantly reduce mortality compared to indigenous chickens.

Opportunity 2: Increased table egg production

This is a largely untapped opportunity to provide scalable, affordable protein with low environmental impact.

- Goldenlay, the largest table egg producer in Zambia, and Irvine's Group sell 150m and 338m eggs annually in Zambia and Zimbabwe, meeting 14% and 70% of local demand, respectively — showing that affordable eggs can be commercialized at scale to low-income consumers (e.g., $10 cents/ egg at Goldenlay).

Opportunity 3: Environmentally friendly by-products

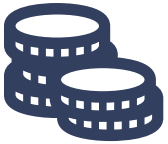
Manure can be used as organic fertilizer, lowering environmental impact while generating additional revenue streams. Additional opportunities around other by-products remain largely untapped (e.g., organ meat, waste oil, manure, feathers).

- Both Goldenlay and Irvine's Group transform manure into fertilizer. Irvine's Group transforms hatchery and abattoir waste into animal feed.

Notes: (1) Any advancements in productivity needs to be balanced with considerations of animal welfare when intensifying poultry farming Under Nutritious Foods Financing Facility's animal welfare checklist, fast growing broiler chicken hybrids have an 'elevated' risk level ranking as their modification for production traits heightens anatomical/metabolic disorders. Best practice is to adopt slower growing hybrids that are well adapted to the local climatic, nutritional, disease conditions.

Aquaculture in S&SE Asia: A large, fast-growing market with opportunities to focus on local consumption, improve environmental practices and breeds

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$197Bn production market, the largest producer with ~70% of global production

5.3% projected annual revenue growth through 2030

Minimally processed fish and seafood have high inherent nutritional value and are rich in protein omega-3 fatty acids, and vitamins D and B2



24.6k consumed per person per year, the highest regional average consumption per capita

High average negative environmental impact, with significant variation by species (by a factor of five for GHG), with tilapia having a similar impact to chicken



Feed (especially fish-based) is the main impact driver, along with farm energy requirements

Opportunity 1: Increased local consumption

A growing urban middle class is driving up local demand for aquatic food across the region. Focusing on serving local markets offers a strategic opportunity that can help close this nutrition gap and reduce dependency of producers on international buyers and trade fluctuations.

- Manit Group, a comprehensive Thai aquaculture organisation, is currently exploring B2C channels to serve local customers directly.

Opportunity 2: Environmentally friendly practices with blue carbon financing

Practices including polytrophic culture, mangrove restoration and sustainable sourcing can significantly reduce aquaculture's environmental impact, offering blue carbon financing opportunities, while improving productivity for smallholder growers.

- Blueyou, a seafood company implementing restoration and sustainable fisheries programs across LMICs[1], restores degraded ponds with mangroves resulting in seafood production that is entirely free of feed, fertilizers, and chemicals and multiplies productivity by four. Its sustainable sourcing programs avoid sourcing from overfished stocks and prioritize capture gears and traditional, community-based methods.

Opportunity 3: Improved breeds

Improved breeds with enhanced survival, growth and yield represent an opportunity to boost productivity and incomes of smallholder growers.

- Manit Group offers tilapia breeds which have higher survival and growth rate as well as higher yield than most alternatives on the market (e.g., the average yield of fillet is 36% for Manit group, vs 25-30% average).

Notes: (1) Low- and middle-income countries.

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1. *Fruits in Latin America*
2. *Vegetables in Sub-Saharan Africa*
3. *Legumes in South and South-East Asia*
4. *Milk in Latin America*
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Appendix

1. *Methodology for environmental impact assessment*
2. *List of experts interviewed*
3. *Summary of environmental best practices*

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While Latam is the second-largest fruit producer, a sizeable share is exported, leading to a local consumption of only 55% of the recommended intake

Fruits are the edible reproductive parts of flowering plants, typically sweet or sour in taste, and consumed raw or processed. They include a wide botanical variety, such as berries, drupes (e.g., mangoes, cherries), pomes (e.g., apples, pears), citrus, and tropical fruits like bananas and pineapples. Fruits provide essential vitamins (notably A and C), dietary fibre, water, and antioxidants and are characterized as having 'high inherent nutritional value' as per GAIN's definition of nutritious and safe foods*[1].

Market overview

Market dynamics

Production volumes

- Latam is the **second-largest** fruit-producing region, accounting for approximately **15–17% of global fruit** and berry production in recent years (behind Asia at ~50%)[2].
  - **Brazil** is the largest fruit producer in Latam, accounting for **30% of the region's total output**, followed by Mexico (15%) and Colombia (7%) [2].
  - Bananas, citrus, and mangoes are the highest produced fruit crops in the region, together representing **over 60% of total fruit volume[3].**
- Latam fruit and berry production reached **~132m tons in 2024**, valued at roughly $140bn[3].
- Latam fruits and vegetables revenues is expected to **grow at an annual rate of 4.2%** until 2030[4].

Trading volumes

- Latam is also a major **exporter of fruits**, accounting for **over 25% of global tropical fruit exports[5]**.

Key challenges

High post-harvest losses: About **30%[6]** of post-harvest fruits and vegetables are lost, especially during on-farm handling and transport, due to poor infrastructure and lack of cold storage[7].

Low productivity: Yields remain below potential due to **limited access to inputs**, improved varieties, and irrigation. Most fruit farms are also small-scale[8].

Pest and disease pressure: Key crops like bananas and citrus face **major biological threats**, reducing yields and export capacity[5].

Nutritional impact

Additionality

Micronutrient intake: There is a high prevalence of vitamin C and A deficiency linked to low fruit consumption in Latam, especially among women and children[9].

Overweight/ obesity: Rising fruit intake is linked to lower BMI, waist circumference, and cardiovascular risk. With adult obesity rates near 24% and NCDs like diabetes and hypertension on the rise in Latam, promoting fresh fruit consumption is increasingly critical[10].

Fit into consumption and cultural habits

Despite fruit consumption remaining below WHO recommendations in Latam, **fruits are culturally accepted and appreciated:**

- People in Latam consume on average **55% of the recommended intake of fruits** (**above the global average** at 40%)[11].
- Traditional Latam diets, shaped by indigenous and colonial influences, are rich in fruits and vegetables. Staples include tropical fruits such as bananas, pineapples, mangoes, papayas, avocados, and native varieties like passion fruit and soursop[5].
- Mexico, Argentina, and Brazil have some of the highest rates of fruit and vegetable consumption in the region, with about 86% of adults regularly including them in their diets[12].

Notes: (*) See appendix for table with the nutritional impact classification rationale.; Source: (1) WHO, (2) FAO, (3) IndexBox (2024), (4) Grand View Research (2024), (5) FAO, (6) Global food losses and food waste (FAO,2011) – Figure 6 excluding agriculture and consumption stages., (7) IDB (2018), (8) IDB (2023), (9) Monge-Rojas, et al. (2023), (10) Miller, et al. (2017), (11) Global Nutrition report, Latin America and the Caribbean profile, (12) Freshplaza (2024).

Fruit investments in Latam have focused on export - Opportunities exist to serve local demand with high-quality fruits

Investability

Existing DFI investments

- Since 2013, the seven DFIs in our research* have invested **$295m in 24** (non-purely export-focus) **companies** in the fruits value chain, out of which four were in Latam.
- Most of the invested companies produce both fruits and vegetables, some of them are organic companies (e.g., Vertical Agro). There are also multi-product distributors/ retailers (e.g., Lona Group). Most of them have at least **part of their sales destined for export.**

Opportunities for investors

- Global and local demand is rising rapidly as **health-conscious consumers seek more nutritious options**[1]: This is among the fastest-growing value chains analysed in this study, with **opportunities to further increase local market presence on top of rising exports.**
- **Post-harvest losses technologies** (e.g., controlled atmosphere chambers) can also increase profitability, with around 30%[2] of fruits and vegetables currently being lost post-harvest. **Regenerative practices** such as mulching and moisture monitoring can help maintain product quality, reduce on-farm losses, and lower water use and costs.
- Investment opportunities can be found among the increasing numbers of **vertically integrated models** in Latam, that combine farming, processing, and export logistics. They have gained traction by ensuring quality, sustainability, and supply chain control[3].

Case studies

- Company: Grupo La Norteñita.
- Geographic footprint: Central America.
- Country for case study: Mexico.
- Size: ~$100m in revenues in 2024.
- Product offering: Focused on apples and its derivatives.
- Export/ import focus: 99% of sales in Mexico.
- Value chain positioning: Production and processing.
- Current investors: No external equity investment, only debt financing.

- Company: Brazil Melon.
- Geographic footprint: Brazil and Europe.
- Country for case study: Brazil.
- Size: ~$15m in revenues in 2024.
- Product offering: Melons and watermelons.
- Export/ import focus: 15% of sales in Brazil.
- Value chain positioning: Production.
- Current investors: No external financing.

Notes: (*) DFIs included in our analysis are: IFC, BII, FMO, Norfund, DEG, Proparco, BIO.; Source: (1) ResponsAbility (2023), (2) Global food losses and food waste (FAO,2011) – Figure 6 excluding agriculture and consumption stages., (3) IDB Lab (2019).

Reader's guide: How to read the following environmental assessments slide[1]

- We calculated the average footprint of the selected value chains on four environmental indicator (GHG, terrestrial acidification, water use and land use), measured per 1kg of retail weight.
- Data is based on Poore & Nemecek global database and is an average of the various foods within a value chain (e.g., chickpeas, groundnuts and "other pulses" for legumes).
- Colour coding of the data point indicates whether the impact is low, medium, or high compared to other value chains[2].

The % difference between the GHG emissions of the selected crop in the selected country compared to the GHG emissions of the selected crop globally. Here, chickpeas in India produce 3% less GHG emissions than global average for chickpeas.

	Environmental performances of legumes at global level	Environmental performances of regional proxy[3] (chickpeas in India)	
	Average	Differences between environmental performance of chickpeas in India vs chickpeas globally	Key contributors to regional proxy's impact
GHG	**2.0 CO_2eq/ kg**	**-3%**	-Irrigation: 35% of carbon emissions. -Nitrous oxide emissions & field emissions from decomposition of crop residue: 25% of emissions. -Emissions from the use of ag machinery: 10% of emissions.

Low	Medium	High

Lower or up to 10% higher than global average	Between 10 and 20% higher than global average	>20% higher than global average

Notes: (1) See detailed methodology for environmental impact assessment in appendix., (2) Value chains studied included: fruits, vegetables, legumes, nuts, milk, poultry, aquaculture, read meat, cereals. See page 104 for details on comparative ranking (low/medium/high) for all value chains., (3) Environmental performance values are highly contextual and should be taken as indicative, as impact is highly dependent on crop, country and agricultural practices. See slide 107 on selected proxies, rationale, and strength of proxy.

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Fruits in general and Latam proxy (Brazilian oranges) in particular, have a low impact across all environmental factors

	Environmental performances of fruits[1] at global level	Environmental performances of regional proxy (oranges in Brazil)	
	Average value[2]	Differences between environmental performance of oranges in Brazil vs oranges globally	Key contributors to regional proxy's[3] impact
GHG	**0.9 CO_2eq/ kg**	**-3%**	▪ **Land use change**, especially in key risk areas such as Brazil. ▪ **Fertilizers** (fossil-based) and other chemical inputs, up to 25% for Brazilian oranges. ▪ **Irrigation**, especially in drier regions or regions prone to water stress. ▪ **Field emissions** (linked to nitrous oxide and decomposition of crop residue).
Terrestrial acidification	**6.4 SO_2-eq/ g**	**+0.4%**	**Fertilizers** (fossil-based) and other chemical inputs, especially for fruits requiring high amounts of fertilizers.
Water Use	**190 L/ kg**	**-89%**	Water usage is driven by irrigation of crops, particular those requiring high water inputs, such as oranges (even though Brazil has 89% lower requirements compared to global average), and those produced in drier regions.
Land use	**1.3 m2/ kg**	**+6%**	Land use change such as deforestation and conversion, especially in key risk areas in Brazil, Bolivia, Colombia, Paraguay.
Comments	▪ Positive outlier: Apples. ▪ Negative outlier: Berries & grapes.	Fruit have a low environmental impact relative to other food types. The overall impact depends on the crop, the agriculturalcontext and practices, with drivers being land use change, fertilizer use and irrigation. The above reflects impact from conventional farming, which is more representative of Latam than organic/ precision production systems.	

N.B., The green colour code here indicates that **the local proxy's[3] impact is equal to or no more than +10% higher than the global average** (Exact difference expressed as a percentage figure; *See page 29 for details on reading the environmental assessment slides*).

Notes: (1) Fruits consist of citrus fruits, bananas, apples, berries & grapes, and 'other fruits', (2) The colour coding of average values indicates whether the impact is low (green), medium (yellow), or high (red) compared to other value chains. See page 29 for details.; Source: Poore and Nemecek (2018).

Notes: (3) Environmental performance values are highly contextual and should be taken as indicative, as impact is highly dependent on crop, country and agricultural practices. See slide 107 on selected proxies, rationale, and strength of proxy.; Source: Quantis expertise, Statista, WFLDB 3.11 and ecoinvent 3.11, IPCC WGI Interactive Atlas, CIRAD, Climate Risk Index (CRI), ND-GAIN Country Index Scores.
Nb: Please note that Poore and Nemecek global data and Quantis regional analysis of proxy foods are not directly comparable, as their scope and units differ.

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Various techniques can reduce post-harvest losses, currently representing over 30% of fruits production in Latam

Lever	Description	Type of impact	Potential for reduction[1]	Contribution driver	Sources
Harvesting and handling	▪ Limiting irrigation during the weeks before harvest. ▪ Harvesting mature products (avoid immature or overmature) during the coolest time of the day. ▪ Careful handling during harvest to reduce bruising, scratching and punctures. ▪ Shading crops once harvested.	▪ Climate ▪ Water ▪ Acidification ▪ Land use	Very high	Farming and distribution practices	Ridolfi et al., Post-harvest losses in fruits and vegetables: the Kenyan context (2018). Ministry of Agriculture & Farmers' Welfare, Government of India, Post-Harvest Handling Protocol for Fruits & Vegetables (2022). ACF International, Post-harvest losses and strategies to reduce them (2014). Chhetri et al., A review paper on post-harvest loss on fruits and vegetables (2022).
Sorting and cleaning	▪ Cleaning produces by using sodium hypochlorite solution, thiabendazole, and chlorinated water. ▪ Systematic sorting and grading by separating higher and lower quality crops. ▪ Using pre-cooling methods (e.g., room cooling, hydro-cooling with disinfectant in water – not applicable to all fruits and vegetables, evaporative cooling). ▪ When possible, refrigerating produces at constant temperature.				
Packaging	▪ Using adapted packaging materials like light-weight fibre-board (CFB) liners for plastic corrugated cardboard boxes and smaller-sized packages. ▪ Providing ventilation to prevent physiological breakdown.				
Transportation	▪ Avoiding watering the produce before transport as this increases decay. ▪ Careful loading of vehicles, avoiding compressing due to overfilled packages. ▪ Using clean, well-ventilated (refrigerated) vehicles covered at the top for transportation.				
Storage	▪ Using adapted storage technique depending on produce and storage period intended (ground storage, ambient storage, refrigerated storage, air cooled storage, zero energy storage, modified atmospheric storage, hypobaric storage, and controlled atmosphere storage).				
Processing	▪ Drying, salting, fermenting and pickling to extend fruits and vegetable shelf-life.				

Notes: (1) Rating based on data showing that >30% of fruits and vegetables are lost post-harvest in LATAM

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Beyond post-harvest loss reduction, regenerative agriculture practices can help further reduce fruits' environmental impact

Regen ag practices

Lever	Description	Type of impact	Potential for reduction[1]	Contribution driver	Sources
No-till practices	▪ Eliminating/ reducing soil disturbance. ▪ Lowers GHG emissions and improves soil health by increasing organic matter and enhancing water retention.	▪ Climate ▪ Water ▪ Acidification	Medium		4p1000 study (INRAE), Quantis and BCG use cases.
Cover cropping	▪ Planting on cropland otherwise fallow. ▪ Enables carbon sequestration, and a soil richer in organic matter which stores water better.	▪ Climate ▪ Water ▪ Acidification	High		Poeplau & Don, 2015, Quantis and BCG use cases.
Legume Crop rotation	▪ Integration of legume into main crop cycle. ▪ Legumes naturally absorb nitrogen from the air, reducing need for synthetic nitrogen fertilizers. ▪ Enriches soil by leaving behind nitrogen, benefiting next crop.	▪ Climate ▪ Acidification	High	Farming practices & inputs	Austrian Federal Ministry of Agriculture, 2015, Quantis and BCG use cases.
Organic mulching and returning residues to soil	▪ Covering ground with plant material. ▪ Permit important water retention and carbon sequestration.	▪ Climate ▪ Water ▪ Acidification	High		Payen, 2021, Lu, X. et al., 2020, Quantis and BCG use cases.
Undersown cropping	▪ Simultaneous growth of secondary crop alongside main crop for enhanced soil cover. ▪ Enables carbon sequestration, and a soil richer in organic matter which stores water better.	▪ Climate ▪ Water ▪ Acidification	Medium		Poudel et. al, 2022, Quantis and BCG use cases.
Agroforestry	▪ Integration of trees, hedges and shrubs in cropland and grassland. ▪ Increases soil organic matter, water retention, carbon sequestration, and creates biodiversity refuges.	▪ Climate ▪ Water ▪ Acidification	High	Farming practices & inputs	Jones et al., 2021, Quantis and BCG use cases.
Biologically activated biochar	▪ Applying biologically activated biochar to fields. ▪ Biochar sequesters carbon and helps retain water and nutrients (reduced fertilizer leaching).	▪ Climate ▪ Water ▪ Acidification	High		Quantis and BCG use cases.
Certified deforestation free	▪ Verify that no forests or grasslands are cleared or converted for animal or feed production (e.g., certification, satellite imagery).	▪ Climate ▪ Biodiversity ▪ Land use	Very high	Land use change	EUDR, Quantis and BCG use cases.

Notes: (1) Rating based on Quantis' expertise.

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Grupo La Norteñita is the main apple producer in Mexico, with 40% market shares

GRUPO LA NORTEÑITA

Grupo La Norteñita is a leading Mexican fruit company producing 40% of the country's apples from over 3 million trees across 2,500 hectares. Based in Ciudad Cuauhtémoc, it employs more than 1,200 people in its 9 farms and partners with 50+ regional producers. Founded in the 1950s, the company is known for its year-round fresh apple supply, strong sustainability practices, and social impact programs supporting rural and indigenous communities. 50% of the board members are women.

	Business model
History of organization	▪ Grupo La Norteñita was founded in the 1950s by Salvador Corral Piñón and Luz Camila Pérez Domínguez, with an initial focus on seeds, forage, and livestock. ▪ In 1968, the company planted its first apple trees. By 1980, it began operating under the brand "La Norteñita," and in 1983, it opened its first cooling and packing plant. ▪ Today, it produces 40% of apples in Mexico, cultivating over 3 million trees across 2,500 hectares.
Product offering and value proposition	▪ La Norteñita offers fresh, high-quality apples year-round, with a shelf life of approximately two months. ▪ Fresh apples represent over 99% of their revenues, but they also sell apple-based products under the Delisana brand.
Sales and distribution	▪ Products are sold through wholesale markets (e.g., Central de Abasto), major supermarket chains such as Walmart, Soriana, Chedraui and regional grocery stores. ▪ Export is minimal (~0.01% of revenues), primarily to the U.S. and Central America.
Results	▪ **Production:** ~74,000 tons of apples annually ▪ **Annual Revenue:** Approximately $1.8 billion MXN in 2024 (~$100m).



	SDG impact
	La Norteñita promotes inclusive and dignified employment by offering formal jobs with benefits, supporting education through dual training programs, and integrating vulnerable populations, including indigenous communities, into its workforce with respect and equity.
	The company promotes sustainable agriculture through efficient irrigation, organic fertilizers, and biodegradable packaging. It also supports community efforts such as reforestation, urban clean-up, and environmental education in schools.
	The company ensures access to healthy and affordable nutritious food through sustainable apple production that reaches a broad segment of the population.
	La Norteñita invests in technological upgrades across its value chain (e.g., modern orchards, cold storage, and sustainable packaging) helping build a more resilient, efficient, and low-impact agri-food infrastructure in the region.

Source: Interview with La Norteñita's team., Photo credit: La Norteñita's website.

Grupo La Norteñita offers fresh, high-quality apples, with a focus on addressing malnutrition among unprivileged communities

Nutritional impact

- **Commitments**: La Norteñita contributes to a healthy diet by selling fresh apples all year round, mainly for the Mexican market.
- **Actions under way**:
  - Year-round product availability thanks to infrastructures that preserve fruit quality post-harvest.
  - Processed products (dip, juice) are sufficiently nutritious that they do not carry warning labels (e.g., excess sodium, sugars, fats) and are 100% natural with no preservatives or artificial additives.
  - Involvement in the Food Security Table and school meal programs.
- **Impact to date**:
  - ~74,000 tons of apples annually.
  - 5,300 breakfasts provided daily during the academic year.



Good practice – On top of offering fresh apples to local markets all year round, the group contributes to addressing malnutrition in local communities through various programs

- **School meals:** In partnership with several local companies and public organizations, Grupo La Norteñita launched in 2022 the “Nutriendo para Aprender” (Nourishing for Learning) program, which consists of providing daily nutritious school breakfasts to students from 22 schools. According to the company, this program has led to up to a 48% increase in the children’s BMI (Body Mass Index) as per the school principals and the Fundacion del Empresariado Chihuahense.

- **Food Security Table program**: the company also contributes to the “Food Security Table” program that aims to address malnutrition for 114,000 Rarámuri people (a group of indigenous people of the Americas living in Chihuahua state). So far, they have distributed food baskets to over 20,000 Rarámuri families across 18 municipalities.

Source: Interview with La Norteñita’s team., Photo credit: La Norteñita’s website.

Grupo La Norteñita leverages regenerative agriculture practices and technology to minimize its environmental impact

Environmental impact

- **Commitments**: The company holds organic certifications (EU, USDA, LOOAA) for 1% of its production and follows circular economy principles.
- **Actions under way**:
  - Reducing emissions via industrial ventilation.
  - Using solar panels for cold storage.
  - Re-using packaging or using biodegradable packaging.
  - Climate-smart irrigation.
- **Impact to date**: Saving up to 80% of water. Post-harvest losses reduced to 2-3% of total production.



Good practice 1 – Climate smart irrigation

- **Drip irrigation systems:** these systems, combined with soil moisture monitoring, both through sensors and manual field checks to irrigate only when needed, help reduce water use by up to 80%.
- **Mulching:** Trees are all covered with ground cover and wood mulch to prevent evaporation, and the use of worm liquid humus, a natural liquid fertilizer made from worm castings, enhances soil permeability and retention.

Good practice 2 – Post-harvest loss reduction through controlled atmosphere technology

To reduce post-harvest losses and ensure year-round availability of apples, the company installed 100 controlled atmosphere chambers that maintain low levels of oxygen and carbon dioxide, a temperature of 0°C and relative humidity above 85%. This process stops the normal ripening of the apples, enabling to reduce post-harvest losses at 2-3%.

Pre-cooling of cold chambers and providing the right inputs in the field are other best practices to reduce post-harvest losses.

Source: Interview with La Norteñita's team., Photo credit: La Norteñita's website.

La Norteñita has stabilized revenues after strong growth and now looks to diversify its products and support partner producers

	Future outlook
Growth perspectives	▪ **Consolidation phase**: La Norteñita has grown 30% over the past five years. Revenue is now more stable: the company is achieving better yields and tree planting continues, but it is no longer expanding land acreage.
Key challenges	▪ **HR:** The company is facing difficulty in recruiting seasonal labour for orchard operations. ▪ **Input prices:** In a low margin-high volume business, rising input costs have a significant impact on production margins and overall profitability.
Financing	▪ **Past funding**: La Norteñita received loans from banking institutions but no external equity investments. ▪ **Future funding**: The company has just completed a debt renegotiation and consolidation process and will not be taking on additional debt in the short term. However, it remains open to financing opportunities that could improve current conditions or enable expansion and technological innovation, including working capital to purchase apples from additional smallholder farmers.
Additional support requirement	The company would benefit from technical assistance for partner producers to improve fruit quality.



Source: Interview with La Norteñita's team., Photo credit: La Norteñita's website.

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Brazil Melon is a melon company producing around 30,000 tons of fruits a year

Brazil Melon is a Brazilian-owned company selling melons, including watermelons, locally and in Europe. Founded in 2001 by two agronomists, one of whom is a woman, it is located in the Northeast of Brazil and employs up to 800 employees during harvest period.

	Business model
History of organization	▪ While the founding agronomists Francisco Vieira and Clemens de Paula started working together in 1997, the company was **formally established in 2001.** ▪ They started selling their products in Brazil, and rapidly expanded their footprint by exporting to Europe. ▪ Today, the company claims to be one of the largest Brazilian fruit companies with melons produced across **4,500 hectares** and 1,200 hectares planted annually.
Product offering and value proposition	▪ Brazil Melon has a portfolio of **melon varieties** (Piel de Sapo, honeydew, galia, cantaloupe, seedless & mini watermelons) – it also sells nuts through a sister company. ▪ Its value proposition lies in **reliable supply with consistent sweetness and shelf life**, underpinned by sustainable farming methods and rigorous post-harvest quality control to meet international standards.
Sales and distribution	▪ **Local sales represent 15-20% of Brazil Melon's revenues**. The company has a retail presence across 5 regions. ▪ It exports 1,150-1,200 containers per year to 12 European countries, with 30% being watermelons and 70% being other types of melons.
Results	▪ **Production:** Around 30,000 tons of fruits produced in 2024, a 17% increase compared to 2023, and with a 5-10% predicted growth rate for 2025[1]. **Annual Revenue:** Approx. $15m for 2024. ▪ **Employees:** 800 during harvest periods.



SDG impact	
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	The company promotes sustainable agriculture through efficient irrigation, organic fertilizers, and use of solar energy
3 GOOD HEALTH AND WELL-BEING	The company makes healthy food products available.

Source: Interview with Brazil melon's team., (1) FreshPlaza (2025), Photo credit: Brazil Melon's website

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Brazil Melon sells 4,500 tons of pesticide-free fruits to local markets every year

Nutritional impact

- **Commitments**: Only melon company in Brazil with an international zero residue certificate. It is a pesticide-free verified company.
- **Actions under way**: Annual audits of products' composition and microbiology
- **Impact to date**: 4,500 tons of pesticide-free melons and watermelons sold every year on the Brazilian market



Good practice 1 – Use of microbiology to reduce harmful residues from chemical pesticides

- Brazil Melon uses beneficial microorganisms, such as fungi, bacteria, and predatory insects, to manage pests. This method relies on natural enemies that leave no residues in food and are harmless to human health.

- By replacing chemical pesticides with microbiological solutions, Brazil Melon reduces consumers' exposure to harmful residues, which can negatively affect neurological development, endocrine function, and overall health. As a result, the fruits are safer, healthier, and retain their natural nutritional value[1]. Brazil Melon performs annual soil sampling and analysis to assess physical-chemical composition, microbiology, and heavy metals and ensure that its products are healthy.

Future opportunity – Increasing sales on the local market

Despite the opportunities presented by exports, the company faces logistical challenges that can delay deliveries to Europe by two weeks, impacting product quality and generating significant losses[2]. The local market has not yet been fully captured (representing 15-20% of total sales) and could be a growth driver for the company while helping to provide Brazilians with nutritionally sound products.

Source: Interview with Brazil melon's team., (1) Craveiro de Andrade et al. (2023), (2) FreshPlaza (2025), Photo credit: Brazil Melon's website

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Brazil Melon leverages climate-smart irrigation and biological practices to minimize its environmental impact

Environmental impact

- **Actions under way**:
  - Plant protection fabrics and automated irrigation to optimize water use.
  - Organic fertilization and bioorganic compost to improve soil health.
  - Biological pest control with beneficial microorganisms and predatory insects.
- **Impact to date**: Reduction of overall waste by up to 25% and of water consumption by 30%, thanks to all farm irrigation using drip systems.



Good practice 1 – Climate Smart Irrigation

- **Automated irrigation for efficiency:** Brazil Melon has implemented modern automated irrigation systems with sensors that measure soil moisture, electrical conductivity, and pH in real time. This approach ensures rational water use with uniform distribution per plant, reducing water consumption by 30% and overall waste by up to 25%.
- **Mulching (bioorganic compost) for water efficiency:** Brazil Melon uses bioorganic compost to improve soil structure and increase water retention, reducing the need for irrigation.

Good practice 2 – In-house production of biopesticides and bio-fertilizer

Facing higher temperatures, lower humidity and a greater incidence of pests, Brazil Melon managed to mitigate these challenges using pesticides and fertilizers with reduced chemicals:

- **Biofactory and biological control:** Brazil Melon developed its own bio factory producing fungi and bacteria for pest control, complemented by predatory insects, resistant varieties, and organic fertilization to improve soil and crop quality.
- **Plant protections and natural extracts:** Brazil Melon uses nonwoven fabrics to protect plants, along with plant extracts that act as natural pest repellents, achieving internationally certified zero-residue production.

Source: Interview with Brazil melon's team. Photo credit: Brazil Melon's website

Brazil Melon expects to continue to grow at 6-10% per year and improve sustainability through technology investments

	Future outlook
Growth perspectives	Brazil Melon has been growing at a rate of 5-6% per year over the past 5 years and is expecting to continue to grow at +**6 to 10% per year over the next 5 years,** thanks to favourable market dynamics and expansion into new varieties of fruits (mini melons and watermelons that are better aligned with recent consumer preferences).
Key challenges	▪ **Climate change** and its impacts on land productivity. ▪ **Labour availability**, particularly during the key period of harvesting. ▪ **Global economic policies**, creating currency risks and business uncertainty, notably for exports.
Financing	▪ Brazil Melon has **not yet received any external financing** ▪ The company could be seeking external capital to **invest more in new technologies to further improve their sustainability practices** such as fruit biological management and fruit genetics, as well as **in machinery and agricultural mechanization**.
Additional support requirement	Brazil Melon would be interested in receiving support in implementing machinery and agricultural mechanization good practices in its production.





Francisco and Gabriel Vieria, President and Commercial Director, respectively, of Brazil Melon

Source: Interview with Brazil melon's team., Photo credit: FreshPlaza (2025)

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SSA has the lowest production and consumption of vegetables and fruits per capita, yet representing ~10% of food budget



Vegetables are the edible parts of plants, either cultivated or harvested wild, in their raw state or in a minimally processed form.[3] The main vegetables cultivated globally are tomato, alliums (onion, garlic, shallot, leek), brassicas (cabbage, cauliflower, broccoli), and cucumber. Vegetables are characterized as having 'high inherent nutritional value' as per GAIN's definition of a nutritious and safe food* and consuming enough (or even more than the recommended amounts) of these foods has many health benefits[3].

Market overview

Market dynamics

Production volumes

- Out of the 1.2bn tons of vegetables produced in 2023 worldwide, only 5% were produced in Sub-Saharan Africa[1] – it is the region with the **lowest per capita production of vegetables** in the world[2].
- The gross production value of vegetables in SSA is estimated at **$18.5bn**[1] in 2023.
- **Production volumes of vegetables doubled** in all Sub-Saharan African regions (though from a very low base) between 2000 and 2018, in line with global trends[3].
- Over the next 5 years, market value is projected to grow at over 10%/ year in East and West Africa[8].

Trading volumes

- **International trade of fresh fruit and vegetables is globally low**, representing around 7–8% of total global production[1].
- In SSA, **4% of vegetables consumed are imported** while **less than 1% produced is exported**[4].

Key challenges

High post-harvest losses: Up to 40% of vegetables are lost post-harvest, with the highest levels of loss occurring on the farm and in wholesale markets[3].

Low productivity: African vegetable yields are far below yields in other regions. This is primarily due to (i) low access to high-quality seeds, (ii) low use of inputs and irrigation and (iii) the small size of farms[5] (30% of the total production of vegetables comes from farms that are less than 2ha)[3].

Lack of market access: Vegetable farmers are seldom organized into producer groups and lack vertical linkages. Poor transport infrastructure also increases the trade costs for many smallholder producers[5].

Nutritional impact

Additionality

Malnutrition: In a region where adults consume only 46% of the recommended serving of vegetables[6], this type of food could help reduce all forms of malnutrition (undernutrition, micronutrient deficiency, overweight and obesity)[3].

Non-communicable disease: They also reduce the risk of non-communicable diseases, with > 350,000 deaths per year attributable to a diet low in fruits or vegetables in SSA[6].

Fit into consumption and cultural habits

While consumers in SSA consume less than the recommended amounts of vegetables, primarily due to affordability reasons, **they still value these food products**:

- Based on a survey of 16,300 people in 30 African countries, **87% report consuming vegetables several times a week, with an average of five different varieties.** Tomatoes, onions, carrots, and cabbage are the most popular[7].

Expenditure for fruit and vegetables accounts for **between 5 and 16 percent of the food budget**[3].

Notes: (*) See appendix for table with the nutritional impact classification rationale.;
Source: (1) FAOstat (2023), (2) Schreinemachers et al., The Dynamics of Africa's Fruit and Vegetable Processing Sectors (2022), (3) FAO, Growing Green (2021), (4) Reardon et al, African domestic supply booms in value chains of fruits, vegetables, and animal products fueled by spontaneous clusters of SMEs (2024), (5) Aboushady et al., Fruits and Vegetables value chains in Africa (2024), (6) Global Nutrition report, Africa profile, (7) Capmad, Study on fresh produce consumption in Africa (2024), (8) Statista, Vegetables market outlook.

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Tackling post-harvest losses and improving market access represent both an economic and impact opportunity for investors

Investability

Existing DFI investments

- Since 2013, the 7 DFIs in our research[1] have invested **$254m in 19** (non-purely export-focus) **companies selling vegetables**,
- The 16 companies invested by DFIs and selling vegetables in SSA include **large regional FMCG distributors** (e.g., Cairns Holding), **companies focused on horticulture with strong focus on exports** (e.g., Vertical Agro, Joytech) and **tech-enabling companies** allowing for more efficient market access (e.g., EA Foods).
- Some of the challenges reported by interviewed DFIs for investing further into the value chain are (i) the **limited number of large-size companies**, (ii) the need to **abide by environmental standards** (e.g., use of pesticide, water consumption) and (iii) the **lack of foreign currency** for non-exporting companies, making investments bear full exchange rate risks (as most financing is done in euro or dollars).

Opportunities for investors

- **Supporting aggregators and distributors to improve market access:** With 30% of vegetable production from farms under 2 hectares, actors providing training, inputs, equipment and market access to smallholder farmers can effectively boost smallholders' productivity.
- **Segmented offer and preservation/ transformation of lower grade produce to reduce post-harvest loss and increase affordability:** Reducing the current 40% of post-harvest losses offers another opportunity to improve farmers' revenues and improve availability of affordable products.
- **Optimising distribution and improving customer service using technology:** The informal fresh vegetable market is highly fragmented with thin margins, making operational efficiency and customer loyalty critical to profitability. Tech-enabled distribution represents an opportunity to develop more resilient and sustainable value chains for vegetables.
- **Expanding reach to increase customers' access to nutritious food**: Vegetable and fruit companies usually start serving larger B2B clients (e.g., supermarkets, HORECA[2] clients) in urban centres, who are easier to serve directly than smaller shops. However, expanding their reach by serving local mom and pop shops, street vendor and leveraging e-commerce can boost revenues and nutritional impact.

Case studies

- Company: FarmWorks.
- Geographic footprint: Kenya.
- Country for case study: Kenya.
- Size: $5m in revenues in 2024.
- Product offering: Tomatoes, onions, avocados, green pepper, potatoes and bananas.
- Export/ import focus: 91% of produce sold locally.
- Value chain positioning: Distribution.
- Current investors: Acumen RAF, Livelihood impact fund, Vested World, Truvalu group and DOB.

- Company: Eden Tree.
- Geographic footprint: Ghana.
- Country for case study: Ghana.
- Size: $1.4m revenues in 2024.
- Product offering: Vegetables, fruits, herbs and juices.
- Export/ import focus: 100% local sales.
- Value chain positioning: Production, processing and distribution.
- Current investors: Investisseurs & Partenaires.

Notes: (1) DFIs included in our analysis are: IFC, BII, FMO, Norfund, DEG, Proparco, BIO., (2) Hotel, Restaurant, and Catering.

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Vegetables have a low impact across all environmental factors

	Environmental performances of vegetables[1] at global level	Environmental performance (data on regional proxy not available)	
	Average value[2]	Differences between environmental performance of vegetables in SSA vs vegetables globally	Key contributors at global level
GHG	**0.8 CO_2eq/ kg**	No data available in WFLDB 3.11 and ecoinvent 3.11 database.	▪ Energy consumption from machinery and site electrification. ▪ Land use change, especially in key risk areas (such as Nigeria, the DRC of Zimbabwe in SSA). ▪ Fertilizers (fossil-based) and other chemical inputs. ▪ Irrigation, especially in drier regions or regions prone to water stress. ▪ Field emissions (linked to nitrous oxide and decomposition of crop residue).
Terrestrial acidification	**7.7 SO_2-eq/ g**		Fertilizers (fossil-based) and other chemical inputs.
Water Use	**127 L/ kg**		Irrigation of crops, particularly those requiring high water inputs, such as tomatoes.
Land use	**0.5 m2/ kg**		Land use change such as deforestation and conversion, especially in key risk areas such as Nigeria, the DRC or Zimbabwe in SSA.
Comments	▪ Positive outlier: Root vegetables. ▪ Negative outlier: Tomatoes.	Key drivers are land use change, fertilizer use and irrigation, but this is highly dependent on the crop and agricultural practices.	

Notes: (1) Vegetables consist of onions & leeks, root vegetables, tomatoes, brassicas, and 'other vegetables'., (2) The colour coding of average values indicates whether the impact is low (green), medium (yellow), or high (red) compared to other value chains. See page 29 for details.; Source: Poore and Nemecek (2018).

Source: Quantis expertise, WFLDB 3.11 and ecoinvent 3.11.

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Various techniques can reduce post-harvest losses, currently representing >40% of vegetables production in SSA

Lever	Description	Type of impact	Potential for reduction[1]	Contribution driver	Sources
Harvesting and handling	▪ Limiting irrigation during the weeks before harvest. ▪ Harvesting mature products (avoid immature or overmature)during the coolest time of the day. ▪ Careful handling during harvest to reduce bruising, scratching and punctures. ▪ Shading crops once harvested.	▪ Climate ▪ Water ▪ Acidification ▪ Land use	Very high	Farming and distribution practices	Ridolfi et al., Post-harvest losses in fruits and vegetables: the Kenyan context (2018). Ministry of Agriculture & Farmers' Welfare, Government of India, Post-Harvest Handling Protocol for Fruits & Vegetables (2022). ACF International, Post-harvest losses and strategies to reduce them (2014). Chhetri et al., A review paper on post-harvest loss on fruits and vegetables (2022).
Sorting and cleaning	▪ Cleaning produce by using sodium hypochlorite solution, thiabendazole, and chlorinated water. ▪ Systematic sorting and grading by separating higher and lower quality crops. ▪ Using pre-cooling methods (e.g., room cooling, hydro-cooling with disinfectant in water for some fruits and vegetables, evaporative cooling). ▪ When possible, refrigerating produce at constant temperature.				
Packaging	▪ Using adapted packaging materials like light-weight fiber-board liners for plastic corrugated cardboard boxes and smaller-sized packages. ▪ Providing ventilation to prevent physiological breakdown.				
Transportation	▪ Avoiding watering the produce before transport as this increases decay. ▪ Careful loading of vehicles, avoiding compressing due to overfilled packages. ▪ Using clean, well-ventilated (refrigerated) vehicles covered at the top for transportation.				
Storage	▪ Using adapted storage technique depending on produce and storage period intended (ground storage, ambient storage, refrigerated storage, air cooled storage, zero energy storage, modified atmospheric storage, hypobaric storage, and controlled atmosphere storage).				
Processing	▪ Drying, salting, fermenting and pickling to extend fruits and vegetable shelf-life.				

Notes: (1) Rating based on data showing that >40% of fruits and vegetables are lost post-harvest.

HYSTRA hybrid strategies consulting

Beyond post-harvest losses reduction, regenerative agriculture practices can help further reduce vegetables' environmental impact

Regen ag practices

Lever	Description	Type of impact	Potential for reduction[1]	Contribution driver	Sources
No-till practices	▪ Eliminating/ reducing soil disturbance. ▪ Lowers GHG emissions and improves soil health by increasing organic matter and enhancing water retention.	▪ Climate ▪ Water ▪ Acidification	Medium		4p1000 study (INRAE), Quantis and BCG use cases.
Cover cropping	▪ Planting on cropland otherwise fallow. ▪ Enables carbon sequestration, and a soil richer in organic matter which stores water better.	▪ Climate ▪ Water ▪ Acidification	High		Poeplau & Don, 2015, Quantis and BCG use cases.
Legume Crop rotation	▪ Integration of legume into main crop cycle. ▪ Legumes naturally absorb nitrogen from the air, reducing need for synthetic nitrogen fertilizers. ▪ Enriches soil by leaving behind nitrogen, benefiting next crop.	▪ Climate ▪ Acidification	High	Farming practices & inputs	Austrian Federal Ministry of Agriculture, 2015, Quantis and BCG use cases.
Organic mulching and returning residues to soil	▪ Covering ground with plant material. ▪ Permit important water retention and carbon sequestration.	▪ Climate ▪ Water ▪ Acidification	High		Payen, 2021, Lu, X. et al., 2020; Quantis and BCG use cases.
Undersown cropping	▪ Simultaneous growth of secondary crop alongside main crop for enhanced soil cover. ▪ Enables carbon sequestration, and a soil richer in organic matter which stores water better.	▪ Climate ▪ Water ▪ Acidification	Medium		Poudel et. al, 2022, Quantis and BCG use cases.
Agroforestry	▪ Integration of trees, hedges and shrubs in cropland and grassland. ▪ Increases soil organic matter, water retention, carbon sequestration, and creates biodiversity refuges.	▪ Climate ▪ Water ▪ Acidification	High	Farming practices & inputs	Jones et al., 2021, Quantis and BCG use cases.
Biologically activated biochar	▪ Applying biologically activated biochar to fields. ▪ Biochar sequesters carbon and helps retain water and nutrients (reduced fertilizer leaching).	▪ Climate ▪ Water ▪ Acidification	High		Quantis and BCG use cases.
Certified deforestation free	▪ Verify that no forests or grasslands are cleared or converted for animal or feed production (e.g., certification, satellite imagery).	▪ Climate ▪ Biodiversity ▪ Land use	Very high	Land use change	EUDR, Quantis and BCG use cases.

Notes: (1) Rating based on Quantis' expertise.

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FarmWorks is Kenya's largest distributor of fresh vegetables, with >90% of local sales

Business overview: FarmWorks is a Kenyan agro distribution company working with over 3,000 smallholder farmers to supply fresh produce including tomatoes, onions, avocados, green pepper, potatoes and bananas to B2B customers. Founded by an agronomist and a management consultant, FarmWorks employs 300 people, equally split between full-time and casual staff. The company's mission is to provide reliable market access to Kenyan farmers so that informal open-market traders, who sell over 80% of all fresh food, have consistent access to produce, at the right price and quality.

	Business model
History of organisation	▪ FarmWorks started in 2020 as a distributor of vegetables produced from its own farms and through contract farming. The company had its own production and training operations over 1,000 acres of leased farmland to trial innovative, climate-smart, regenerative practices and to demonstrate them to farmers. ▪ Since then, it has stopped its own farming operation to focus on what it does best: distribution of fresh produce sourced from contract farmers.
Product offering and value proposition	▪ FarmWorks exclusively commercializes nutritional fresh produce. It is Kenya's largest domestic distributor of fresh vegetables. ▪ The company differentiates itself as a distributor by providing end-to-end support to partner farmers in the form of inputs, access to finance and training, based on a points system that rewards farmers' performance on quality, volume, and consistency.
Sales and distribution	▪ 25 branches set up in wholesale markets across Kenya sell 70% of produce to 12,000+ clients. The remaining 30% is delivered to supermarkets directly. ▪ Exports represent only 9% of sales with logistics handled by a third-party.
Results	▪ The company works with 3,000+ farmers selling 1,100+ tons/ month and has a market share of 3% for tomatoes (lower for other products). ▪ It generated $5m revenues in 2024 and is currently contribution margin positive.



SDG impact	
1 NO POVERTY, 8 DECENT WORK AND ECONOMIC GROWTH	▪ Farmers who receive training, inputs, equipment and market access from FarmWorks increase their productivity per plot by 30% in 5 years.
2 ZERO HUNGER, 3 GOOD HEALTH AND WELL-BEING	▪ The company ensures consistent access to fresh produce in informal markets. ▪ The Malaika kitchen program cost-efficiently feeds 6,000+ children across 10 schools.
5 GENDER EQUALITY	▪ The company has a female CEO and co-founder. 40% of permanent staff is female and 90% of the 12,000 market vendors served are female.
12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION	▪ The company reduced post-harvest losses to 3% (used in soldier fly production).

Source: Interview with Yi Li, June 2025, FarmWorks' service delivery model analysis by IDH, 2023., Photo credit: FarmWorks' website.

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FarmWorks' nutritional impact is driven by its contribution to ensuring consistent supply of vegetables to the mass market

Nutritional impact

- **Commitments**: Multiplying the number of partner farmers by 5 and developing self-sustaining meal programs in schools across Kenya.
- **Actions under way**: Implementation of a gamified points system for farmers, and a school meal program.
- **Impact to date**:
  - 13,000+ tons of fresh vegetables sold per year on local markets.
  - 1m+ meals served to school kids through 10 schools.



Good practice 1 – Increasing smallholders' productivity to ensure greater access to affordable vegetables for Kenyan customers

- **Increased yield:** After working for 5 years with FarmWorks, farmers' productivity per plot increases by 30% on average. Such increase is due to a combination of input provision, financing, training, but most importantly, guaranteed offtake. FarmWorks has developed a points system for its suppliers that identifies best performers based on the quality of their vegetables, volume, and consistency of supply. Best performers receive productivity boosting rewards such as ensured offtake volumes, inputs (at cost) on credit, and introduction to FarmWorks' partner financial institutions.

- **Consistent distribution:** Kenya has one of the most fragmented fresh food supply chain and markets in the world – 80% of all food is sold through open-market traders. FarmWorks' sourcing, grading and distribution infrastructure ensures consistent provision of high-quality nutritious fresh vegetables for customers.

Good practice 2 – Malaika Kitchens program

In response to dropouts observed in rural settings, FarmWorks started fundraising philanthropic money to finance the opening of kitchens in primary schools (construction, equipment and training of cooks cost $1,500-3,000 based on kitchen size). Once set up, the kitchens self-sustainingly provide 5 meals/ week at 100 shillings ($0.77). FarmWorks does not yet supply these kitchens with vegetables but facilitates connections between the schools and local suppliers of maize and beans, which are key ingredients in the meals.

Source: Interview with Yi Li, June 2025., Photo credit: FarmWorks' website.

FarmWorks' environmental impact is driven by its commitment to promote sustainable farming practices and ensure zero waste

Environmental impact

- **Commitments**: Promoting sustainable farming practices and ensuring zero waste.
- **Actions under way**: Training of thousands of farmers on sustainable farming practices.
- **Impact to date**: Product spoilage reduced to just 3%, saving 50 tons of produce each month compared to 2021.



Good practice 1 – Training farmers on regenerative farming

The company partners with the non-profit, Pemu agrifood academy, started by FarmWorks' ex-founder Peter Mwangi to train farmers on Good Agricultural Practices (GAP) and regenerative farming, shifting them towards more sustainable and profitable production. With the adoption of GAP (along with assured offtake), farmers increase their productivity per plot by 30% in 5 years.

Good practice 2 – Minimising post-harvest losses

- **Reduced post-harvest losses:** The company reduced harvest-to-sales time to 48 hours thanks to efficient logistic operations, notably with the support of an app that allows to track produce all the way from farm procurement to the sales branches, ensuring traceability and reducing delays and losses.
- **Tier pricing**: Smaller grade or slightly damaged vegetables are commercialized at a lower price through a dedicated branch in the mass market, increasing affordability and availability. As a result, FarmWorks sells 97% of all vegetables sourced from farmers.
- **Zero waste**: The remaining 3% that is spoiled is sold as organic waste to Chanzi, a company producing black soldier flies.

Source: Interview with Yi Li, June 2025, FarmWorks' service delivery model analysis by IDH, 2023., Photo credit: FarmWorks' website.

FarmWorks is looking to raise $5m for business expansion

	Future outlook
Growth perspectives	▪ **Initial rapid growth**: As an asset light (leasing its infrastructure) and operations heavy model, FarmWorks saw rapid growth (50-100% p.a.) in the initial 3 years by developing an extensive logistics networks and thousands of farmer relationships. ▪ **Expansion**: The company's short-term goal is to sell 100 tons/ day, and its ambition is to multiply sales volumes 10 times by 2030, confirming their position as a market leader and ensuring stable offtake from farmers.
Key challenges	▪ **Operational losses**: In a business with very thin margins, FarmWorks will need to ensure strict operational discipline during it scale-up, to avoid petty theft and product losses across the supply chain. ▪ **Low penetration of irrigation:** This limits crop variety and business expansion across a larger portfolio of agro products. ▪ **Fundraising:** Finding patient and flexible capital from VC/ PE is a struggle for businesses that are not high margin or high tech.
Financing	▪ **Past funding**: The company received $6m of patient capital in angel and seed rounds from investors including Acumen Resilient Agriculture Fund, Livelihood Impact Fund and Vested World. The Truvalu Group and DOB Equity, a Dutch family-backed impact investor, took equity as of October in 2024 and 2025, respectively. ▪ **Future funding**: FarmWorks intends to raise $5m in series A funding by early 2026 to expand regionally and add more SKUs. In addition, the company actively seeks small grants for expanding the Malaika program to more schools.

Additional support requirement	▪ **Tech Integration**:
	  ○ The company wants to advance integration of tech solutions across the supply chain. It has piloted an AI-driven branch app that monitors stock, prices and customer purchase behaviour.
	  ○ FarmWorks wants to leverage the data collected on customers to derive insights on how to improve services for customers and increase their share of wallet.
	▪ FarmWorks would require technical assistance **on organizational excellence** as it scales operations.



Source: Interview with Yi Li, June 2025., Photo credit: LinkedIn.

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Eden Tree is one of the top three processors and distributors of vegetables, fruits, herbs and juices in Ghana's Greater Accra region

Business overview: Eden Tree is a Ghanian processor and distributor of whole and pre-cut vegetables, fruits, herbs and juices – sourcing all its produce from local farmers. Founded by an ex-banker Catherine Krobo - Edusei, the company employs 65 full-time workers and casual seasonal workers. The company's aims is to promote healthy eating habits and create employment in Ghana.

	Business model
History of organisation	▪ Incorporated in 1997, Eden Tree processes and supplies over 70 products sourced from >150 smallholder and larger contract farmers. ▪ Initially focused on B2B sales of herbs, vegetables, and fruits to supermarkets and HORECA[1] clients, the company expanded into B2C in 2017 with walk-in sales at its processing facility. Since 2023, it has extended its reach through small retailers, street vendors, and e-commerce, and in 2024 launched its own-brand store and added fruit juices to its product portfolio.
Product offering and value proposition	▪ Vegetables, fruits, herbs and juices account for 50%, 30%, 10% and 10% of sales, respectively. About 60% of these products are sourced from 100-150 smallholders, ~40% comes from larger contract farmers. ▪ It offers a comprehensive service to its B2B clients including procurement, packaging and labelling under Eden Tree's reliable and recognised brand, in-store merchandising and recovery of damaged/ unsold products.
Sales and distribution	▪ 70% of sales are made B2B to retail and HORECA clients. The remaining 30% are B2C sales including walk-ins at the processing facility and own-brand store (20%), and via e-commerce/WhatsApp orders (10%). ▪ Eden Tree sells exclusively in the greater Accra region and Takoradi (Central Ghana). It does not export.
Results	▪ The company sells ~480 tons of vegetables and fruits and >8 tons of juice each year. ▪ It has an annual turnover of $1.4m in 2024 and is net profit positive.





	SDG impact
1 NO POVERTY, 8 DECENT WORK AND ECONOMIC GROWTH	▪ Training to farmers to increase their income and decrease costs. ▪ 5% average price premium for Ghana green labelled products.
3 GOOD HEALTH AND WELL-BEING	▪ Diversified portfolio of healthy vegetables, fruits and herbs.
5 GENDER EQUALITY	▪ The company's founder and managing director, and 60% of staff, are female.
12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 13 CLIMATE ACTION	▪ Water recycling and use of solar energy. ▪ Use of innovative sustainable farming techniques.

Note: (1) Hotel, Restaurant, and Catering; Source: Interviews with Catherine Krobo-Edusei (Founder and MD of Eden Tree) in August 2025, Ghana Investment Support Program, Investisseurs & Partenaires., Photo credit: Eden Tree's website.

HYSTRA hybrid strategies consulting

Eden Tree's impact is driven by increasing market access for Ghanian smallholders and customers' access to nutritious food

Nutritional impact

- **Commitments**: Promoting healthy eating habits by producing, packaging, and supplying high quality products.
- **Actions under way**: Accreditation from Hazard Analysis and Critical Control Point (HACCP) and Ghana Food and Drug Authority on food safety and quality.
- **Impact to date**:
  - 15% of output (0.3 tons/ day) sold in markets far from the city centre via smaller retailers and street vendors.
  - Shelf life of products increased by up to three weeks under the Farm2Market program (see more below)[1].





Good practice 1 – Increasing access to healthy food via expansion into smaller, local shops

- **Targeted channel expansion to reach underserved customers**: Starting in 2023, with GhISP's[2] advisory on customer segmentation, pricing, sales agents, and marketing, Eden Tree expanded beyond major supermarkets into local shops and street vendors, adding new revenue streams. It recently also began supplying schools and hospitals.

- **Rapid execution**: In less than a year, Eden Tree implemented the strategy in-house, piloted new outlets and a sales agent network. The new sales boosted the company's turnover and accessibility for communities outside city centers, with 15% of produce now sold through these channels.

Good practice 2 – Improving market access for smallholders

- Eden Tree partners with Horticulture Business Platform (HBP), The Sustainable Trade Initiative (IDH), Holland GreenTech and AkoFresh Ltd. under the 'Farm2Market' project (supported by the Netherlands Embassy) to enhance vegetable production, cut losses, and link smallholders to markets. Holland GreenTech provides agronomy support, AkoFresh supplies solar-powered cold storage solutions, and Eden Tree serves as the off-taker.

- Launched in early 2025, this project helps smallholders **extend shelf life by up to three weeks**, reduce waste, and access more stable markets[3], while Eden Tree secures a reliable supply of higher-quality produce.

Note: (1) The three-week claim assumes proper refrigeration from the time of procurement till consumption by end-clients. (2) Powered by British International Investment (BII), the Ghana Investment Support Program (GhISP) works to increase investment flows to SMEs in Ghana through pipeline development, capacity building, and matchmaking activities., (3) Concrete quantitative impact on farmer revenues or yield have not been reported so far.; Source: Interviews with Catherine Krobo-Edusei (Founder and MD of Eden Tree) in August 2025, HBP, Ghana Investment Support Program, Investisseurs & Partenaires., Photo credit: Eden Tree's website.

HYSTRA hybrid strategies consulting

Eden Tree's impact is driven by efforts to promote sustainable agriculture practices across its value chain

Environmental impact

- **Commitments**: Increasing solar power in energy mix to 80% and installing a solar-powered dryer to valorise damaged produce, reducing the post-harvest loss from 20% to 10%.
- **Actions under way**:
  - Piloting sustainable agriculture practices to reduce input requirements.
  - Producing 2500 kWh of energy from solar panels and recycling ~50,000 litres of water each month.
- **Impact to date**:
  - 20% of the processing plant's energy requirement fulfilled by solar energy.
  - 90% savings on the processing facility's water bill each month from recycling and reuse.
  - 10% of sales sourced from smallholder farmers with Ghana Green Label certification at a 5% price premium.





Good practice 1 – Promoting sustainability through the Ghana Green label

- 10% of Eden Tree's sales come from Ghana Green Label–certified smallholders. The label requires farmers, processors and retailers to meet sustainability standards such as using clean water, protecting biodiversity, and responsible input use. The label's governing body provides farmers with training from accredited agronomists to adopt and document these practices.
- By sourcing from these farmers, Eden Tree helps secure market access and better incomes for smallholders (5% average price premium for farmers), while lowering environmental impact through safer farming practices.

Good practice 2 – Training farmers on innovative sustainable practices

- As a part of the Farm2Market program, Eden Tree in partnership with HBP, IDH and Holland GreenTech, uses a 500m² demo farm at its facility to train smallholder farmers, who receive starter kits and inputs, and sell their produce to Eden Tree.
- Launched in 2025, and as of August 2025, 10 farmers, with a 500m^2 parcel each, have been trained on smart methods like drip irrigation, mulching and fertigation(2) for growing crops such as peppers, tomatoes, lettuce, and cucumbers. These practices boost yields, cut input use, and reduce weeds and pesticide needs.

Note: (1) Dutch organization Sustainable Trade Initiative, (2) Fertigation is the injection of fertilizers via an irrigation system and helps to precise and limit fertiliser use.; Source: Interviews with Catherine Krobo-Edusei (Founder and MD of Eden Tree) in August 2025, Ghana Investment Support Program, Investisseurs & Partenaires, HBP, GNBCC., Photo credit: Eden Tree's website.

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Eden Tree is seeking $1m for an investor buy-out and at least an additional $1m in debt to expand operations

	Future outlook
Growth perspectives	▪ **Past growth**: Annual revenue has seen a 150% increase over the past 5 years reaching $1.4m in 2024. ▪ **Growth plans**: o The group aims to increase daily output from 2.2 tons to 4 tons/ day over the next three to five years. o With new capital infusion, it has a 30% year-over-year revenue growth target.
Key challenges	▪ **Working capital shortage**: Eden Tree requires additional capital to scale procurement by working with more farmers and acquire new refrigerated delivery vans. ▪ **Low productivity of smallholder farmers**: Between January and August 2025, Eden Tree was unable to fulfil orders worth ~$49,000 due to supply shortages. Procuring from more farmers would imply higher costs for logistics, farmer onboarding and quality verification, particularly for products with sharp price spikes during shortages. ▪ **High energy costs**: Eden Tree operates four cold storage units and a banana ripening chamber, with 80% of energy needs met by costly grid power and diesel generators. ▪ **High waste levels**: The company currently loses ~20% of production between harvest and sales.
Financing	▪ **Current shareholders**: Investisseurs & Partenaires (I&P) owns 57% of the company and the remaining 43% is owned by the founder's family. ▪ **Future funding**: o The company is looking to raise $1m to enable I&P's exit from capital o It is looking to raise at least an additional $1m in debt to (i) increase procurement volumes, (ii) invest in new washing, peeling and drying machinery, (iii) buy additional refrigerated delivery vans, (iv) finance new solar energy systems and (iv) expand its product portfolio to include imported fruits like apples, grapes and tangerines from Europe and South Africa.
Additional support requirement	▪ **Facilitating access to solar-powered irrigation pumps and greenhouses for smallholder suppliers.** ▪ **Refining its expansion strategy** including the development of its B2C sales via smaller retailers, e-commerce and new own-brand retail stores. ▪ Technical assistance to **ensure operational efficiency** and **reduce post-harvest losses.** ▪ **Succession planning** for the current CEO over the next 5-10 years.







Source: Interviews with Catherine Krobo-Edusei (Founder and MD of Eden Tree) in August 2025, Ghana Investment Support Program, Investisseurs & Partenaires., Photo credit: Eden Tree's website.

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India and Myanmar produce 1/3 of the world's legumes, representing >10% of protein intake for their population

Legumes are defined as members of the large and diverse bean family containing over 20,000 species. Lentils, peas, broad beans, chickpeas, soybeans, beans (lima, common), and peanuts are some of the important groups of legumes in the human diet today[1,2]. Legumes are rich in proteins, fibre, and complex carbohydrates, they are characterized as having 'high inherent nutritional value' as per GAIN's definition of a nutritious and safe food*.

Market overview

Market dynamics

Production volumes

- Asia is the **largest producer of legumes**, accounting for almost **50% of the global production** (2018)[3].
  - India is the world's largest producer with 28% of the global production, Myanmar is the second largest producer (7%)[3].
  - Dry beans and chickpeas are the highest produced crops, accounting for 2/3 of the regional production[3].
- The 42m tons of pulses produced in the region in 2024 represented a **market of $49.2bn**[4].
- The market is expected to **grow at an annual rate of 2.3%** (in value) over the next 10 years, slightly below the 2.8% rate observed over the past 10 years[4].

Trading volumes

- Despite being the largest producer of legumes, and exporting 5.4m tons annually, the **S&SE Asian region still imported 13m tons** in 2024[4].

Key challenges

Price: Over the past decades, legumes have been replaced with cheaper carbs like rice and wheat[3].

Yield: Legumes are mainly grown in marginal areas** under low-input conditions, leading to low yield. Unpredictable weather patterns have led to fluctuating harvests[3].

Lack of investment: Legumes suffer from a lack of access to improved seeds, low seed replacement rates***, weak institutional arrangements, low research priorities, and a lack of government support compared to cereals[3].

Market structure: The market is highly fragmented into a large number of small players[3].

Nutritional impact

Additionality

Affordable proteins: Legumes are the most affordable source of protein[2].

Anaemia: Legumes are particularly rich in iron and folate while S&SE Asia accounts for the highest burden of anaemia globally (57.3% of children)[5].

Overweight/ obesity: Legumes are low in calories, help improve heart health, and lower blood cholesterol – this is particularly valuable given that the prevalence of overweight in adults and children is on the rise in the region (from 22.4 to 52.4%, and 1.3–7.6%, respectively, depending on countries)[6].

Fit into consumption and cultural habits

Legumes have been essential to how the region feeds itself since the first agricultural revolution in the Neolithic Age[3].

- In **India**, pulses are one of the most important sources of protein, especially for a large part of the population who are vegetarians. 12.7%[7] of proteins in people's diets come from legumes[4].
- **Myanmar** has the highest levels of legumes per capita consumption in the world (29 kg/ person in 2024)[4].

SEA has a higher consumption of legumes than global average but still consumes only 36% of the recommended daily intake[8].

Notes: (*) See appendix for table with the nutritional impact classification rationale.; (**) Marginal land is land that has little or no agricultural or industrial value.; (***) Seed Replacement Rate (SRR) refers to the percentage of the total sown area of a particular crop that is cultivated using certified or quality seeds, rather than farm-saved seeds. Source: (1) USDA, (2) FAO, (3) The future of pulses in Asia Pacific (2021), (4), IndexBox, Asia - Pulses - Market Analysis, Forecast, Size, Trends and Insights, (5) Sunuwar et al., Factors associated with anemia among children in South and Southeast Asia: a multilevel analysis (2023), (6) Awashi et al., Prevalence of overweight/ obesity in South Asia: A narrative review (2023) (7) IFPRI, (8) Global Nutrition report, South-Eastern Asia profile.

HYSTRA
hybrid strategies consulting

There has been limited investment in legumes, but opportunities exist to further localise production and develop a larger value-added portfolio

Investability

Existing DFI investments

- Since 2013, the seven DFIs in our research[1] have invested **$152m in 10** (non-purely export-focus) **companies** in the legumes value chains, out of which four were in South and SE Asia.
- Invested companies include large agro-traders (e.g., Société Louis Dreyfus), organic companies (e.g., Suminter), and multi-product distributors/ retailers (e.g., Big Basket).
- Some of the challenges reported by interviewed DFIs for investing further into the value chain are (1) **informal, smallholder-based market, with very few big companies** in the sector, and (2) **quality issues** (e.g., aflatoxin).

Opportunities for investors

- **Increased productivity coupled with market access:** While S&SE Asia is the largest producer of legumes, it still imports several millions of tons per year. Importation levels are highly volatile across the years (they almost doubled from 2022-2023 to 2023-2024), affecting processors' asset utilization rate and hence, profitability. Given the fragmented supply with varying quality and low productivity, contract farming could incentivize farmers to increase their production, while better quality seeds/ inputs and regen ag practices could help improve their productivity – supported by local regulations encouraging local production.
- **Organic segment:** While the market is still niche and low-margin, some segments have strong growth potential (e.g., 20% CAGR in India's organic market) and the ability to generate carbon credits.

Case studies

- Company: ETG.
- Geographic footprint: Global.
- Country for case study: India.
- Size: 400,000- 500,000 metric tons of pulses/ year
- Product offering: Legumes and nuts.
- Export/ import focus: >90 of ETG India legumes' revenues come from the Indian market.
- Value chain positioning: Processing and trading.
- Current investors: >20 DFIs.

ETG

- Company: NatureLand Organics.
- Geographic footprint: India, Gulf region.
- Country for case study: India.
- Size: $20m revenues in 2024.
- Product offering: Organic pulses accounting for 30% of total sales of company's >175 organic products.
- Export/ import focus: 90% of revenues from Indian market.
- Value chain positioning: Processing and distribution.
- Current investors: N/A.

NATURE LAND ORGANICS

Notes: (1) DFIs included in our analysis are: IFC, BII, FMO, Norfund, DEG, Proparco, BIO. We excluded companies selling soybean only as this is mainly used for animal feed and does not fit into our "nutritious food" scope

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Legumes have low GHG emissions but are water-intensive; Acidification and land use impact can be significantly limited with good agro practices

	Environmental performances of legumes[1] at global level	Environmental performances of regional proxy (chickpeas in India)	
	Average value[2]	Differences between environmental performance of chickpeas in India vs chickpeas globally	Key contributors to regional proxy's[3] impact
GHG	**2.0 CO_2eq/ kg**	**-3%**	▪ Irrigation: 35% of carbon emissions. ▪ Nitrous oxide emissions & field emissions from decomposition of crop residue: 25% of emissions. ▪ Emissions from the use of ag machinery: 10% of emissions.
Terrestrial acidification	**17.7 SO_2-eq/ g**	**-1%**	▪ Nitrous oxide emissions & field emissions from decomposition of crop residue: 46% of emissions. ▪ Irrigation.
Water Use	**895 L/ kg**	**-10%**	Irrigation.
Land use	**10.7 m2/ kg**	**0%**	Land use change such as deforestation and conversion.
Comments	▪ Positive outlier: Peas. ▪ Negative outlier: Groundnuts.	Chickpeas, like other types of pulses, are a source of protein that is generally less carbon-intensive than animal-based protein; However, they are water-intensive crops. Irrigation and nitrous oxide emissions are the main drivers of impact for conventional agricultural practices.	

N.B., The green colour code here indicates that **the local proxy's[3] impact is equal to or no more than 10% higher than the global average** (Exact difference expressed as a percentage figure; *See page 29 for details on reading the environmental assessment slides*).

Notes: (1) Legumes consist of peas, groundnuts, and 'other pulses', (2) The colour coding of average values indicates whether the impact is low (green), medium (yellow), or high (red) compared to other value chains. See page 29 for details.; Source: Poore and Nemecek (2018).

Notes: (3) Environmental performance values are highly contextual and should be taken as indicative, as impact is highly dependent on crop, country and agricultural practices. See slide 107 on selected proxies, rationale, and strength of proxy.; Source: Quantis expertise, Statista, WFLDB 3.11 and ecoinvent 3.11, IPCC WGI Interactive Atlas, CIRAD, Climate Risk Index (CRI), ND-GAIN Country Index Scores.

Nb: Please note that Poore and Nemecek global data and Quantis regional analysis of proxy foods are not directly comparable, as their scope and units differ.

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Regenerative agriculture practices help improve water retention and reduce legumes' environmental impact

Regen ag practices

Lever	Description	Type of impact	Potential for reduction[1]	Contribution driver	Sources
No-till practices	▪ Eliminating/ reducing soil disturbance. ▪ Lowers GHG emissions and improves soil health by increasing organic matter and enhancing water retention.	▪ Climate ▪ Water ▪ Acidification	Medium		4p1000 study (INRAE), Quantis and BCG use cases.
Cover cropping	▪ Planting on cropland otherwise fallow. ▪ Enables carbon sequestration, and a soil richer in organic matter which stores water better.	▪ Climate ▪ Water ▪ Acidification	High		Poeplau & Don, 2015, Quantis and BCG use cases.
Legume Crop rotation	▪ Integration of legume into main crop cycle. ▪ Legumes naturally absorb nitrogen from the air, reducing need for synthetic nitrogen fertilizers. ▪ Enriches soil by leaving behind nitrogen, benefiting next crop.	▪ Climate ▪ Acidification	High	Farming practices & inputs	Austrian Federal Ministry of Agriculture, 2015, Quantis and BCG use cases.
Organic mulching and returning residues to soil	▪ Covering ground with plant material. ▪ Permit important water retention and carbon sequestration.	▪ Climate ▪ Water ▪ Acidification	High		Payen, 2021; Lu, X. et al., 2020, Quantis and BCG use cases.
Undersown cropping	▪ Simultaneous growth of secondary crop alongside main crop for enhanced soil cover. ▪ Enables carbon sequestration, and a soil richer in organic matter which stores water better.	▪ Climate ▪ Water ▪ Acidification	Medium		Poudel et. al, 2022, Quantis and BCG use cases.
Agroforestry	▪ Integration of trees, hedges and shrubs in cropland and grassland. ▪ Increases soil organic matter, water retention, carbon sequestration, and creates biodiversity refuges.	▪ Climate ▪ Water ▪ Acidification	High	Farming practices & inputs	Jones et al., 2021, Quantis and BCG use cases.
Biologically activated biochar	▪ Applying biologically activated biochar to fields. ▪ Biochar sequesters carbon and helps retain water and nutrients (reduced fertilizer leaching).	▪ Climate ▪ Water ▪ Acidification	High		Quantis and BCG use cases.
Certified deforestation free	▪ Verify that no forests or grasslands are cleared or converted for animal or feed production (e.g., certification, satellite imagery).	▪ Climate ▪ Biodiversity ▪ Land use	Very high	Land use change	EUDR, Quantis and BCG use cases.

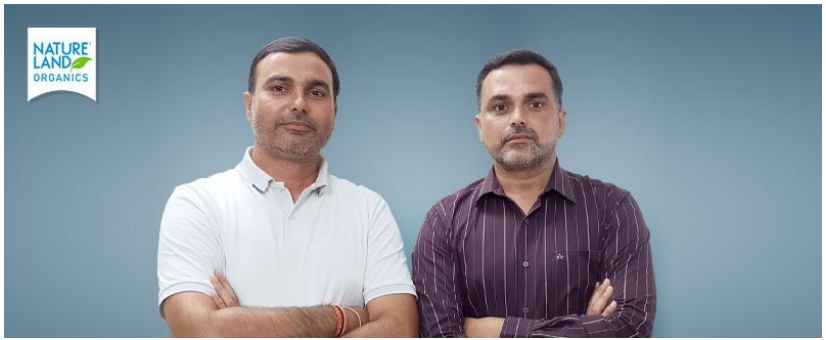
Notes: (1) Rating based on Quantis' expertise.

HYSTRA hybrid strategies consulting

NatureLand is an organic brand with strong presence in the legumes category and >90% of its sales coming from India

Business overview: NatureLand Organics is an Indian company offering >175 organic food products, including pulses, cereals, dry fruits and spices, to B2B and B2C consumers. It also sells conventional fruits and vegetables as well as seeds. Founded by two brothers, the company has recently been nominated in the "Indicorns 2025" list and currently employs 250 people. The company's ambition is to build efficient bridges between marginalized farmers and the rising urban demand for affordable organic products.

	Business model
History of organisation	▪ After converting their land to organic farming in 2002, Arvind and Ajeet Godara started supporting other farmers in this transition and launched a processing unit of organic products in 2007. ▪ Initially focused on bulk sales and private labelling, it launched a B2C brand in 2016.
Product offering and value proposition	▪ Out of the >175 organic products sold, pulses represent approximately 30% of their sales; flour and oils are their other top categories. The organic portfolio represents ~75% of their revenues. ▪ The company aims to be the cheapest quality organic brand in India. To deliver on such promise, it has strong control over their supply chain, incl. close support to their partner farmers and in-house processing of 85% of the raw materials across four plants.
Sales and distribution	▪ 90% of their revenues come from the Indian market: These are split between retail (45% of Indian sales) via 15,000 retail points served by 150 partner stockists, and e-commerce (55%). ▪ It only started exporting products 3 years ago, with a strong focus on the Gulf region.
Results	▪ The company works with >10,000 farmers across 9 Indian states. ▪ It generated $20m revenues in 2024 and have been profitable since year 1.



SDG impact
▪ Training to farmers to increase their income and decrease cultivation costs. ▪ Price premium for organic products.
Diversified portfolio of healthy and affordable food products.
>50% of their workforce is female.
Organic practices across 35,000 acres of land.

Source: Interview with Arvind Godara, June 2025., Photo credit: YourStory.

HYSTRA hybrid strategies consulting

NatureLand Organics offers a diversified portfolio of healthy and affordable organic products

Nutritional impact

SROI: An independent third-party company has calculated the Social return on investment of NatureLand Organics: under normal conditions and with a deadweight assumption of 10%[1], a social value worth Rs 1.90 was generated per one rupee invested (analysis made for SIDBI, a past investor of the company).



Good practice 1 - Affordable organic products

- **Commitment to affordable products**: In 2016, the company decided to venture into the D2C[2] segment "to expand the reach of organic food products at a fair price point to mass consumers and not just premium ones". While pulses are sold at a premium compared to conventional products, they are cheaper than other organic brands (e.g., Rs 90 for conventional pulses vs Rs 120 for NatureLand and Rs 140 for competitors) thanks to lower margins. Today, the D2C segment represents 40% of their sales.
- **Distribution:** While recognising that their products primarily reach the highest income segments, the increasing use of e-commerce and quick-commerce, as well as their expansion into general trade (35% of their retail sales) is progressively helping the company reach more middle-class segments.

Good practice 2 - Diversified portfolio of nutritious food products

- **Extended portfolio:** NatureLand Organics is looking to offer all the products required for day-to-day use by Indian families, from oil to flour to spices.
- **Healthy composition:** For each type of product, it aims to develop healthy formulation – for instance, offering cold-pressed oil and flour made of amaranth or millet.

Notes: (1) Deadweight is an estimate of the changes and impacts that would have been created if the organization had not intervened., (2) Direct-to-Customer.;
Source: Interview with Arvind Godara, June 2025, Natureland Organics, impact report 2022, ESG Assessment of Natureland Organic Foods (endline report)., Photo credit: NatureLand Organics, Impact report 2022.

NatureLand Organics offers holistic support to its partner farmers to ensure organic production

Environmental impact

- **Commitments:** Organic production (as per EU, American and Indian standards).
- **Actions under way:** NatureLand Organics is proactively minimising water and energy resources by using solar panels (generating 70% of energy needs) and a rainwater harvesting system in the factory premises.
- **Impact to date:** 35,000 acres of land converted to organic farming.



Good practice - Integrated approach towards organic food

- **Tailored advice**: Each farmer gets a preliminary assessment of their farm and then receives tailored advice based on soil sampling, including best crops/ rotation, inter-cropping and mulching practices, water preservation practices (e.g., farm ponds, drip irrigation), and how to produce organic fertiliser from farm resources (manure, vermicompost). Farms are organized in clusters (300-500 per cluster) and receive 3-5 training per year.
- **Seed provision**: NatureLand sells its seeds to the farmers, which helps guarantee quality and yield levels.
- **Product offtake:** The company also purchases products from farmers at a premium price (+10% on average, depending on the crops, compared to non-organic products). NatureLand Organics pays for the organic certificates and remains proprietor of those, which helps limit side sales to competitors.
- **Carbon credits**: The company started a partnership with Boomitra to monetise extra benefits from organic cultivation. The certification is still in process, but could bring $10-30 of additional revenues to farmers every year (as well as extra commissions for NatureLand Organics).

Source: Interview with Arvind Godara, June 2025; Natureland Organics, impact report 2022; ESG Assessment of Natureland Organic Foods (endline report)., Photo credit: NatureLand Organics, Impact report 2022.

HYSTRA hybrid strategies consulting

NatureLand is looking to raise $5-6m to continue its geographic expansion

	Future outlook
Growth perspectives	▪ **Organic growth:** The Indian organic market is expected to grow at a 20% rate annually (CAGR), suggesting strong growth for NatureLand Organics. ▪ **Geographic expansion**: The company is looking to expand to 5-6 new Indian states over the next 5 years and acquire 3-4 more processing units, as well as continue growing its revenues from exports. In the long term, NatureLand Organics is considering replicating its model in Africa. ▪ **Product portfolio**: NatureLand Organics will also continue developing new product lines, with higher added value (e.g., healthy snacks, ready-to-eat).
Key challenges	▪ **Recruitment**: The company is entering a new phase of growth; while it needs to keep its strong local ties, it also requires adding more strategic skills to the team.
Financing	▪ **Past funding:** NatureLand Organics has received approximately $3m (convertible shares) from Samridhi Fund in 2015. The fund exited in 2022-2023, with a reported premium according to Arvind Godara. ▪ **Future funding:** The company is currently looking to raise $5-6m, in equity. The funding would help them fund (i) new factories, (ii) marketing activities and (iii) product development.
Additional support requirement	▪ **Board member:** Onboarding a new board member would benefit the company's strategic thinking during this growth phase, notably regarding the geographic expansion plans. ▪ **R&D**: The company would also welcome R&D support to expand its portfolio of nutritious products.



Source: Interview with Arvind Godara, June 2025, iMARC, India Organic Food Market Size, Share, Trends and Forecast by Product Type, Distribution Channel, and Region, 2025-2033., Photo credit: ESG Assessment of Natureland Organic Foods (endline report).

HYSTRA hybrid strategies consulting

ETG is one of the largest pulse traders and processors in India

Business overview: ETG is a leading commodity supply chain operator working across seven business areas: Fertilisers and Agri Inputs, Pulses (used as a synonym of legumes in this case study), Nutrisco (food ingredients), ETG Commodities, Vamara | Parrogate (consumer branded goods business), ETG Logistics, and EIRS (insurance brokerage). ETG Agro India, is a subsidiary company of ETG that mainly trades and processes pulses and nuts. The company employs about 9,000 employees, of which 350 in India.

	Business model
History of organisation	▪ The ETG Indian branch was opened in 2008 and is today the main Asian hub of the company. ▪ Initially, ETG was primarily importing pulses from other countries (Australia, Canada) to serve the Indian market. The company then ventured into processing: In 2017, they invested in a pulse processing facility of 30,000 tons/ year in Kolkata, the largest pulse processing plant in the world.
Product offering and value proposition	▪ Today, ETG is the biggest pulse processor in India and one of the largest distributors – their unique scale enables them to offer consistent volumes of a wide range of high-quality pulses. ▪ Other products in the Indian portfolio include nuts and coffee (only sourcing) – pulses are by far the largest business line, representing over 50% of their activities.
Sales and distribution	▪ 90 to 95% of ETG India pulses' revenues come from the Indian market – out of which 85% are sold through wholesale, 13% to large B2B clients (e.g., other processors, large retailers, hotels and restaurants) and 2-3% is sold in retail directly. ▪ To increase its brand recognition, ETG launched 3 months ago a consumer brand called "ETG AGRO NATURZ", available through e-commerce and selected retail stores.
Results	▪ Annually, ETG India moves an approximate 400,000- 500,000 metric tons of pulses.



SDG impact

As part of a sustainability linked loan, ETG has committed to KPIs related to SDGs, monitored annually:

1 NO POVERTY	ETG is committed to providing extension services to farmers in its supply chains, as well as access to improved inputs and financial services.
5 GENDER EQUALITY	ETG has specific targets on women farmers benefitting extension services and provide specific tailored gender-oriented initiative.
13 CLIMATE ACTION / 15 LIFE ON LAND	The company also has commitments regarding its carbon footprint, deforestation-free supply chains and landscape reforestation.

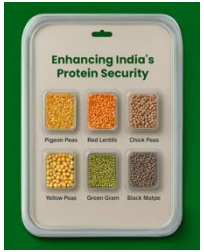
Source: Interview with Christof Walter, Anand Garg and Prasenjit Gorai in July 2025., Photo credit: ETG India.

HYSTRA hybrid strategies consulting

By supplying affordable legumes to Indian consumers, ETG contributes to the country's protein security

Nutritional impact

- **Commitments:** ETG embraced the Zero Hunger Pledge in September 2022 – a commitment to eliminate hunger, ensure food security, improve nutrition, and promote sustainable agriculture.
- **Impact to date:** 60,000 – 70,000 tons of legumes sold on average to the Indian government and NGOs every year.





Good practice 1 – Offering affordable proteins as part of partnerships with the Indian government and NGOs

- **Partnership with the government of India:** ETG is frequently winning procurement tenders from the government of India to supply mid-day meal school schemes as well as free-of-cost food to the most vulnerable households.
- **Partnership with NGOs:** ETG India also sells pulses to local NGOs at factory prices. Globally, it is one of the providers of the World Food Programme (based on tenders).
- Overall in India, sales to the government and NGOs represent approximately 15% of ETG volumes – contributing to India's food security.

Good practice 2 – Ensuring consistent access to high-quality legumes

- **Consistent supply thanks to an integrated business across geographies:** despite being a large producer of legumes, India still imports a large share of its consumption with strong variations over the years (imports almost doubled from 2022-2023 to 2023-2024)[1], in part due to weather variations. Thanks to large-scale, integrated operations across Africa, Canada and Australia, ETG helps meet the local demand by offering a consistent volume of legumes despite supply volatility.
- **High-quality legumes:** In light of the reported adulteration of legumes (e.g., mixed with pebbles or synthetic coloring that is injurious to health), ETG is a guarantee of quality – offering 100% pure products.

Source: Interview with Christof Walter, Anand Garg and Prasenjit Gorai in July 2025, 1 Stutee, From imports to Atmanirbharta: The Future of India's oilseeds & pulses (2025)., Photo credit: ETG India.

HYSTRA hybrid strategies consulting

In India, ETG aims to align its business with the 1.5°C target by focusing on processing activities

Environmental impact

- **Commitments:** ETG is committed to aligning all its business activities with the below 1.5°C global warming target. The company also aims to strengthen the resilience of its supply chains and has embedded this in their emissions reduction trajectory.
- **Actions under way:** Worldwide, ETG provided extension services to more than 400,000 farmers, including on how to increase resilience to climate change through techniques such as agroforestry, soil nutrition management, and organic farming.



Good practice – Reducing the environmental impact of processing activities

As one of the largest pulse processors in the country, the main drivers of ETG's environmental impact are its processing plants; the company has worked on minimizing its waste and resource consumption:

- **Water pollution:** Indian plants are ”Zero liquid discharge."
- **Husk re-use:** legume husk is collected and sold to dairy farm owners as animal feed.
- **Solar energy:** The company is in the process of installing solar panels on all its plants – today renewable energy represents 18% of plants' total energy consumption and will represent 32-35% once all panels have been installed.

Future opportunity – Offering extension services to Indian farmers

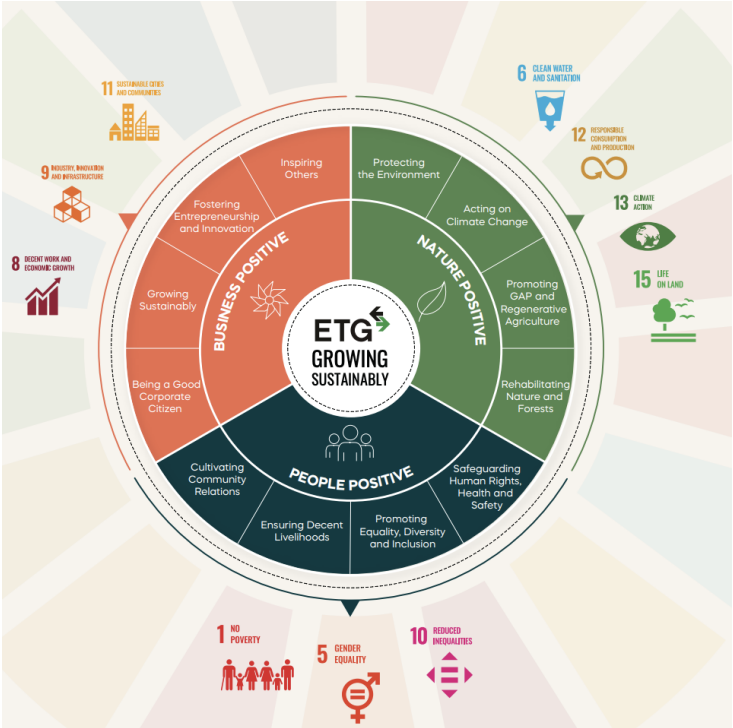
- Currently, ETG sources approximately 70% of its legumes outside of India and when sourced locally, legumes are purchased from local traders rather than farmers directly. The main reasons for this high share of imports are (i) the fragmented, highly volatile local supply market which makes local procurement unpredictable and expensive, and (ii) varying quality levels.

- As the government is setting food self-sufficiency targets, ETG is looking to increase the share of local supply to at least 50% in the upcoming 3-5 years. As such, the company will look for opportunities to work with local farmers, notably located near its processing plants, including by providing extension services – already offered in other countries.

Source: Interview with Christof Walter, Anand Garg and Prasenjit Gorai in July 2025, ETG Sustainability report 2023-2024., Photo credit: ETG Sustainability report 2023-2024.

ETG will continue to build partnerships with suppliers, clients and lenders to advance its social and environmental objectives

	Future outlook
Growth perspectives	▪ The company is looking to continue to grow its Indian legumes business over the coming years by (i) increasing its presence in regions where it is less available today, (ii) developing domestic supply and (iii) strengthening its consumer brands.
Key challenges	▪ **Fragmented, volatile local supply market**: The local supply market is fragmented and volatile, making it difficult to cost-effectively source legumes from local farmers. Volatility also reduces returns on processing assets, in which the company has invested heavily in recent years. ▪ **Local regulation**: Uncertainty regarding future government regulations (e.g., restrictions on exportation and new regulations on importation) is creating risk for ETG activities.
Sustainability	▪ Sustainability considerations play an increasing role in the company's sales markets and financial markets. ▪ As the company continues to grow and amplify its sustainability practices, it will continue to work with its suppliers, clients and lenders and leverage synergies as well as financial support for pioneering solutions (e.g., feasibility studies on how to meet some of ETG's decarbonization targets).
Additional support requirement	▪ **Further partnerships with NGOs, Development Finance Institutions and Nutritional Research** bodies will help ETG penetrate further and reach new milestones in enriching the market for highly nutritious foods.



Sources: Interview with Christof Walter, Anand Garg and Prasenjit Gorai in July 2025, ETG Sustainability report 2023-2024., Photo credit: ETG Sustainability report 2023-2024.

HYSTRA hybrid strategies consulting

Latam is the second-largest dairy-producing region, with high local consumption levels



Milk is a nutrient-dense liquid produced by mammals to nourish their young and widely consumed by humans as fresh milk or processed dairy products such as cheese, yogurt, and butter. Cow's milk is the most consumed type globally, while goat, sheep, and buffalo milks are significant in certain regions. It contains a unique combination of **high-quality protein**, **calcium**, **potassium**, **phosphorus**, and B-vitamins, as well as fats and other essential micronutrients[1]. Milk is classified as having **"high inherent nutritional value"** as per GAIN's definition of nutritious and safe foods.

Market overview

Market dynamics

Production volumes[2]

- Latam is the **second-largest** dairy-producing region, with a production of around 94m tons of milk in 2024 (behind Asia).
  - **Brazil** leads in the region with 39m tons, followed by Mexico (14m tons), and Argentina (13m tons).
  - Whole fresh milk dominates output (93%), with skim milk making up the rest.
- The dairy industry in Latam is valued at $85.5bn in 2024.
- Milk production in Latam is expected to **grow at an annual rate of 0.7% in value** until 2035, thanks to a slightly rising consumption across the region, and **yoghurt production to grow by 1.8% in 2026** with reducing sugar content in yoghurts becoming a key focus for the sector[3].

Trading volumes[2]

- As most milk produced is consumed fresh, exports are minimal ($2.4bn in 2024) and dominated by processed products such as powdered milk, cheese, and condensed milk.

Key challenges

Environmental and economic volatility: Climate events (like droughts and floods) and broader economic instability drive price and supply fluctuations, leading to tight domestic supply and increased imports, especially in Brazil and Mexico. In parallel, economic hardship in some countries has reduced domestic dairy consumption, straining producers reliant on local markets[3].

Weather and climate variability: Dry conditions reduce pasture growth, forcing greater reliance on purchased feed, which increases costs and pressures margins. Flooding and infrastructure issues in key dairy regions, such as southern Brazil, have disrupted milk collection and distribution[4].

Nutritional impact

Additionality

Micronutrient intake: In Latam, calcium and vitamin D intake remains inadequate with over 80% of adults consuming too little calcium, and nearly all lacking sufficient vitamin D[5]. In this context, milk and dairy are key sources of protein, calcium, phosphorus, potassium, iodine, and vitamins A, B2, B12, and D[6].

Overweight/ obesity: With adult obesity nearing 24% and NCDs like diabetes and hypertension rising in Latam, providing low-sugar dairy options is essential[7].

Fit into consumption and cultural habits

Dietary staple: Milk and dairy products are staples in Latam diets, commonly consumed as fresh milk, cheese, yogurt, and in traditional dishes. Dairy habits have been shaped by European immigrants and their dairy farming culture[8].

High consumption levels: Average milk consumption is 132 kg per person per year, about three times higher than in other developing regions, but still lower than Europe and North America. However, there is a need to steer this consumption towards more nutritious, unsweetened, milk products[9].

Urban demand: Dairy intake is especially high in urban areas, where per capita consumption is greater.

Notes: (*) See appendix for table with the nutritional impact classification rationale.; Source: (1) FIL IDF, (2) Indexbox (2024), (3) Statista (2025), (4) Hoard's Dairyman (2024), (5) Monge-Rojas, et al. (2023), (6) Wineman, et al. (2025), (7) World Bank (2023), (8) Instituto Nacional de Investigacion Agropecuria (2022), (9) Our World in Data (2022).

HYSTRA hybrid strategies consulting

DFIs have tapped into Latam's dairy potential, with further opportunities to improve its nutritional and environmental impact

Investability

Existing DFI investments

- Since 2013, the seven DFIs in our research[1] have invested **$719m in 24** (non-purely export-focus) **companies** in the dairy value chain, out of which eight were in Latam.
- Most of the invested companies have expanded to include a **broad range of dairy products** (both minimally and highly processed products). They include multi-product distributors/ retailers (e.g., Synercore), cooperatives (e.g., Conaprole), and organic companies (e.g., AkshayaKalpa Farms).
- Some reasons mentioned by DFIs to invest in this value chain include (1) **dairy's potential for improving smallholder productivity and (2) potential for reducing carbon emissions**. Some also note growing interest in plant-based alternatives, though affordability remains a barrier.

Opportunities for investors[2]

- This sector being already mature and well invested, opportunities lie in improving the nutritional and environmental impact of this value chain.
  - Milk's **environmental footprint can be significantly improved** by adapting farming practices and large cooperatives and processors have a role to play in helping small-scale farmers in their supply chains adopt these practices. There is also room for companies to implement carbon credit projects.
  - Milk and dairy products' nutritional benefits are highly dependent on the level of sugar and additives they contain. **Revising product formulation to lower sugar** is another opportunity for impact investors.

Case studies

- Company: Alquería.
- Geographic footprint: Colombia.
- Country for case study: Colombia.
- Size: $400m in revenues in 2023.
- Product offering: Over 300 products, mainly dairy.
- Export/ import focus: Activities focused on Colombia.
- Value chain positioning: Processing and distribution.
- Current investors: Mesoamerica Investments owns 35% of shares.

- Company: Dos Pinos.
- Geographic footprint: Latam.
- Country for case study: Costa Rica and Panama.
- Size: $1.235 bn in revenues in 2024.
- Product offering: 900 products in >20 categories, with a strong focus on dairy.
- Export/ import focus: Sales in 10 Central American countries.
- Value chain positioning: Processing and distribution.
- Current investors: IDB, DEG, Proparco.

Notes: (1) DFIs included in our analysis are: IFC, BII, FMO, Norfund, DEG, Proparco, BIO.

HYSTRA hybrid strategies consulting

Milk has a "medium" environmental footprint but the lowest among studied animal-based foods, further reducible through sustainable feed practices

	Environmental performances of milk[1] at global level	Environmental performances of regional proxy (milk in Mexico)	
	Average value[2]	Differences between environmental performance of milk in Mexico vs milk globally	Key contributors to regional proxy's[3] impact
GHG	**3.2 CO_2eq/ kg**	**+1%**	▪ **Enteric emissions:** Production and release of methane linked to cows' digestion (c. 45-60% of total GHG emissions for milk produced in Mexico and Brazil respectively, the 2 largest producers in region). ▪ **Feed:** Emissions from feed production (c. 30% of total emissions in Mexican milk). ▪ **Manure management:** Emissions resulting manure storage (c. ranging from 2-20% of total GHG emissions in Brazilian vs Mexican milk).
Terrestrial acidification	**20.0 SO_2-eq/ g**	**-6%**	▪ **Feed:** Acidification linked to fertilizer use in feed production (c. 55-85% total acidification in Mexican & Brazilian milk respectively). ▪ **Manure management:** Emissions resulting manure storage (ranging from c. 10-40% of total acidification in Brazilian vs Mexican milk respectively).
Water Use	**628 L/ kg**	**-5%**	▪ **Feed:** Irrigation of crops used as animal feed (c. 75-95% of total water use in Mexican & Brazilian milk respectively). ▪ **Dairy farm exploitation:** Especially if mechanized.
Land use	**9.0 m2/ kg**	**+32%**	▪ Land occupation for grazing (c. 50-80% of land use for Mexican vs Brazilian milk). ▪ Land occupation & land use change for production of animal feed.
Comments	▪ Positive outlier: N/A. ▪ Negative outlier: N/A. Note that cheese has a significantly higher impact.	The regional conclusion hides the variability of impact of milk production from country to country, with GHG impacts for instance ranging from 1.6kg CO2eq/ kg of milk in Uruguay, to 2.9kg in Colombia. Despite country variability in overall impact, the key drivers of impact remain the same: Feed, enteric emissions, manure management. Overall, Latam can leverage on the availability of low impact feed such as mountain pasture to mitigate the impact of milk production.	

N.B., The green colour code here indicates that **the local proxy's[3] impact is equal to or no more than 10% higher than the global average** (Exact difference expressed as a percentage figure; *See page 29 for details on reading the environmental assessment slides*).

Red = More than 20% higher than global average.

Notes: (1) Dairy consists of milk only, (2) The colour coding of average values indicates whether the impact is low (green), medium (yellow), or high (red) compared to other value chains. See slide 29 for details.; Source: Poore and Nemecek (2018).

Notes: (3) Environmental performance values are highly contextual and should be taken as indicative, as impact is highly dependent on country and agricultural practices. See slide 107 on selected proxies, rationale, and strength of proxy.; Source: Quantis expertise, Statista, WFLDB 3.11 and ecoinvent 3.11, IPCC WGI Interactive Atlas, CIRAD, Climate Risk Index (CRI), ND-GAIN Country Index Scores. ***Nb: Please note that Poore and Nemecek global data and Quantis regional analysis of proxy foods are not directly comparable, as their scope and units differ.***

HYSTRA hybrid strategies consulting

Acting on feed and manure management helps reduce terrestrial acidification and milk's environmental impact

Regen ag practices

Lever	Description	Type of impact	Potential for reduction[1]	Contribution driver	Sources
Grassland: Interseeding	▪ Enhancement of existing cover on pastures through seeding of grasses, legumes, herbs. ▪ Legumes fix atmospheric nitrogen, reducing the need for synthetic fertilizers. ▪ Flowering grasses and legumes attract pollinators and crop auxiliaries.	▪ Climate ▪ Biodiversity ▪ Acidification	High	Farming practices and inputs	De Deyn et al., 2010, Quantis and BCG use cases.
Grassland: Adaptive grazing	▪ Optimizing movement of grazing animals through pasture: Uniform manure distribution. ▪ Displacement management avoids over-cultivation, improving water infiltration.	▪ Climate ▪ Water ▪ Acidification	Medium (low to high)	Manure management	Rowntree et. al, 2020; Kurtz et. al, 2020, Quantis and BCG use cases.
Feed additive	▪ Reduces activity of enzyme in cow rumen that produces methane from digested food (e.g., 3-NOP additive).	▪ Climate	High	Enteric fermentation	Melgar et al., 2020.
On-farm anaerobic manure digestion	▪ Installing sealed impermeable covers on anaerobic lagoons and combined heat and power digesters. ▪ Reduces methane emissions while capturing biogas.	▪ Climate	High	Manure management	Quantis use cases.
Certified deforestation free	▪ Verify that no forests or grasslands are cleared or converted for animal or feed production (e.g., certification, satellite imagery).	▪ Climate ▪ Biodiversity ▪ Land use	Very high	Land use change	EUDR, Quantis and BCG use cases

Notes: (1) Rating based on Quantis' expertise.

HYSTRA hybrid strategies consulting

Alquería is a leading Colombian dairy company distributing 358m litres of milk per year through 140,000 points of sale

Business overview: Alquería is a leading Colombian dairy company with origins dating to 1959 in Rionegro, Antioquia. From UHT production to expanding its portfolio through acquisitions and in-house innovation, it now operates across seven plants and over ten distribution centres, working with more than 7,000 milk suppliers and serving consumers nationwide across four major brands. It is Colombia's largest Certified B Corporation and is65% owned by the founding family and 35% owned by Mesoamerica Investments[1].

	Business model
History of organization	▪ Founded in 1959 by Jorge Cavelier Jiménez, Alquería began as a small pasteurization plant distributing 2,500 litres per day to Bogotá. ▪ It expanded in the 1990s after adopting UHT processing, increasing daily output to 150,000 litres, enabling distribution across Colombia. This led to regional production plants being established in the 2000's. ▪ During the 2010s, Alquería acquired Freskaleche and Del Vecchio, and entered a strategic partnership with Danone in 2008 to jointly develop yogurt and fermented dairy products using Alquería's distribution network.
Product offering and value proposition	▪ 300 dairy products including UHT and pasteurized milk (whole, low-fat, lactose-free), yogurt, flavoured milk, oatmeal drinks, and juices (less than 5% of their products have low nutritional value, such as soft drinks and gelatine). ▪ They are sold under four brands: o Alquería: Core dairy line including milk, yogurt, and oatmeal drinks. o Freskaleche: Regional milk and yogurt brand. o Del Vecchio: Specialty cheeses. o Vitad: Nutritious snacks and functional foods. ▪ Alquería positions itself as a trusted source of affordable nutrition with a strong sustainability promise, focused on local sourcing.
Sales and distribution	▪ Alquería operates seven production plants, 10 distribution centres, and 13 milk collection hubs across Colombia. ▪ Its products are sold through 140,000+ corner stores, kiosks and retail supermarkets.
Results	▪ Collects over 328m litres of milk/ year from 13 regions. ▪ Achieved revenues of ~$400m in 2023.



	SDG impact
	Alquería supports food security and consumer health by improving access to affordable, nutritious dairy products for vulnerable communities, through initiatives like *Alimenta Compartiendo,* a social initiative launched in 2009 that has led to 23 million litres of milk being distributed to children and youth in vulnerable situations, and efforts to promote informed consumption.
	Alquería collaborates with national and international institutions, including ABACO, ILSI, Asoleche, and ANDI, to strengthen its sustainability and nutrition impact.

Source: Alquería website, (1) Lavca (2019)., Photo credit: Available on Alquería's website

Alquería is proactively improving the nutritional profile of its dairy products, and has a wide distribution network enabling them to serve low-income consumers

Nutritional impact

- **Commitments:** Alquería's core mission includes providing high-quality, nutritious dairy products while contributing to sustainable development. Its product portfolio includes lactose-free and fortified milk options, and it promotes healthy consumption through accessible, affordable offerings.
- **Actions under way:** Review of 79 products' formulation to improve nutritional profile.
- **Impact to date:** In 2024, 1.5m kgs of products donated, benefitting 1.3m people in vulnerable situations. Alquería also serves 140,000 corner stores in Colombia and has developed 21 formulations with added micronutrients.



Good practice 1 - Expanding access to affordable dairy products[1]

- **Small-scale retail focus:** Alquería distributes to 140,000 corner stores and kiosks, accounting for 69% of sales, that are key access points for low-income consumers.
- **Pre-sales system:** Company staff take daily orders from shops (e.g., 150 pre-sellers in Bogotá covering ~12,000 shops).
- **Micro-sales model:** In remote areas, Alquería partners with local individuals, using their homes as warehouses; representing 5% of total revenue.
- **UHT milk advantage:** Shelf-stable UHT products enable distribution without refrigeration, making it viable for informal shops lacking cold storage infrastructure.
- **Adapted packaging:** Alquería offers dairy products in packaging formats such as milk bags, which provide lower-cost options accessible to low-income households (15% cheaper than tetrapak[2]).

Good practice 2 – Improving product nutritional profile

- **Review of nutritional attributes of Alquería products:** In 2023, Alquería developed a methodology to assess its products' nutrient profiles.
- **Product reformulation:** As a result, the company reformulated 79 products to maximize their nutritional quality without sacrificing their sensory quality or adding any price premium.
- **Additional nutritional benefits:** 21 formulations have added micronutrients or probiotics that contribute to the health and nutrition of the population.

Source: Alquería website, nutrition page (2025), One Planet Network, Driving sustainable consumption in Latin America with better product information and design (2021), (1) IFC, 2023, (2) Exito prices August 2025., Photo credit: Alquería.

HYSTRA hybrid strategies consulting

Alquería is very active in environmental matters, both with its suppliers and in its operations to achieve carbon neutrality by 2030

Environmental impact

- **Commitments:**
  - Alquería aims to achieve carbon neutrality by 2030 through its **Planeta Larga Vida** strategy, which targets sustainability across the full value chain.
  - In 2019, it became one of the first dairy companies to sign Colombia's **Zero Deforestation Agreement.**
- **Actions under way:** Support to 5,500 families to adopt sustainability practices, incl. regenerative grazing with 1,000 farmers.
- **Impact:** Alquería reduced its carbon footprint by 20% between 2017 and 2019. This reduction is less visible since 2022 due to the increase in Colombia's emission factor, reflecting changes in how national electricity and fuel emissions are calculated.

PLANETA LARGA VIDA Alquería

Good practice 1 – Supporting farmers in reducing their environmental footprint

Alquería works closely with its suppliers and supports them with:

- **Land-use monitoring to prevent deforestation:** The company uses geo-referencing to map and monitor supplier farms, particularly in páramo ecosystems (high mountain ecosystems), which are sensitive to deforestation and land-use change. This helps promote conservation-compatible farming practices.
- **Clean energy adoption:** Alquería supports the installation of solar panels on farms, particularly for milk refrigeration systems, improving both environmental impact and energy access in rural area. It also turns 700+ tons of manure per year into biogas thanks to biodigesters and composters.
- **Farmer training programs:** Alquería supports more than 5,500 rural families to improve dairy productivity, ensure milk safety and quality, and adopt environmentally sound practices
- **Carbon projects:** Partnering with Boomitra, Alquería is working on regenerative grazing and carbon projects with over 1,000 dairy farmers across 130,000 acres in Colombia[1].

Good practice 2 – towards plastic neutrality

- **Packaging improvements:** In 2018/19, the company reduced plastic use in packaging by 18% by implementing a new eco-design. In 2024, this led to the saving of almost 2,000 tons of virgin plastic.[2]
- **Plastic recycling:** In 2023, the company collected 104% of the plastic it put on the market, equivalent to more than 4,000 tons.

By working on packaging design, circular operations, education and waste recovery, Alquería aims to become plastic neutral.

Source: Alquería website, sustainability page (2025) and their sustainability report (2024), One Planet Network, Driving sustainable consumption in Latin America with better product information and design (2021), (1) Carbon Herald (2024), (2) Portafolio, Alquería: pioneros en democratizar la leche de Calidad en Colombia (June 2025)., Photo credit: Alquería.

HYSTRA hybrid strategies consulting

Alquería has benefitted from equity investments to scale operations and improve corporate governance

	Future outlook
Growth perspectives	▪ **Company growth:** Alquería projects continued growth, with a planned investment in 2025 focused on expanding yogurt and cheese production facilities, improving product quality, and strengthening its existing brands such as Vitad and Del Veccio. The company reported 4% growth in 2024 and aims to maintain momentum through operational upgrades[1]. ▪ **Sustainability perspectives:** Alquería aims to scale its carbon neutrality efforts across more products by expanding farmer training programs and investing in cleaner production and industrial symbiosis.
Key challenges	▪ **Milk imports:** A major concern is the rising volume of milk imports, particularly from the U.S. and Europe, which threatens local dairy production. There is a need for government action and sector-wide productivity improvements to protect domestic producers and reduce import dependency[1]. ▪ **Sustainability challenges:** There are challenges in decarbonizing upstream agricultural inputs and improving traceability across smallholder supply chains. Ensuring compliance with deforestation-free commitments and scaling sustainable practices among thousands of suppliers also requires ongoing effort.
Financing	▪ **Equity vs debt:** Alquería has benefitted from easy access to debt but limited access to equity financing due to its unavailability in Colombia. In response, in 2010, the **IFC invested as a shareholder** to strengthen the company's capital structure, reduce costly debt, and support its five-year growth plan. IFC's presence also facilitated access to international investors and supported improved corporate governance through its role on the board. The IFC transferred its minority participation to **Mesoamerica Investments** in 2019, which now owns 35% of the company[1]. ▪ **Sustainability financing:** Alquería's sustainability initiatives are supported through internal investment and partnerships with organizations such as the World Wildlife Fund, ONF Andina, and the Fedemaderas PROCLIMA carbon credit program.
Additional support requirement	▪ With successful past investment and support from IFC, Alquería did not express additional needs for technical assistance.





Source: Alquería website (2025), One Planet Network, Driving sustainable consumption in Latin America with better product information and design (2021), (1) Valora Analitik (2024)., Photo credit: Alquería.

HYSTRA hybrid strategies consulting

Dos Pinos is a leading dairy cooperative in Central America, collecting ~500m litres of milk per year through 1,400 producers

Business overview: Dos Pinos is a Costa Rican cooperative founded in 1947 that has grown into one of the largest dairy companies in Central America. Owned by over 1,400 dairy producers, it operates across Costa Rica, Guatemala, Nicaragua, Panama, and the Dominican Republic, with 14 production plants and a wide logistics network. Its portfolio includes more than 900 products across dairy, beverages, and food. As a vertically integrated cooperative, it processes around 85% of Costa Rica's formal milk supply[1].

	Business model
History of organisation	▪ Dos Pinos was founded in 1947 by 25 dairy producers in Costa Rica seeking price stability and collective processing capacity. ▪ While initial operations focused on basic milk collection, the cooperative began industrial milk processing and distribution in 1952. ▪ Through the 1970s–1990s, Dos Pinos expanded to include juices, ice cream, cheeses, and powdered milk in its product mix; it also introduced aseptic packaging to enable longer shelf life and exports. ▪ In the 2000's, it grew regionally through acquisitions and by establishing processing plants in Panama, Nicaragua, and the Dominican Republic.
Product offering and value proposition	▪ Dos Pinos offers over 900 products in >20 categories, spanning among other dairy (milk, yogurt, cheese, ice cream, butter), beverages, and juices. ▪ Key brands include Pinito (powdered milk), Deligurt (yogurt) and Lula (flavoured milk). ▪ The company positions itself as a nutritious brand grounded in cooperative values and sustainable practices, using local raw materials and food tech to ensure quality and freshness.
Sales and distribution	▪ It collects milk from over 1,400 affiliated producers, 92% of whom are small and medium-sized farms in Costa Rica and Nicaragua. ▪ It distributes to more than 11 countries in Central America, supported by a logistics fleet of over 1,000 vehicles, regional logistics hubs and partnerships.
Results	▪ Dos Pinos incurred revenues of $1.24bn in 2024, collecting ~500m litres of milk per year.



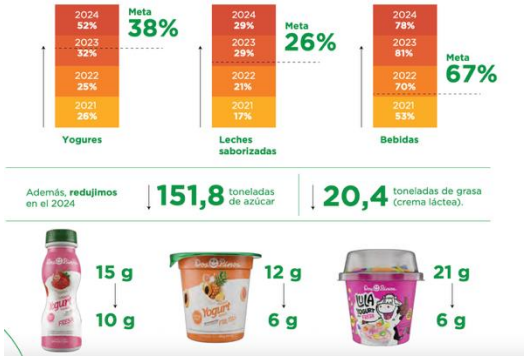
	SDG impact
8 DECENT WORK AND ECONOMIC GROWTH	As a regional cooperative, Dos Pinos directly supports small and medium producers, promotes decent work and regional inclusion.
3 GOOD HEALTH AND WELL-BEING	The cooperative improves access to nutrition through school and community programs and proactively aims to improve the nutritional profile of its dairy products.
12 RESPONSIBLE CONSUMPTION AND PRODUCTION 13 CLIMATE ACTION	Dos Pinos reduces its environmental footprint through water reuse, energy efficiency, waste recycling, regenerative agriculture, and climate-smart farming practices.

Source: (1) The Costa Rica Star, Dos Pinos website (2025), Dos Pinos sustainability report (2023), Dos Pinos sustainability report (2024)., Photo credit: Dos Pinos sustainability report (2024).

Dos Pinos is proactively improving the nutritional profile of its dairy products

Nutritional impact

- **Commitments:** Dos Pinos' **Nutrition Manifesto 2023–2026** commits to improving the nutritional quality of its products, promoting milk as a complete food, and reducing sugar and fat where possible. It also aims to provide transparent nutritional profiles.
- **Actions under way:** Developed updated **nutrient profiles** for products since 2021. Implemented **reduced-sugar formulations** across key dairy lines.
- **Impact to date: 152 tons of sugar removed** from products in 2023. **154 new products launched**, many with improved nutritional profiles.



Good practice 1 – Heathier formulation to combat overweight

- **New formulation with reduced sugar content:** Since 2021, Dos Pinos has undertaken a phased reformulation of its dairy portfolio to lower added sugar content without using artificial sweeteners, aligning with internal nutritional standards and consumer expectations. Reformulated products were introduced gradually to preserve taste preferences. By 2023, this effort achieved a cumulative reduction of 152 tons of sugar. Yogurt sugar content was reduced by up to 83%, and 90% of flavoured milk now contains less than 7g of sugar per 100 ml (i.e., 3.1g more than whole milk). All products display sugar content voluntarily for consumer transparency.
- **Product adapted to children's nutritional needs:** According to an FAO study on private-sector initiatives to combat malnutrition in Latin America, Dos Pinos' products for children, such as juices, flavoured milk, and yogurts, have been formulated to lower calories, sugar and fat. Some are fortified with multivitamins, free of preservatives and with natural flavours and colours to meet children's specific nutritional needs.

Source: Dos Pinos website (2025), Dos Pinos sustainability report (2023), Dos Pinos sustainability report (2024), FAO COMBATING OBESITY AND OVERWEIGHT Private sector initiatives in Latin America and the Caribbean (2021)., Photo credit: Dos Pinos sustainability report (2024).

HYSTRA hybrid strategies consulting

Dos Pinos pushes circular economy practices within its operations and supports its members in improving their environmental practices

Environmental impact

- **Commitments:** Dos Pinos's 2024 Sustainability Plan includes specific commitments to reduce resource use on farms and in factories, adopt circular economy practices, and support community resilience.
- **Actions under way:** Convert industrial sludge into biofertilizer, provide technical assistance to farmers on environmental sustainability, improve water and energy efficiency at production plants.
- **Impact to date:** Converted all processing sludge into biofertiliser, certified 60 farms under "Azul Ecologica" standard (a local program recognizing organizations for their exceptional efforts in sustainability).



Good practice 1 – Implementing circular economy practices in direct operations

- **Organic waste:** Dos Pinos processes 100% of the organic sludge from its Costa Rican plants into biofertilizer, avoiding landfill disposal and reducing contamination. The biofertilizer is applied on affiliated farms, enhancing farm productivity while reducing the application of chemical fertilizer.
- **Water management:** The company re-used over 200,000 m³ of treated water in 2023 at its main plants (representing 10% of the total water used by the company), primarily for cleaning and auxiliary operations, reducing pressure on freshwater resources.
- **Packaging materials:** Dos Pinos redesigned packaging to reduce material use and lower plastic intensity per unit sold.

Good practice 2 – Tailoring farmer support to optimize their social and environmental practices

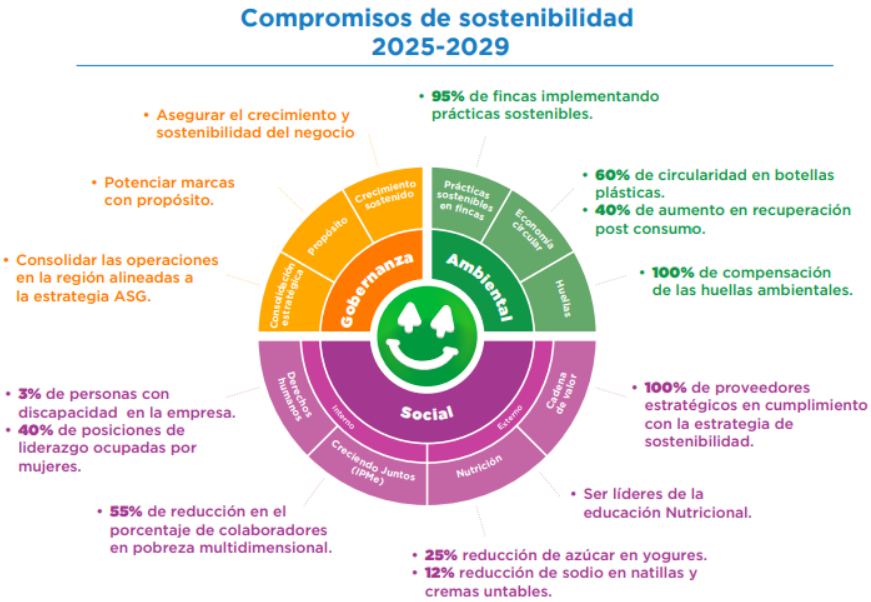
- **Dedicated technical assistance department:** Through a dedicated "Agribusiness and Member Service department", all farmers in the cooperative have access to technical assistance on topics such as milk quality, milking equipment, animal welfare, environmental practices, and productivity.
- **Tailored support:** Dos Pinos has developed a point-based evaluation system to assess farms based on four criteria: Animal welfare, social, environmental, and economic. Depending on the number of points, farms are classified in three categories, with tailored support adapted to each level of performance.

Source: Dos Pinos website (2025), Dos Pinos sustainability report (2023), Dos Pinos sustainability report (2024)., Photo credit: Dos Pinos sustainability report (2024).

HYSTRA hybrid strategies consulting

Dos Pinos has benefitted from debt to scale operations and aims to further improve sustainability without burdening small producers

	Future outlook
Growth perspectives	▪ Continued **regional expansion**, especially in Central America and the Caribbean. In 2024, Dos Pinos exported **13,000 tons of milk**, and international sales grew by **6%.** ▪ Continuing to introduce new products, including functional and health-oriented options, and diversifying the company's value proposition.
Key challenges	▪ **Cost burden for small farmers:** Ensuring inclusion of small and medium producers (92% of members) in climate-smart and certification programs, without increasing their cost burden. ▪ **Imports:** Market volatility or trade pressure (e.g., milk imports) are also a risk to Dos Pinos, especially with the first American dairy cooperative recently approved for export to Costa Rica[1].
Financing	▪ Historically, Dos Pinos has relied on external financing and debt for growth. For example, in 2017, Dos Pinos raised a $100m loan from Bladex, Banco General and Banistmo to improve the debt maturity profile of the company[2]. In 2021, it raised $55m of debt from DEG, Proparco, and IDB Invest to drive expansion and another $60m from DEG in 2024 through its 100%-owned subsidiary “Productos Nevada.” ▪ Being a cooperative, Dos Pinos has not and will not be looking to raise equity.
Additional support requirement	▪ With recent investment and support from DFIs, Dos Pinos did not express additional needs for technical assistance.



This schematic represents Dos Pinos’ sustainability commitments for 2025–2029. For example, they aim to reduce sugar in yoghurts by 25% and ensure that 95% of farms have environmentally sustainable practices in place.

Source: (1) USDA (2025), (2) CentralAmericaData (2017), Dos Pinos website (2025), Dos Pinos sustainability report (2023), Dos Pinos sustainability report (2024)., Photo credit: Dos Pinos sustainability report (2024).

HYSTRA hybrid strategies consulting

At 3.8 kg per capita[1,2], Africa's poultry consumption remains low, reflecting productivity challenges

Poultry refers to any kind of domesticated or captive bird which is raised for meat, eggs or feathers[3]. Varieties include chicken, turkey, ducks, geese etc. In 2022, **chickens accounted for 97% of Africa's total poultry numbers**[4], which is why the study focuses on chicken meat and eggs. **Eggs and organ meats are characterized as having 'high inherent nutritional value'** and **minimally processed poultry as having 'Some inherent nutritional value'** as per GAIN's definition of a nutritious and safe food*. However, highly processing meat makes it food of "little or no nutritional value and potential harm"*.

Market overview

Market dynamics

Production volumes

- With 2.4m tons of hen eggs and 4m tons of chicken meat produced in 2023, SSA **accounts for 2.6% and 3% of global production volumes**[5].
  - West Africa is dominating the market, representing 44% of SSA's hen egg production and 46% of chicken meat.
  - An estimated 50%, of poultry stocks are kept in extensive scavenging** (30% in intensified and 20% in intensive systems)[4].
- In 2025, the poultry meat and eggs market was estimated at around **$27bn and $6.8bn** respectively[6].
- The African poultry market volume is expected to **grow at an annual rate of +1.9%** over the next decade, below the +3.2% rate observed between 2007 and 2020[7].

Trading volumes

- Poultry imports into SSA rose from 0.33m tons/ year to 1.96m between 2001 and 2021 and are projected to reach 2.54m tons by 2031, making SSA the world's top importer.[8] South Africa, Angola, DRC and Congo are the biggest importers[7].

Key challenges

Productivity: Growing demand for poultry has not been accompanied by equivalent growth in local production – due to inadequate grain production, infrastructure, low investment in research and limited technical training – necessitating imports.[4] In 2023, the average chicken meat yield per animal in Africa was 1.31 kgs, compared to 1.66 kgs globally[9].

Feed: Feed can account for up to 70% of costs[10] in poultry production. Expanding local feed production requires investing in grain production, especially corn and soyabean[4].

Foreign exchange fluctuations: Feed production inputs like seeds and blends of amino acids, vitamins and minerals are mostly imported into SSA, with trade between neighbouring countries often in US$, exposing the sector to local currency devaluation risks.

Disease prevalence: Sporadic infectious disease outbreaks – including Newcastle disease, avian influenza, and bursal disease – threaten flock health, productivity, and profitability[11].

Nutritional impact

Additionality

Affordability: Chicken is generally the most affordable meat option (except some local small fish), and eggs are both a highly affordable and sustainable source of high-quality animal protein and micronutrients[12]. Chicken meat retails at as low as $1/kg in Central African Republic to $10/ kg for expensive brands in Zambia[13]. Companies studied for this report sell eggs for as little as 10 cents per piece.

Undernutrition: Meat (both muscle and organ meat) and eggs constitute a high-quality food source, densely packed with essential macro- and micronutrients. Animal-source foods are particularly concentrated in highly bioavailable iron, vitamin A, vitamin B12, zinc, and riboflavin - nutrients that are often deficient or absent in in rural, resource-poor settings diets[14].

Fit into consumption and cultural habits

- Regional consumption of chicken per capita has more than doubled over the past 20 years[15] and has overtaken beef and mutton as the **most consumed meat**.
- Yet, with **3.8 kg per capita** (and 4.75 kg predicted in 2050[14]), yearly poultry consumption in Africa is **far below the 14 kg global average**[2].
- As far as eggs are concerned, the per capita consumption is at 2.2 kg per year in Africa (expected to grow to 2.45 kgs in 2050[14]), **far below the 10.23 Kg global average**[16].

Notes: (*) See appendix for table with the nutritional impact classification rationale, (**) A small scale low input and output method of rearing.; Source: (1) Statista, (2) FAO, (3) Eurostat, (4) Trends and prospects of poultry value chains in Africa, (5) FAOSTAT, (6) Statista, (7) Index Box, (8) USDA, (9) Our World in Data, (10) Poultry World, (11) Springer, (12) National Library of Medicine, (13) Selina Wamucii, (14) ResearchGate, (15) Erdaw, 2023, (16) Our World in Data, Per capita egg consumption, 2022.

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The poultry sector already attracts DFI investments, but increasing investments is key to meet growing demand

Investability

Existing DFI investments

- Since 2013, the 7 DFIs in our research[1] have invested **$419m** in 23 companies (non-purely export-focused) in the poultry value chain, out of which 15 were in SSA.
- Invested companies include companies focused on producing day-old-chicks and feed (e.g., Ethio chicken), egg producers (Avi Niger), chicken and other meat producers (Ranchers Finest and Monatana Meats) and vertically integrated players producing day-old-chicks, feed, meat and processing for distribution (e.g., Higest, Dayntee Farms, Couvoir Amar etc.).
- Reasons mentioned by some DFIs to invest in this value chain include poultry being a healthy, affordable and drought-resistant alternative to red meat, with increasing demand.
- Animal welfare standards and biosecurity measures were mentioned among important considerations in DFIs' investment process.

Opportunities for investors

- **Increased productivity (weight per head/kg of feed):** To address low poultry productivity in SSA, improved breeds like cobb and dual-purpose chickens offer cost-effective, lower environmental impact opportunities to meet rising demand.
- **Increased egg production:** This is a largely untapped opportunity to provide scalable, affordable protein with low environmental impact.
- **Circular poultry and crop farming models** integrating feed input production, feed milling and fertilizer production is another promising opportunity, with potential for higher profit margins and greater resilience.
- **Environmentally friendly by-products:** Manure can be used as organic fertilizer, lowering environmental impact while generating additional revenue streams. Additional opportunities remain largely untapped (e.g., organ meat, waste oil, manure, feathers, black soldier fly).

Case studies

- **Company**: Goldenlay.
- **Geographic footprint**: Zambia and DRC.
- **Country for case study**: Zambia.
- **Size**: $15m in revenue (2024).
- **Product offering**: Table eggs.
- **Export/ import focus**: 70% sales in Zambia and 30% in neighbouring countries.
- **Value chain positioning**: Production and distribution.
- **Current investors**: Phatisa and AgDevCo.



- **Company**: Irvine's Group.
- **Geographic footprint**: 22 countries in SSA.
- **Country for case study**: Zimbabwe, Tanzania, Mozambique, Kenya and Botswana.
- **Size**: $500m in revenue (2024).
- **Product offering**: day-old chicks, feed, table eggs, frozen chicken and animal health and hygiene products.
- **Export/ import focus**: Exclusively serving countries in SSA.
- **Value chain positioning**: Integrated operations across value chain.
- **Current investors**: Irvine's family, Innscor, Tyson, Donnie Smith and Norfund.

IRVINE'S
Trust earned.

Notes: (1) DFIs included in our analysis are: IFC, BII, FMO, Norfund, DEG, Proparco, BIO. We excluded companies selling soybean only as this is mainly used for animal feed and does not fit into our "nutritious food" scope., (2) Any advancements in productivity needs to be balanced with considerations of animal welfare when intensifying poultry farming. Under Nutritious Foods Financing Facility's animal welfare checklist, fast growing broiler chicken hybrids have an 'elevated' risk level ranking as their modification for production traits heightens anatomical/metabolic disorders. Best practice is to adopt slower growing hybrids that are well adapted to the local climatic, nutritional, disease conditions.

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Chicken and eggs have a low environmental impact compared to other animal-based foods but have high terrestrial acidification impact

	Environmental performances of poultry meat[1] at global level	Environmental performances of eggs[1] at a global level	Environmental performance (data on regional proxy not available)	
	Average value[2]	Average value[2]	Differences between environmental performance of poultry in SSA vs. poultry globally	Key contributors at global level
GHG	**9.9 CO_2eq/ kg**	**4.7 CO_2eq/ kg**	No data available in WFLDB 3.11 and ecoinvent 3.11 database.	**Feed production**: Globally, emissions from feed production is the main source of impact (c.90-95% across Brazil, China and US), despite variability in underlying feed mix.
Terrestrial acidification	**102.4 SO_2-eq/ g**	**53.7 SO_2-eq/ g**		▪ **Manure storage**: Ammonia and nitrous oxide emissions from storing manure can account for c. 55-65% of total acidification. ▪ **Fertilizer use in feed production**: Contributes to c. 35-45% total acidification Brazil, China and US poultry.
Water Use	**660 L/ kg**	**578 L/ kg**		**Irrigation of feed crops** can represent c. 95% of water use.
Land use	**12.2 m2/ kg**	**6.3 m2/ kg**		**Feed production**: c.99% of land use and land use change impact across Brazil, China and US, driven by the land use change impacts of soy.

Notes: (1) Value chains studied included: Fruits, vegetables, legumes, nuts, milk, poultry, aquaculture, read meat, cereals . For this slide only, we have distinguished poultry meat from eggs environmental impact to provide better granularity. (2) The colour coding of average values indicates whether the impact is low (green), medium (yellow), or high (red) compared to other value chains. See page 29 for details.; Source: Poore and Nemecek (2018).

Source: Quantis expertise, Statista, WFLDB 3.11 and ecoinvent 3.11

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Deforestation-free feed cultivated through regenerative agriculture practices and reusing manure are the main drivers to reduce the poultry value chain's environmental impact

Transforming manure to organic fertiliser[1]

Lever	Description	Type of impact	Potential for reduction[2]	Contribution driver	Sources
Certified deforestation free	▪ Verify that no forests or grasslands are cleared or converted for animal or feed production (e.g., certification, satellite imagery).	▪ Climate ▪ Biodiversity ▪ Land use	Very high	Land use change	EUDR; Quantis and BCG use cases
Regen ag practices	▪ Regen ag practices for feed production.	▪ Climate ▪ Biodiversity ▪ Land use	High	Farming practices & inputs	CIMMYT, Turning waste into wealth: harnessing chicken waste to strengthen soil health for smallholder farmers (2025)
Collection and treatment	▪ Sourcing from producers of nutrient–rich manure with adequate volumes. ▪ Ensuring frequent collection to prevent ammonia buildup. ▪ Separating solids and liquids for wet manure. ▪ Air or mechanical drying to reduces moisture content and prevent microbial growth.	▪ Climate ▪ Water ▪ Acidification	Medium	Farming and distribution practices	Manure resource, How to Convert Chicken Manure into Organic Fertilizers? (2013)
Composting	▪ Mixing with carbon-rich materials like straw, leaves, or sawdust to balance nitrogen. ▪ Turning regularly to maintain oxygen flow and uniform decomposition within composting vessel. ▪ Maturation and cooling post-composting to avoid nutrient burn[3] at application. ▪ Optionally, mixing with inorganic fertilizer to improve input use efficiency and overall soil health.				NBSSI, What are the methods of organic fertilizer fermentation? (2024)
Packaging and delivery	▪ Screening to remove contaminants. ▪ Testing nutrient composition, heavy metals and moisture content. ▪ When possible, pelleting by compressing screened compost using extrusion or pan granulation machines. ▪ Packing in moisture-resistant plastic-lined or woven polypropylene bags. ▪ Storing in a dry, shaded, and ventilated area. ▪ Delivering in a timely way without compromising quality or agronomic relevance.				
Application	▪ Matching soil nutrient needs and pH with quantity of manure. ▪ Avoiding application to frozen or waterlogged soil to avoid risks of runoff and pollution.				

Notes: (1) Manure can also be used in the production of biogas. Moreover, other organic waste from hatcheries and abattoirs like feathers, organs, blood, eggshells, etc. can also be processed and reused, (2) Rating based on Quantis' expertise., (3) Nutrient burn occurs when plants are given excessive amounts of nutrients,especially nitrogen, phosphorus, and potassium. This overfeeding leads to a toxic buildup in the plant tissues, causing damage to the roots and visible signs of stress on the leaves.

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Goldenlay is Zambia's largest producer of table eggs with 70% of sales in local markets and 30% in neighbouring countries

Business overview: Goldenlay is the largest table egg producer in Zambia, distributing its products locally and in the Democratic Republic of Congo, Namibia and Tanzania. Goldenlay also sells ancillary products such as organic fertilizer and spent hens. It operates a separate farming business that sells wheat on the open market and produces soya and maize for Goldenlay's feed. Founded by its current Managing Director, Fletcher Broad, the company employs 460 people. The company's ambition is to maintain their position as Zambia's leading provider of fresh, high-quality affordable eggs.

	Business model
History of organization	▪ Goldenlay was founded in 2005, near Luanshya in Zambia's fast-growing Copperbelt province. ▪ The company received investment from Phatisa's African Agriculture Fund (AAF) in 2012 to upgrade facilities, buy farmland for feed input production and boost working capital. ▪ Over the past 20 years, it has developed a strong brand image as a supplier of grain-fed A grade large eggs.
Product offering and value proposition	▪ Eggs represent 91% of sales revenue. Sale of spent hens and manure accounts for 6% and 3% of revenues, respectively. ▪ The company's core difference is based on ensuring consistency of supply, high quality, and genuine value.
Sales and distribution	▪ Zambia accounts for 70% of total sales: 50% of total sales are made through 28 depot spread across the country, serving wholesalers, independent traders and mobile cycle vendors distributing to small informal retailers, and 20% to formal retailers (supermarkets). ▪ The remaining 30% of their production is exported primarily to the DRC, with some exports to Namibia and Tanzania.
Results	▪ The company has 600,000 layer hens and 180,000 pullets in rearing. ▪ It generated $15m revenues in 2024 and have 12-14% of market share in Zambia.



	SDG impact
1 NO POVERTY, 8 DECENT WORK AND ECONOMIC GROWTH	▪ Sourcing 70% of soy and maize required for feed from smallholder farmers.
2 ZERO HUNGER, 3 GOOD HEALTH AND WELL-BEING	▪ c. $3 for a tray of 30 eggs, targeting low-income consumers. ▪ Distribution of eggs using bicycle peddlers to small informal retailers targeting low-income customers.
5 GENDER EQUALITY	▪ 35% female employees and has increased permanent female employees from 48 in 2014 to 128 in 2023.
12 RESPONSIBLE CONSUMPTION AND PRODUCTION, 15 LIFE ON LAND	▪ Zero waste practices, production and use of organic fertilisers.

Source: Interview with Fletcher Broad, June 2025, Phatisa's AAF impact report 2023/ 2024.,
Photo credit: Goldenlay's website.

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Goldenlay's nutritional impact is driven by its affordable eggs, providing high-quality protein and micronutrients to its clients

Nutritional impact

- **Commitment :** Affordable, high-quality eggs.
- **Actions under way:** Adhering to international best practices in animal welfare, including breeding, vaccination, and biosecurity.
- **Impact**: 150m eggs/ year sold at 10 cents per egg.

Good practice – Increasing access to affordable protein for low-income customers

- **Commitment to affordable products:** Eggs are one of the most affordable sources of high-quality protein and the company strategically aims to serve bottom-of-the-pyramid consumers who are underserved and lack financial resources. Goldenlay produces its feed in-house, which accounts for 60% of costs, giving it a competitive edge on pricing. As a result, Goldenlay has one of the lowest prices in the market, selling a tray of 30 eggs for c. $3.

- **Bicycle-based delivery for easier access to BoP consumers:** Goldenlay employs 36 cycle peddlers that distribute eggs from the 28 depots across Zambia to *ntembas* (small informal retailers). 3,835 ntembas were supplied in 2024, with 1,352 of these being female-run.

- **Boma software:** Goldenlay uses software through which its depots and their customers can place orders in advance and receive the exact sales price. This removes chances of drivers demanding increased prices at time of delivery and allows optimizing logistics to reduce waste. The mobile app has approximately 3,700 registered customers.



Source: Interview with Fletcher Broad, June 2025, Phatisa's AAF impact report 2023/ 2024., Photo credit: Goldenlay's website.

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Goldenlay improves its environmental impact through circular operations and efficient natural resource management

Environmental impact

- **Commitments**: Application of an environmental management program overseen by a dedicated ESG officer.
- **Actions under way**:
  - In-house organic fertilizer and feed production.
  - The company is currently exploring solar alternatives for its electricity requirements.
- **Impact to date**:
  - 30,000+ tons of manure transformed into fertilizer each year and sold to other farms at $23/ ton – a price comparable to synthetic fertilizer alternatives.
  - 22% increase in income for smallholders supplying maize and soy to Goldenlay between 2021 and 2023.



Good practice 1 – Circularity of organic fertilizer and feed

- **Organic fertilizer**: Goldenlay composts the nutrient-rich manure (and other organic materials, like eggshells) produced by chickens and uses it as fertilizer for its wheat, maize and soy cropping operations spread over 1,200 hectares of land. It sells surplus manure to local farmers as a low-cost organic fertilizer solution to enhance soil structure and increase yields.

- **Feed mill:** Goldenlay's farm, fertilized by its organic manure, supplies 30% of input requirements (maize and soy) for its in-house feed mill (the remaining 70% is sourced from 10,800 smallholder farmers) that produces the mash feed consumed by Goldenlay's chicken.

Good practice 2 – Water management

- **Water recycling:** Goldenlay has implemented water recycling systems across its operations, particularly in the cooling systems, to reuse water multiple times before it is responsibly discharged.

- **Smart irrigation:** The company plants over 80% of its crops during the rainy season, minimizing reliance on stored water resources. It operates a dam on their farm and have government approval for building two additional dams which will allow them to increase irrigated land from 164 to 654 hectares. It plans to integrate cover crops in their cultivation cycle to improve water retention and soil health.

Source: Interview with Fletcher Broad, June 2025, Phatisa's AAF impact report 2023/ 2024., Photo credit: Goldenlay's website.

Goldenlay is looking to raise $17m to scale operations

	Future outlook
Growth perspectives	▪ **Organic growth**: The local consumption of eggs has grown from 40 to 60 eggs/ person/ year in the last 20 years, and the market is expected to grow annually by 8.65% (CAGR 2025-2030). ▪ **Growth plans**: The company would need capital to increase its production capacity. It currently sells all its stock 2-3 days in advance, and production volumes have remained stable in the last 5 years. With the influx of new private capital, Goldenlay aims to grow 15% p.a.
Key challenges	▪ **Climate change and its impact on profitability**: Prices of feed are highly affected by droughts, such as the severe ones experienced in 2024. Disease outbreaks are also aggravated by climate change and negatively impact productivity. ▪ **Foreign exchange fluctuations**: Prices for imported feed inputs like chemicals, fertilizers, amino acids and export revenues are highly exposed to forex risks.
Financing	▪ **Past funding**: Goldenlay received $24m from AAF in 2012 and $8m as convertible debt from AgDevCo in 2019. ▪ **Current shareholders**: AAF and AgDevCo hold 69% and 7.5% of the company's shares, respectively. The remaining 23.5% of shares belong to the founder and MD. AAF plans to exit this year and will be replaced by a local private investor. ▪ **The company is currently looking to raise $17m**. This would help them to (i) increase production capacity by adding two new production houses immediately, followed by a new rearing house with four new layer houses, and (ii) construct two new dams, adding irrigation capacity of 490 hectares.
Additional support required	▪ **Professionalizing organic fertilizer sales**: Exploring the feasibility of processing plant for transforming manure into fertilizer, boosted with additional inputs, to create a new revenue channel. ▪ **Exploring innovative opportunities to finance capital expenditure of transition towards solar energy**: Making the business more resilient to energy cuts and environmentally sustainable.



Source: Interview with Fletcher Broad, June 2025, Statista., Photo credit: Goldenlay's website.

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Irvine's Group is a vertically integrated poultry company selling its products in 22 SSA countries

Business overview: Irvine's Group comprises of three businesses including Irvine's Zimbabwe, Buchan and Irvine's Africa. Irvine's Zimbabwe is an integrated poultry company that sells day-old chicks (DOCs), feed, table eggs and frozen chicken products. Buchan is the holding company for the group's DOC and feed operations in Botswana, Mozambique, Tanzania and Kenya. Irvine's Africa is a South African agribusiness inputs supply chain company providing feed inputs and animal health and hygiene products. Founded in 1950 in Zimbabwe by the Irvine family, the group employs 2,700 permanent employees.

Business model

History of organisation

- Founded as a small chicken producer, the group scaled and partnered with the American Cobb Genetics in 1962 to set up Africa's first Cobb breed grandparent farm[1] in Zimbabwe.
- It expanded to Botswana in 2001 and launched its supply chain business in 2004, followed by Mozambique (2006) and Tanzania (2018) respectively. In 2024, it expanded operations to Kenya and opened a new grandparent farm in Tanzania in 2025.

Product offering and value proposition

- With vertically integrated operations, the group provides complete poultry solutions – from DOCs to feed, health products, equipment, training, broiler processing, and logistics – for both in-house operations (DOCs, eggs and frozen chicken production) and external clients across 22 SSA countries.
- Parent chicks[1] and broiler DOCs sales generate 20-25% of the group's revenue. Frozen chicken and eggs contribute 13% and 8%, respectively. Animal nutrition and healthcare products (including vitamin and mineral premixes, vaccines) account for 22% and feed for 15%. Another 15-20% of revenue comes supplying clients with imported commodities like feed inputs and equipment.

Sales and distribution

- **Parent chicks and broiler DOCs**: ~30% of parent chicks produced are used by the group for its own operations and the rest are sold to external clients. Most broiler DOCs are sold in the country of production. Small-medium scale farmers represent 70-80% of sales in Zimbabwe, 90% in Tanzania, and 100% in Mozambique and Kenya. Botswana is an outlier with ~50% of sales to large corporate growers.
- All imported **agribusiness inputs** are supplied B2B to clients.
- **Feed**: 90% of the feed produced in the in-house mill in Zimbabwe is used for own operations; In Botswana, 90% of production is sold to external growers. In Mozambique, Kenya, and Tanzania, all feed is produced via partner mills and sold to external growers. Tanzania will soon have its own in-house mill.
- **Frozen chicken and table eggs**: In Zimbabwe, frozen chicken is sold B2B to HORECA[2] and distributor clients, and eggs are mainly distributed in informal markets as affordable protein for low-income groups.

Results

- Scale: Yearly production of 104m broiler chicks/ year, 2.46m cobb parent chicks, 327,000 tons of feed, 338m table eggs and 15,600 tons of frozen chicken.
- Yearly turnover of $500m: 40% from Irvine's Zimbabwe, 40% from Irvine's Africa and 20% from Buchan.



SDG impact

- Gathering 163,000+ tons of maize and 131,000 tons of soya from local partners.
- Working with 60,000 small growers, supplying 73m DOCs and training 12,000+ growers/ year.
- Producing 70% of total eggs consumed and 300 tons of frozen chicken/ week in Zimbabwe.
- ~25% of country-level c-suite team members are female.
- 40% of employees and 70% of partner small-scale growers are women.
- Water and waste recycling.
- Reducing feed consumption.

Notes: (1) A grandparent farm refers to a specialized facility in the poultry industry that is dedicated to breeding and producing the initial generation of breeding birds. Grandparents produce parent chicks which in turn produce broiler chicks., (2) Hotels, Restaurants and Catering.; Source: Interviews with Irvine's Group's executive management team, company documents., Photo credit: Irvine's group.

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Irvine's Group's offers a holistic and cost-competitive solution for smallholder farmers

Nutritional impact

- **Commitments**: Providing training, technical support and high-quality products to 100% of client farmers.
- **Actions under way**: Establishing two grandparent farms in Africa and providing free support to poultry farmers.
- **Impact to date**: 12,000 farmers trained/ year and 60,000[1] small-scale growers served. An average grower can earn $6,000+/ year with ~$1,900 in gross profit. Some of these farmers have scaled to 5,000 chicks/ cycle, with few even reaching 25,000 chicks/ cycle.



Good practice 1 – Establishing local grandparent farms to provide consistent access to highly productive breeds

- **Consistent access to DOCs:** Irvine's Group is one of the few African poultry companies with grandparent farms – reducing reliance on imported parent chicks. By breeding both parent and broiler chicks locally, it overcomes logistical hurdles — especially during disease outbreaks like avian influenza or Newcastle.
- **Highly productive breeds**: Using Cobb breeds that have low feed conversion ratios (FCR), increased egg production and better disease resilience compared to indigenous breeds (representing 75% of stocks in SSA) leads to savings on inputs and better productivity.

Good practice 2 – Providing holistic support to partner growers

- **One-stop grower's shops**: Irvine's operates 24 'grower's shops' and partners with 300+ local shops to supply farmers with all inputs necessary for growing broilers including DOCs, feed, equipment and animal health products.
- **Free training and technical support**: Each grower's shop includes a training centre. Each year, 12,000+ growers receive free weekly 3-hour sessions on key poultry business topics. For remote areas, Irvine's experts conduct on-ground trainings in the communities. Irvine's technical advisors regularly visit growers, monitoring flock performance and troubleshooting any problems.
- **Quality products and support measures help growers maximize performance and value derived from the products purchased**, driving repeat business and upselling as farmers scale – creating a **win-win** for both the farmers and Irvine's Group.

Notes (1) These smallholders are customers for Irvine's Group, purchasing DOCs and feed. Unlike contracted out-growers, these smallholders do not sell back grown chicken to the Group.; Source: Interviews with Irvine's Group's executive management team, company documents., Photo credit: Irvine's group.

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Irvine's Group's breed helps use feed, the main source of environmental impact, more efficiently

Environmental impact

- **Commitments**: Monitoring and managing waste responsibly; Continuous innovation to improve efficiency, productivity, robustness and welfare of broiler chickens.
- **Actions under way**: Water recycling, proper waste management, and tracking carbon emissions.
- **Impact to date**:
  - Water: 80m^3 of water recycled/ day in Zimbabwe.
  - Organic waste reuse: 1,220 tons of chicken litter composted and transforms 200 tons of hatchery and abattoir waste into poultry byproduct meal each month.
  - Waste recycling: 16.18 tons of plastic, scrap metal and paper waste recycled/ month.







Cobb500™

Efficient and balanced performance.

Good practice 1 – Reuse and recycling measures for proper waste management

- **Water recycling project**: Irvine's Zimbabwe installed water filtration systems to reduce consumption and mitigate drought risk, recycling 80,000 litres (80 m³) of water daily used to clean crates.
- **Reuse of organic waste**: The group reuses composted manure in its own operations in Zimbabwe and sells it to farmers as an organic crop fertilizer in other countries. Hatchery and abattoir waste is sent to a rendering plant, where it is heat-processed into poultry byproduct meal, a high-protein feed ingredient.
- **Other waste recycling**: The group separates different types of waste and sells its egg trays, plastic packaging, paper, cardboard and glass waste to recycling companies.

Good practice 2 – Improved breeding and R&D efforts to reduce feed consumption

- **Improved breeding:** The Cobb 500 breed of broiler DOC sold by Irvine's Group is considered the most efficient broiler on the market and requires less feed to reach final weight (which varies across markets). Since feed is responsible for up to 90% of poultry emissions (at global level), this is an effective way to reduce poultry's environmental impact. Increasing feed use efficiency thanks to improved genetic selection has led to an average 1.7% annual reduction in GHG emissions for the group's broiler DOC production.
- **Additional R&D efforts:** Cobb Genetics[1] also recently launched the 'Cobb Research Initiative' to fund and publish research on poultry science to further improve its breed productivity.

Notes: (1) Cobb Genetics is an American poultry genetics company that partnered with Irvine's Group to set up Africa's first Cobb breed grandparent farm in Zimbabwe and Tanzania. Source: Interviews with Irvine's Group's executive management team, company documents, Innscor, Cobb Africa, Springer Nature, African Geographical Review, Irrd., Photo credit: Irvine's group.

HYSTRA hybrid strategies consulting

Irvine's Group is looking to raise $30m to expand operations

	Future outlook
Growth perspectives	▪ **Business expansion**: With recent expansion into Kenya and the new grandparent farm in Tanzania, the group's revenue and operating profit have grown at a CAGR of 20% and 15%, respectively, over the last five years. ▪ **Growth plans**: With increasing business maturity, the group aims to achieve a CAGR of 10% over the next five years, with a focus on scaling its breeding and hatchery operating in East Africa.
Key challenges	▪ **Fluctuations in commodity prices** caused by geopolitical uncertainties **and the foreign exchange rate** have an immediate and significant impact on the group's commodity imports and most of its cross-border transactions. ▪ **Instability of government regulation** creates uncertainty for the business. ▪ **Finding, training and retaining skilled staff** to support the group's rapid expansion is often difficult in in local markets. ▪ **Fundraising** for expansion, notably from impact-focused investors like DFIs, is complicated for the group which is seen as a 'big commercial company'. ▪ **Heightened risk of avian influenza** on the continent requires exceptional biosecurity measures and threatens production.
Financing	▪ **Current shareholders**: o Irvine's Zimbabwe: 51% of shares are held by the Irvine family and 49% by Innscor. o Buchan: Tyson (owner of Cobb Genetics), Irvine family, Donnie Smith and Norfund hold equity. o Irvine's Africa:100% family owned. ▪ **Past funding**: Over the last 7 years, the group has raised $50m in equity including an investment of $18m from Norfund in 2024. It has additionally contracted over $15m in debt during the same period. The Norfund investment helped the group to expand feed and chick production in Kenya, Tanzania, Botswana and Mozambique, including the establishment of the grandparent farm in Tanzania. ▪ **The company is looking to raise $30m mixing debt and equity** for expanding breeding and hatchery operations in Kenya and Tanzania over the next five years.
Additional support required	▪ **Training smallholder growers**: On good agricultural practices has a significant impact on their productivity and environmental impact. DFIs can support the expansion of the group's training program in rural communities. ▪ **Access to finance**: For growers through derisking of loans by DFIs can enable them to access more working capital and scale production







Source: Interview with Irvine's Group management team, July 2025., Photo credit: Irvine's group.

HYSTRA hybrid strategies consulting

S&SE Asian countries produce 1/3 of aquaculture products and have the highest average consumption per capita

Aquaculture refers to the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants[1]. Out of the **600 species[2]** that are farmed, carps, seaweeds, shrimp, prawn, oyster, tilapia, catfish and salmon are the main groups commercialized today[3] - 89% of which are used for human consumption, the remaining 11% being mainly used to produce fishmeal and fish oil[4]. **Minimally processed fish and seafood (including canned or dried) are characterized as having 'high inherent nutritional value'** as per GAIN's definition of a nutritious and safe food*, however, highly processing fish makes it food of "little or no nutritional value and potential harm".

Market overview

Market dynamics

Production volumes

- Asia is the **largest producer of aquaculture**, accounting for **91% of the global production** (2020, 34% if excluding China)[4].
  - **Indonesia, India, Vietnam and Bangladesh are the world's largest producers (after China),** with respectively 12%, 7%, 3.7% and 2% of global production[4].
  - Semi-intensive fish farming systems** represent approx. 60% of total aquaculture areas in the region.[5]
  - The top 12 fish species produced in Asia are all categorized as "low-trophic," which are inexpensive to grow and environmentally friendly[6].
- In 2020, the **global market size** for aquaculture products was estimated **at $281bn**[4], out of which approx. **70% is generated by the Asian Pacific region** (including China)[7].
- The regional market size is expected to grow at a **CAGR of 5.3%** (in value) **over the next five years**[7].

Trading volumes: Vietnam, India and Thailand are among the top 10 exporting countries, exporting $20bn in 2020[4].

Key challenges

Aquatic animal diseases: Aquaculture intensification has resulted in increased disease problems in cultured animals. The overuse of antimicrobials contributes to the development of antimicrobial-resistant pathogens, impacting aquaculture production and profitability[8].

Climate change: Changes in mean temperature, level and quality of water are posing serious threats to aquaculture productivity[8].

Regulation: According to NACA***, the constantly changing regulatory environment and safety requirements of importing countries pose a special challenge to small-scale aquaculture producers[8].

Nutritional impact

Additionality

Undernutrition: The consumption of aquatic foods in the first 1,000 days of life is associated with reduced stunting and a decline in the prevalence of severe acute malnutrition[9]. This is particularly relevant in Asia, which has 40% of the world's stunted and 53% of undernourished children[10].

Overweight: In light of the fast-growing overweight prevalence in SE Asia, research has shown a positive relationship between fish consumption and reduced risk of cardiovascular disease as a result of the high levels of omega-3 fatty acids in some marine fish species[9].

Fit into consumption and cultural habits

In 2019, Asia accounted for 72% of total aquaculture product consumption, with the highest average consumption per capita (24.6kg/ year)[4].

- Indonesia, Malaysia, Cambodia, Thailand, Philippines, Myanmar and Bangladesh are all countries for which +20% of animal protein intake comes from aquatic food[4].
- The growing consumption of aquatic food is due to the rise of aquaculture production, income growth - creating a larger middle class - and the migration of rural populations to cities where aquatic foods are more accessible[4].

Notes: (*) See appendix for table with the nutritional impact classification rationale. (**) Semi-intensive fish farming is characterized by 0.5 to 1 hectare ponds with production of 3.3 to 10 tons/ ha/ annum; ***Network of Aquaculture Centres in Asia Pacific.; Source: (1) FAO, (2) Crona et Al, Four ways blue foods can help achieve food system ambitions across nations (2021), (3) FAO, Top 10 species groups in global aquaculture (2021),(4) FAO, The state of World Fisheries and Aquaculture (2022), (5) Giri, Sustainable aquaculture practices in South Asia: A comparative analysis of feed formulation and utilization, 2024; (6) World Bank, Lessons from Asia on aquaculture growth potential amid resource and climate challenges (2023); (7) Horizon Grand View Research, Asia Pacific Aquaculture Market size (2024), (8) Virapat, The Current Challenges of Sustainable Aquaculture in the Asia-Pacific Region and the Measures Recommended (2023); (9) UN, The role of aquatic foods in sustainable healthy diets (2021), (10)Rahut et al., Geospatial and environmental determinants of stunting, wasting, and underweight: Empirical evidence from rural South and Southeast Asia (2024).

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While aquaculture has long been under-invested, it is now one of the most attractive sectors for investors

Investability

Existing DFI investments

- Since 2013, DFIs in our research* have invested **$125m in 7** (non-purely export-focus) **companies** in the aquaculture value chain, of which only one was in South or SE Asia.
- Invested companies include **large shrimp and tilapia producers/ processors** (e.g., Lake Harvest, Almar group, Songa), **FMCG distributors** including fish in their portfolio (e.g., Terramar, Pan Group) as well as **feed suppliers** (Haid international group) and **tech platforms** supporting farmers in animal husbandry (Agromalin).
- The role of aquatic foods in sustainable healthy diets is increasingly recognized by public institutions (e.g., the UN) and investors alike (e.g., FMO recent article).

Opportunities for investors

- **Increased local consumption:** A growing urban middle class is driving up local demand for aquatic food across the region. However, most large producers still prioritize premium export markets. Focusing on serving local markets offers a strategic opportunity that can help close this nutrition gap and reduce dependency of producers on international buyers and trade fluctuations.
- **Environmentally friendly practices:** Aquaculture can have a high GHG emissions, acidification and water use impact depending on the species, feed type, and method of production. Practices including polytrophic culture, mangrove restoration and sustainable sourcing can significantly reduce aquaculture's environmental impact, offering blue carbon financing opportunities, while improving productivity for smallholder growers.
- **Improved breeds:** With small ponds of 0.5 to 1 hectare representing 60% of total aquaculture area in S&SE Asia, improved breeds with enhanced survival, growth and yield represent an opportunity to boost productivity and incomes of smallholder growers.

Case studies

- **Company**: Manit group.
- **Geographic footprint**: Thailand, Philippines, Myanmar, Vietnam and India.
- **Country for case study**: Thailand.
- **Size**: $18.5m revenues in 2024.
- **Product offering**: Tilapia and catfish fry*, animal health lab services, feed, probiotics, vaccines, tilapia filets and shrimp.
- **Export/ import focus**: Only 5% of production (not including shrimp sales) exported.
- **Value chain positioning**: Comprehensive aquaculture organisation.
- **Current investors**: 100% family-owned.

- **Company**: Blueyou Seafood.
- **Geographic footprint**: 7 countries across SEA, Europe, Africa and Latam.
- **Country for case study**: Global focus.
- **Size**: $20m revenues in 2024.
- **Product offering**: 25+ species of frozen, fresh, and canned seafood.
- **Export/ import focus**: 10% of production exported.
- **Value chain positioning**: Mangrove restoration and seafood distribution.
- **Current investors**: Seed funding raised 10 years ago, and restoration program financed through multiple grants.

Notes: (*) DFIs included in our analysis are: IFC, BII, FMO, Norfund, DEG, Proparco, BIO. We excluded companies selling soybean only as this is mainly used for animal feed and does not fit into our "nutritious food" scope., (**) Fry refers to recently hatched fish measuring <10 cm in size and ~1 gram in weight.

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Aquaculture's environmental impact varies significantly by species (by a factor of 5 for GHG), with tilapia having an impact similar to chicken

	Environmental performances of aquaculture[1] at global level	Environmental performances of regional proxy (Tilapia in SE Asia)	
	Average value[2]	Differences between environmental performance of tilapia in SE Asia vs tilapia globally	Key contributors to regional proxy's[3] impact
GHG	**13.6 CO_2eq/ kg**	**-4%**	▪ Electricity consumption from aquaculture ponds: c. 50% of total GHG emissions for tilapia. ▪ Emissions from feed production: c. 35% of total GHG emissions for tilapia, notably due to rice and soybean cultivation. Note that the relative weight of emissions from electricity vs feed highly depend on the type of fish/ seafood farmed, and whether it is carnivorous (in which case feed is the largest contributor of emissions) or herbivorous.
Terrestrial acidification	**65.9 SO_2-eq/ g**	**-3%**	Feed: Acidification linked to fertilizer use in feed production (i.e., in maize, rice, soybean production) as well as to diesel burned in fishing vessels in fishmeal production.
Water Use	**3691 L/ kg**	**0%**	Feed: Irrigation of crops (e.g., Rice) represents c. 95% of water use in tilapia farming. Beyond intensive water use, aquaculture can also have important impacts water quality and marine biodiversity.
Land use	**8.4 m2/ kg**	**-2%**	Feed: Land occupation and land use change for feed production are the main drivers of impact in tilapia production.
Comments	▪ Positive outliers: Small pelagic or unfed species. ▪ Negative outliers: Flatfish and diadromous fish. **Environmental impact varies significantly by aquaculture species, with factors from 1 to 5 for GHG and 1 to 20 for water use*.**	The environmental impact of aquaculture is highly dependent upon the species farmed, feed, production mode (intensive vs extensive, etc., whether the water is recirculated).	

N.B., The green colour code here indicates that **the local proxy's[3] impact is equal to or no more than 10% higher than the global average** (Exact difference expressed as a percentage figure; *See page 29 for details on reading the environmental assessment slides*).

Notes: (1) Aquaculture consists only of farmed fish. Crustaceans have been removed for affordability reasons., (2) The colour coding of average values indicates whether the impact is low (green), medium (yellow), or high (red) compared to other value chains. See page 29 for details.; Source: Poore and Nemecek (2018).; Source: Poore and Nemecek (2018), (*) Gephart et al., Environmental performances of Blue Foods (2021).

Notes: (3) Environmental performance values are highly contextual and should be taken as indicative, as impact is highly dependent on crop, country and agricultural practices. See slide 107 on selected proxies, rationale, and strength of proxy.; Source: Quantis expertise, Statista, WFLDB 3.11 and ecoinvent 3.11, IPCC WGI Interactive Atlas, CIRAD, Climate Risk Index (CRI), ND-GAIN Country Index Scores.
Nb: Please note that Poore and Nemecek global data and Quantis regional analysis of proxy foods are not directly comparable, as their scope and units differ.

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Improving aquaculture feed is the strongest lever to reduce this value chain's environmental impact

Lever	Description	Type of impact	Potential for reduction*	Contribution driver	Sources
Sustainable aquaculture feed	▪ Replace fish-based feed with deforestation-free plant-based or alternative protein sources (e.g., algae, insect meal). ▪ Reduces reliance on wild-caught fish and associated marine ecosystem pressure.	▪ Climate ▪ Biodiversity ▪ Land use	Very high	Feed	Rosle et al., 2024; Quantis use cases
Renewable energy use in aquaculture farms	▪ Transition aquaculture facilities from fossil fuels to renewable energy sources (solar, wind, biogas, …).	▪ Climate	Medium	Energy consumption	Koričan et al., 2021; Quantis use cases

Notes: (*) Rating based on Quantis' expertise.

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Blueyou works with smallholders on restorative, climate-smart blue food systems and creates direct market access

Business overview: Blueyou is an impact-first company that works with small-scale producers of farmed and wild capture seafood and implements restoration and sustainable fisheries programs across low- and middle-income countries. Harvested seafood is aggregated in Blueyou's brand and marketed regionally and internationally. The company currently operates two Integrated Mangrove Agriculture (IMA) programs covering an area of 18,000 hectares in Vietnam and Indonesia, and 13 ethical sourcing projects across 7 countries. Headquartered in Switzerland, the company was founded by a marine biologist and an agronomist; its team of 55 is split between 25 ocean scientists and impact experts for its restoration programs, and 30 staff for its commercial operations.

	Business model
History of organization	▪ Blueyou started in 2004 as a consultancy for sustainable fisheries and aquaculture. In 2008, it launched its flagship 'Selva Shrimp' IMA program in Vietnam. This program was expanded to Indonesia in 2019. ▪ Since 2006, the company also provides market access to smallholders by setting up aquaculture programs including handline tuna and shrimp in the Philippines, fair trade fish in Maldives, arapaima fish in the Amazon, and many more. ▪ Blueyou launched its new seafood brand featuring 25+ species in 2024 and became a certified B Corporation in 2025.
Product offering and value proposition	▪ Blueyou sells 25+ species of frozen, fresh, and canned seafood, sourced: ○ 50% from its two **IMA programs** in SE Asia, under which Blueyou restores degraded ponds by planting mangroves, allowing smallholders to grow organic seafood - 10-15% of volumes are commercialized by Blueyou. ○ 50% from **13 ethical sourcing programs worldwide,** under which Blueyou works with fishermen on certifications, ensuring traceability and compliance, processing seafood, and implementing conservation and livelihood programs.
Sales and distribution	▪ Blueyou commercializes 10% of the total production of its programs (20,000 tons in raw weight) to retail (B2C) and food service (B2B) sales channels in SE Asia, Europe and North America. ▪ ~90% of the production from the mangrove restoration programs is sold by the farmers themselves at prevailing market price both locally (75%) and internationally.
Results	▪ Blueyou partners with 169 communities, involving >9,000+ smallholder producers. ▪ It generated $20m sales revenue in 2024 and became net profit positive in Q2 2025.



	SDG impact
8, 10	Blueyou partners with 169 communities, involving 9,000+ smallholder producers.
13, 14, 15	▪ 'Planet positive' seafood accounts for 50% of sales. ▪ 12,400 hectares mangroves restored. ▪ 95% of products are certified as sustainable.
12	Reducing packaging as much as possible and using FSC certified paper and recyclable plastic packaging.

Source: Interview with René Benguerel, June 2025, Company website and documents., Photo credit: Blueyou.

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Blueyou's impact is driven by its commitment to support community-based fisheries and aquaculture

Nutritional impact

- **Commitments**: Increasing smallholder fishers and farmers in Blueyou's programs from ~9,000 today to 26,000 by 2032.
- **Actions under way**: 15 active programs on mangrove restoration and certified sustainable aquaculture with 9,000+ farmers.
- **Impact to date**: 80%+ of seafood origins are community-based, smallholder seafood harvesting systems, and another 15%[1] from certified commercial operations.



Good practice 1 – Increased yield to boost smallholders' income

- **Integrated Mangrove Aquaculture (IMA) program:**
  - Blueyou works with farmers and other public and private local actors to restore degraded zones (with <5% of mangrove coverage) by covering at least 50% of a pond with mangroves (funded by grants). The initial high-risk phase (2 to 7 years depending on level of restoration required) of IMA programs is financed using grants until the gross revenues from seafood sales can cover program costs.
  - The pond's production increases by 4x on average after 5 years, while also increasing the number of seafood species and resilience, without any increase in input costs. Increased income for farmers creates a long-term incentive for communities to uphold restoration efforts
  - While the fishermen produce and commercialise five to seven species of organic seafood in the restoration program, Blueyou commercialises only the Black tiger shrimp in export markets. One of the species commercialized locally by fishermen (including those working with Blueyou) is milkfish, a highly nutritious and affordable fish that is sold by farmers for less than a dollar per kilo (farm gate price).

- **Price premium**: Restorative mangrove aquaculture and certified (Fair Trade, ASC and others) seafood production yields high net margins and offers viable profitability.

Notes: (1) <5% of Blueyou's portfolio is represented by the yellowfin tuna product which is not certified by a third party yet.; Source: Interview with René Benguerel, June 2025, Company website and documents., Photo credit: Blueyou.

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Blueyou's impact is driven by its commitment to maximize 'planet positive' seafood

Environmental impact

- **Commitments for 2030**:
  - Reducing scope 1 and 2 emissions by 25% and scope 3 emissions[1] by 20% based on the 2023 baseline.
  - Increase total area of restorative mangrove aquaculture program from 12,400 hectares today to 50,000 hectares.
  - Increase share of planet positive (<3 kg CO_2 eq./ kg product at store) seafood to >75% of sales turnover and add new milkfish and mangrove crab products.
- **Actions under way and impact**:
  - Blueyou is certified as a B Corporation and a Swiss Triple Impact directory member with five binding and measurable goals on promoting seafood in line with planetary boundaries, fostering IMA, reducing emissions, smallholder producers and community inclusiveness and circular economy.
  - 88m trees planted (which are still alive), and 18,000 hectares covered under restoration programs.
  - 50% of revenues from planet positive seafood achieved.



Good practice 1 – IMA enabling carbon sequestration and production of feed, fertilizer and chemical-free seafood

- The 'Selva Shrimp' mangrove restoration program in Vietnam is the **largest IMA program worldwide**, encompassing a surface of 18,000 hectares and working with 3,500+ farmers.
- Restored mangroves **sequester large amounts of carbon**. Compared to conventional shrimp farming, selva shrimp emit 4x lower GHG and use 200x less freshwater.
- The seafood production is **feed, fertilizer and chemical free**. Selva shrimps save 11.2 kgs feed/ kg of shrimp, with feed contributing 75–80% to the environmental footprint of conventionally farmed seafood.

Good practice 2 – Adoption of sustainable harvesting

Blueyou prioritizes capture gears and traditional, community-based methods that catch target species selectively, i.e. with minimal bycatch and discards. It adheres to minimal catch size limits, avoids sourcing from overfished stocks without effective management, and actively supports fishery improvement projects.

Good practice 3 – Open-source impact measurement tools

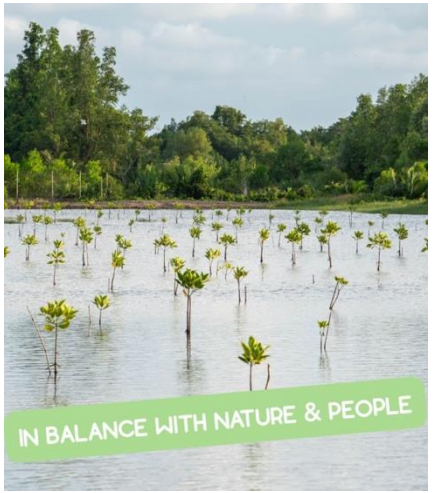
Beyond calculating and minimizing its emissions, Blueyou has developed a **toolbox for seafood carbon footprint analysis and an ocean impact matrix** with impact parameters on planet, people and animal welfare for different seafood species and origins, as open-source solution for ecosystem actors.

Notes: (1) Scope 1, 2, and 3 greenhouse gas (GHG) emissions categorise a company's carbon footprint as follows: Scope 1 covers direct emissions from sources owned or controlled by the company, Scope 2 includes indirect emissions from the generation of purchased electricity, steam, heating and cooling, and Scope 3 encompasses all other indirect emissions across the value chain, such as those from suppliers, business travel, product use, and waste disposal.; Source: Interview with René Benguerel, June 2025, Company sourcing policy, website and documents., Photo credit: Blueyou.

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Blueyou is currently raising $10m in equity, $5m in debt and $3.5m as catalytic grants for its IMA programs

	Future outlook
Growth perspectives	The company's current expansion plan aims to: ▪ Scale the business to $88m in revenue by 2032 with a gross profit of 25%. ▪ Scale its network of restorative mangrove aquaculture projects to 100,000 hectares by 2040.
Key challenges	▪ Commercial operations of export sales: o To grow its business and impact, Blueyou needs to 1) access more working capital to source higher volumes from farmers across its programs and 2) expand its sales channels beyond niche/ organic early adopters to large volume retailers. o Fundraising is challenging as a nature-based service provider without proprietary tech in a VC/ PE landscape focused on tech-first models (AI, blockchain, etc.). ▪ IMA program bottlenecks include developing: o Solutions and models for blue carbon financing and bio-diversity credits. o Robust scientific monitoring of IMA interventions (carbon, biodiversity and socio-economic parameters). o Technology solutions for impact tracking and reporting.
Financing	▪ **Past Funding**: Blueyou has raised $2.5m in grant funding and another $2.5m in commercial debt for their IMA program over the last 10 years. Since 2015, the 'Selva Shrimp' program in Vietnam has operated without grant funding, relying instead on commercial debt for working capital. ▪ **Future funding:** o **Equity**: The company is currently fundraising $10m in equity to expand its commercial operations and have received a soft commitment on 50% of the amount from an 'ocean fund' managed by a European family office. In parallel, it is undergoing due diligence and negotiations with a European food system transition fund. o **Debt**: It is additionally seeking $5m in debt for financing their global business expansion. o **Grants**: For their IMA program, Blueyou is raising grants of $2m for scientific monitoring in Asia and $1.5m for a feasibility study for scaling Tarakan pilot in Indonesia.
Additional support requirement	▪ Improving advocacy and marketing for public authorities and retail actors on nature-based restorative systems and their impact. ▪ Designing blueprint for blue carbon financing at scale. ▪ Partnering with scientific institutions to make the restoration systems more robust.





Source: Interview with René Benguerel, June 2025., Photo credit: Blueyou.

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Manit Group is a comprehensive Thai aquaculture organisation with almost 20 years of expertise in tilapia breeding

Business overview: Manit Group is a family-owned business headquartered in Thailand comprised of three companies: Manit Aquaculture (tilapia andshrimp farming), Manit Genetics (tilapia and catfish breeding and hatchery, and aquatic animal health lab), and Manit Intertrade (trading feed, probiotics and vaccines). Founded by Mr. Manit and Mrs. Wipa Luengnaruemitchai in 1968, the company has 270 full-time employees and serves Thailand and nearby markets including Vietnam, Laos, Philippines, Myanmar and India.

	Business model
History of organisation	▪ Founded as a catfish farm, the group launched shrimp and tilapia farming in 1986 and established its tilapia hatchery business in 1993. ▪ In 2004, it began selling feed through partnerships with feed manufacturers and, in 2007, expanded further upstream and started breeding tilapia in-house to gain a competitive edge on price and quality. ▪ Since 2023, the group also breeds catfish and partners with third-party manufacturers to sell frozen tilapia fillets.
Product offering and value proposition	▪ Black and red tilapia and catfish fry* account for 40% of the group's sales revenue. Another 40% comes from the trading business supplying feed, probiotics and vaccines. The remaining 20% of revenue comes from the sale of shrimp and frozen tilapia fillets. ▪ The group sets itself apart as a comprehensive one-stop shop for aquaculture and breeding, supported by a dedicated genetics program and animal health laboratory to ensure high-performance products.
Sales and distribution	▪ Approx. 95% of the fry production is sold within Thailand: 50% to individual farmers, >40% to wholesale distributors, and <10% to large farming operations. The remaining 5% is exported regionally, mainly in Laos and Vietnam. ▪ 100% of shrimp is sold to processing plants which themselves sell for export. ▪ Tilapia filets are sold B2B to airline catering companies and some hospital and restaurants in Thailand.
Results	▪ The group produces >300m fry/ year – making it one of the top three producers in Thailand – 200 megatons of shrimp, 300 megatons of tilapia and ~8,400 megatons of feed/ year. ▪ The group recorded $18.5m in revenue in 2024 with a small profit margin. Annual revenue fluctuates considerably due to varying production levels influenced by external factors such as climate change.







SDG impact	
	▪ >300m fry sold each year with the vast majority supporting livelihoods of small independent farmers.
	▪ The Group CEO and ~50% of staff is female.
	▪ Developing clean energy, planting mangroves and proper waste management.

Note: (*) Fry refers to recently hatched fish measuring <10 cm in size and ~1 gram in weight.; Sources: Interviews with Amorn Luengnaruemitchai (MD, Manit Genetics and Intertrade), July 2025, INVE Aquaculture., Photo credit: Manit Group.

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Manit Group's genetic selection program helps increase the average volume of edible fillet per fish

Nutritional impact

- **Commitments**: Continuous improvement in product quality and productivity.
- **Actions under way**: Setting up an in-house breeding program, genetics and R&D team and animal health lab to improve quality and fillet yield
- **Impact to date**: >300m fry sold each year, with the majority destined to small and medium scale farmers.



Good practice 1 – Selective breeding program enhancing survival, growth and yield

- **In-house breeding program**: Manit group has been developing fish breeds for 18 years. Today, its genetic selection program works with 200 families (one female and one male) that are bred to produce offsprings (fry fish). The offspring are tested in grow-out operations under different conditions and closely monitored to identify the best performers, which are used as broodstock[1] by the commercial hatchery team. In 2022, the Group opened an aqua-health laboratory, which includes a research facility conducting feeding trials, challenge tests[2] and other experiments, enabling continuous improvement of breeding programs. Since 2007, the group has increased the survival rate and growth of its tilapia (150 days post-hatch) by 24.2% and 115%, respectively.

- **Increased yields:** Manit Group actively works on improving numerous variables in the animals' health and performance including growth, robustness, taste and meat quality as some of the targeted enhancement factors. Today, the average yield of fillet[3] of the group's fish is 36%, which represents a 20% increase compared to the market average yield of 30%. Farmers sell raw fish to fillet processors at prices ranging from $1.55 to $2.16/kg, with higher yielding fish commanding higher prices.

Note: (1) Broodstock is a group of mature individuals used in aquaculture for breeding purposes. (2) Challenge tests identify the ability of different families to cope with a variety of diseases and stress factors. (3) Fillet yield percentage represents the edible portion of the whole fish.; Sources: Interviews with Amorn Luengnaruemitchai (Managing Director of Manit Genetics and Intertrade), July 2025, INVE Aquaculture., Photo credit: Manit Group.

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Manit Group's impact is driven by its commitment to high environmental standards, embodied by its BAP[1] certification

Environmental impact[2]

- **Commitments**: 10% reduction in footprint by 2026 from 2023 baseline of 2,665 tCO_2eq.
- **Actions under way**:
  - Participation in the government's Low Emission Support Scheme (LESS).
  - Obtention of BAP certification for meeting responsible environmental, social, food safety, and animal health and welfare standards.
  - Responsible waste management practices, utilization of solar rooftop systems (since '21) and LED solar lighting (since '22).
- **Impact to date**:
  - 108,669 $kgCO_2eq$ of GHG emissions reduced in 2024 from waste separation for recycling certified by LESS. Reduced waste to landfill from 650 to 45 kgs/month.
  - Generated ~800,000 kWh of electricity from the solar rooftop systems and LED lighting respectively, reducing 276,829 and 145,532 $kgCO_2eq$.



Good practice 1 – Meeting environmental responsibility standards for BAP certification

To obtain its BAP certification, the group's hatchery was audited and validated across a wide range of environmental clauses including the protection of ecologically sensitive areas, effluent monitoring and management, water quality and sediment monitoring, soil and water conservation, responsible feed use, genetic modification of species, control of escapes, and interactions with wildlife.

Good practice 2 – Planting mangroves for filtration of organic waste from discharged water and carbon sequestration

Water drained from growth tanks flows into a reservoir, where 6,000 mangrove trees have been planted in an area of three hectares. These trees filter organic matter, allowing water to be reused in future cycles. Mangrove forests can sequester an average of 56.40 tCO2eq/hectare/year.

Good practice 3 – Using transport tanks and feed silos to minimize plastic waste[2]

- **Transportation using tanks**: Since 2019, the group has promoted delivering fry in metal tanks instead of plastic bags. In 2024, >66 million fry were transported this way, replacing ~95,000 plastic bags and cutting GHG emissions by 28,595 tCO_2e/kg.
- **Feed silos**: The group installed silo-feed tanks in 2021, partially replacing non-recyclable feed bags. In 2024, >9,800 bags were eliminated, reducing emissions by >4,700 $kgCO_2e/kg$ and saving $0.40 per bag.

Note: (1) Best Aquaculture Practices, (2) GHG emission reduction figures were calculated by Manit Group based on emissions data from the Thai National LCI Database using LESS methodology.;
Sources: Interviews with Amorn Luengnaruemitchai (Managing Director of Manit Genetics and Intertrade), July 2025., Photo credit: Manit Group.

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Manit Group has grown production by 30% over the past five years despite climate change challenges – Strategic support can secure a resilient, climate-smart future

	Future outlook
Growth perspectives	▪ **Past growth**: Production volumes in 2025 are up ~30% over the past five years, though annual growth has varied significantly. ▪ **Growth plans**: The group aims to increase production by 15% this year compared to 2024.
Key challenges	▪ **Climate change:** Higher temperatures lower reproduction levels, reducing the number of fertile eggs produced by fishes in the hatchery. Production volumes fell 40% y.o.y. in 2024. ▪ **Recruiting trustworthy and skilled employees**: The business requires heavy investment in training and retaining internal staff over time due to limited trust in external senior hires. Attracting young graduates is difficult, as many are reluctant to work in rural areas or in a sector involving physical labor. ▪ **Rising trade pressure on local aquaculture**: A sharp rise in U.S. trade tariffs may redirect cheap Chinese tilapia exports towards Thailand, intensifying local competition. Moreover, free trade agreements signed by the Thai government — particularly those without quota protections — could further disrupt the aquaculture market currently dominated by domestic producers.
Financing	▪ **Current shareholders**: The Manit Group is 100% family-owned since its inception. ▪ **Past funding**: The company has occasionally borrowed money from commercial banks to finance capital investment like new production infrastructure. ▪ **Future funding**: The company is currently negotiating a bank loan of <1m$ for expanding its production capacity. It does not plan to fundraise equity in the short run but is open to explore external financing options as it scales further.
Additional support required	▪ **Professional management and financial support**: to formalize the group's shareholder structure, explore new financing options and conduct financial planning. ▪ **Developing e-commerce**: as a B2C sales channel. ▪ **Expert support to increase resilience of production systems to climate change**.







Sources: Interviews with Amorn Luengnaruemitchai (Managing Director of Manit Genetics and Intertrade), July 2025.. Photo credit: Manit Group.

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Appendix

1. *Methodology for environmental impact assessment*
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Environmental impact assessment methodology (1/5): The global value chain assessment leverages Poore and Nemecek data

- The data on environmental footprint of the nine food value chains included in this analysis is drawn from a study by Poore and Nemecek[1]. It compiles data from 570 studies selected from a meta-analysis of 1,530 papers and additional input from 139 authors. The compiled dataset spans ~38,700 farms in 119 countries and covers 40 products accounting for ~90% of global protein and calorie consumption.
- 24 food groups from the study's dataset belong to the nine food value chains included in our analysis. Based on existing literature on food life cycle assessments – including GAIN's 'Identifying Highly Nutritious Foods with Low Environmental Impacts' study – and availability of comparable data, we have prioritized and analysed average footprints* across four key impact indicators: GHG emissions, Terrestrial acidification, Water use and Land use.
- For each value chain, the impact indicators are measured per unit of retail weight (kg or grams). The retail weight of a food product accounts for distribution and retail losses, but not consumer-level losses in weight. For example, in poultry, this would be the weight after removing bones and excess fat.
- **Range/ variability of impact:** Relying on global averages overlooks the wide **variation in food footprints across producers (companies)**, potentially leading to a misleading picture in certain contexts[2]. Thus, our analysis includes the 10th percentile of each impact indicator across the nine food value chains. For a given impact indicator, a significantly lower 10th percentile footprint value compared to the average suggests strong potential for improving the value chain's environmental footprint through the adoption of best practices.
- We have clustered the footprint values for each impact indicator, classifying each food value chain as **low/ medium/ high impact** (see next slides for detail). This is a **relative ranking**, across the nine value chains, for each indicator's average footprint* value.
- The relative ranking implies that the low/ medium/ high impact is **not an absolute judgement** of the food value chain's impact for a given indicator, but the **comparative position of a food value chains for each impact indicator.** This analysis of the environmental footprint of food value chains is intended to be a dynamic, evolving resource, and we welcome any additional contributions.

N.B. These individual rankings compare the overall relative environmental performance of different food value chains based on available data (cumulating the four impact indicators).

Notes: (*) Average footprint of a given value chain is the average of footprints of individual food groups that comprise the value chain.; Source: (1) Poore and Nemecek (2018) - "Reducing food's environmental impacts through producers and consumers", (2) Hannah Ritchie (2020) - "Less meat is nearly always better than sustainable meat, to reduce your carbon footprint" - Our World in Data.

Environmental impact assessment methodology (2/5): The global value chain assessment leverages Poore and Nemecek data

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Assuming equal weightage for all indicators.
Low = Value Chain with at least three criteria scoring low and no high
Medium = At least two ranked as medium and/ or one high max
High = Two or more criteria ranked high

Global average values of environmental impact indicators

Value chains	GHG (kg CO_2eq/ kg)	Terrestrial Acidification (SO_2-eq/ g)	Water Use (L/ kg)	Land Use (m^2/ kg)	Overall Rating
Vegetables	0.8	7.7	127	0.5	Low
Fruits	0.9	6.4	190	1.3	Low
Cereals	2.0	12.0	565	5.7	Medium
Dairy	3.2	20.0	628	9.0	Medium
Legumes	2.0	17.7	895	10.7	Medium
Poultry	7.3	78.0	619	9.2	Medium
Nuts	0.4	45.2	4134	13.0	High
Aquaculture[2]	13.6	65.9	3691	8.4	High
Red Meat	46.2	236.0	1941	189.2	High

Legend: Relative negative environmental impact

Low	Medium	High

Notes: (1) Aquaculture environmental impact varies significantly by aquaculture species, with factors from 1 to 5 for GHG and 1 to 20 for water use based on Gephart et al., Environmental performances of Blue Foods (2021).; Source: Poore and Nemecek (2018) - "Reducing food's environmental impacts through producers and consumers."

Environmental impact assessment methodology (3/5): The global value chain assessment leverages Poore and Nemecek data

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Assuming equal weightage for all indicators.
Low = VC with at least three criteria scoring low and no high
Medium = at least two ranked as medium and/or one high max
High = two or more criteria ranked high

10th percentile values of environmental impact indicators

Value chains	GHG (kg CO_2eq/kg)	Terrestrial Acidification (SO_2-eq/g)	Water Use (L/kg)	Land Use (m2/kg)	Overall Rating
Vegetables	0.3	3.2	21	0.1	Low
Fruits	0.4	3.5	27	0.3	Low
Cereals	0.8	7.1	1	2.0	Low
Dairy	1.7	8.0	19	1.1	Low
Legumes	1.1	8.3	231	5.8	Low
Poultry	3.6	32.3	80	5.5	Medium
Nuts	-3.7	20.6	0	4.5	Low
Aquaculture	5.7	34.8	1117	0.8	High
Red Meat	22.6	111.5	161	41.3	High

Legend: relative negative environmental impact — Low | Medium | High

Food value chains that have a significantly better environmental footprint when looking at best practices (i.e., 10th percentile) compared to the average

Environmental impact assessment methodology (4/5): Given limited data from Poore and Nemecek at regional level, the regional assessment is based on proxies and leverages alternative WFLDB 3.11 and ecoinvent 3.11 database

HYSTRA hybrid strategies consulting

- While the dataset of Poore and Nemecek is large enough to provide some robust analysis at a global level, data is too limited to draw meaningful conclusions at the regional level. In partnership with Quantis, an environmental consulting firm, we therefore decided to leverage some proxies (one food in one country) from their large database (World Food LCA Database (WFLDB) 3.11 and ecoinvent 3.11) to develop some insights at the regional level.
- While these proxies are not representative of all crops within a value chain, nor of all countries or production systems, they provide a good representation of some of the most widely produced crops in the region. Unfortunately, data for poultry and vegetables in Sub-Saharan Africa was not available. Details on the rationale for selection of each proxy can be found in the following slide.
- Leveraging the WFLDB 3.11 and ecoinvent 3.11 database, Quantis has compared the global average of the selected proxy crop (e.g., oranges for fruits in Latam) on each of the four environmental impact indicators to the average of the leading producing country in the selected region (e.g., Brazil for oranges in LATAM). The percentage difference between the global and proxy's averages gives an indication of how the region is performing.
- Please note that the database used by Quantis differs in scope (e.g., it includes land use change on top of land use) and in units (e.g., acidification is measured in mol H+ vs in SO_2-eq/ g in Poore and Nemecek database) from the Poore and Nemecek dataset. As a result, findings are not directly comparable.

Notes: Average footprint of a given value chain is the average of footprints of individual food groups that comprise the value chain.; Source: Poore and Nemecek (2018) - "Reducing food's environmental impacts through producers and consumers", Hannah Ritchie (2020) - "Less meat is nearly always better than sustainable meat, to reduce your carbon footprint" - Our World in Data.

Environmental impact assessment methodology (5/5): Proxies have been selected based on regional production data – but are not equal in strength

	Selected Proxy & name of dataset (both regional & global)	Rationale for selection/ comments	Overall Strength of proxy
Fruits ***South America***	▪ Regional: Oranges, fresh grade, for processing, at farm/ BR U. ▪ Global: Oranges, fresh grade, at farm/ GLO U. ▪ Both from WFLDB 3.11.	▪ Oranges produced in Brazil are used as a proxy to represent the Latin America fruit value chain: ○ Oranges are the second most produced fruit in Latin America (20%, from FAO), after bananas. ○ Brazil is the largest fruit producer in Latin America, and the largest producer of oranges in the world (20%, from FAO).	Medium
Vegetables ***Sub-Saharan Africa***	NA.	▪ No Sub-Saharan vegetables datasets were available in Quantis databases.	NA
Legumes ***South Asia***	▪ Regional: Chickpea, at farm/ IN U. ▪ Global: Chickpea at farm/ GLO U. ▪ Both from ecoinvent 3.11.	▪ An Indian chickpea dataset was available in Quantis databases. It is used as proxy for legumes in South Asia as: ○ Chickpeas is the only reliable available dataset which covers South Asian legumes of Quantis datasets. ○ Moreover, chickpeas are the most produced legume in South Asia, and India is the largest world producer of chickpeas (70% of world production).	High
Milk ***South America***	▪ Regional: Raw milk, production mix, at farm/ BR U. ▪ Global: Raw milk, production mix, at farm/ GLO U. ▪ Both from WFLDB 3.11.	▪ Mexican milk is used as a proxy to represent the Latin American dairy value chain, as it is the second largest producer of milk in South and Central America (16% based on FAO) after Brazil (excluded because of the specificities of the country regarding deforestation issues).	Medium
Poultry ***Sub-Saharan Africa***	NA.	▪ No Sub-Saharan poultry datasets were available in Quantis databases.	NA
Aquaculture ***South-East Asia***	▪ Regional: Tilapia {RoW}| tilapia production, extensive aquaculture, in pond/ Cut-off, U. ▪ GLO: Tilapia {GLO}| market for tilapia/ Cut-off, U. ▪ Both from ecoinvent 3.11.	▪ Tilapia produced in extensive aquaculture, in pond, is used as a proxy to represent the South-East Asian aquaculture value chain, as: ○ It is the only aquaculture dataset available in Quantis databases. ○ South-East Asia represents 67% of world tilapia production (Rabobank and Global Seafood Alliance study).	Medium

Source: Quantis expertise, FAO, Statista

List of experts interviewed during the research

Generalist experts	Organisation
Laura Pereira	Stockholm Resilience Centre
Carin Smaller	Shamba Centre
Martin Slawek	Open Capital
Axel de Martene	Le lHab Solutions
Florence Jeantet	Vivae
Alaïs Faucon	Quantis
Roel Messie	IDH Trade

Experts for specific value chains	Organisation
Michael Adams	Ocean Assets
Michael Phillips	Futurefish
Anh Pham	ResponsAbility
Dan Zook	ISF
Corentin Larue	Fundes
Fred Puckle Hobbs	Tathva
Ekanath Khatiwada	SNV Uganda

Summary of relevant levers to reduce the environmental impact of selected food value chains

Lever	Fruits	Vegetables	Legumes	Milk	Poultry	Aquaculture
Certified deforestation free	✓	✓	✓	✓	✓	
Biologically activated biochar	✓	✓	✓		✓	
Agroforestry	✓	✓	✓		✓	
Undersown cropping	✓	✓	✓		✓	
Organic mulching and returning residues to soil	✓	✓	✓		✓	
Legume Crop rotation	✓	✓	✓		✓	
Cover cropping	✓	✓	✓		✓	
No-till practices	✓	✓	✓		✓	
On-farm anaerobic manure digestion				✓		
Feed additive				✓		
Grassland: Adaptive grazing				✓		
Grassland: Interseeding				✓		
Sustainable aquaculture feed						✓
Renewable energy use in aquaculture farms						✓