

Building the business case for resilience investments: A layered returns framework

Robert Horster & Navya Kumar

Key Takeaways

- Food producing landscapes face a widening gap between the cost of climate-driven disruptions and the finance deployed to build resilience against it - despite growing evidence that inaction is the costlier path.
- This gap reflects not weak economics, but a missing translation: a validated pathway that connects ecological and social outcomes of resilience investments to the financial metrics that drive corporate capital allocation.
- Existing risk-reward models for investment appraisal are not wrong but incomplete. We propose the Layered Returns Framework (LRF), paired with a transmission mechanism that traces financial, market-based, and system-level returns across stakeholders and, where possible, translates them into investor-relevant value.
- Identifying and financializing this full spectrum of returns broadens the pool of potential investors, including providers of concessionary capital. Because different investors have different risk appetites, investment horizons and return requirements, this diversity lowers the overall cost of capital.
- The LRF thus reframes resilience investment from a sustainability mandate into a strategic capital-allocation decision that stands on its own terms.

Introduction

Risks are material, cascading, and non-linear

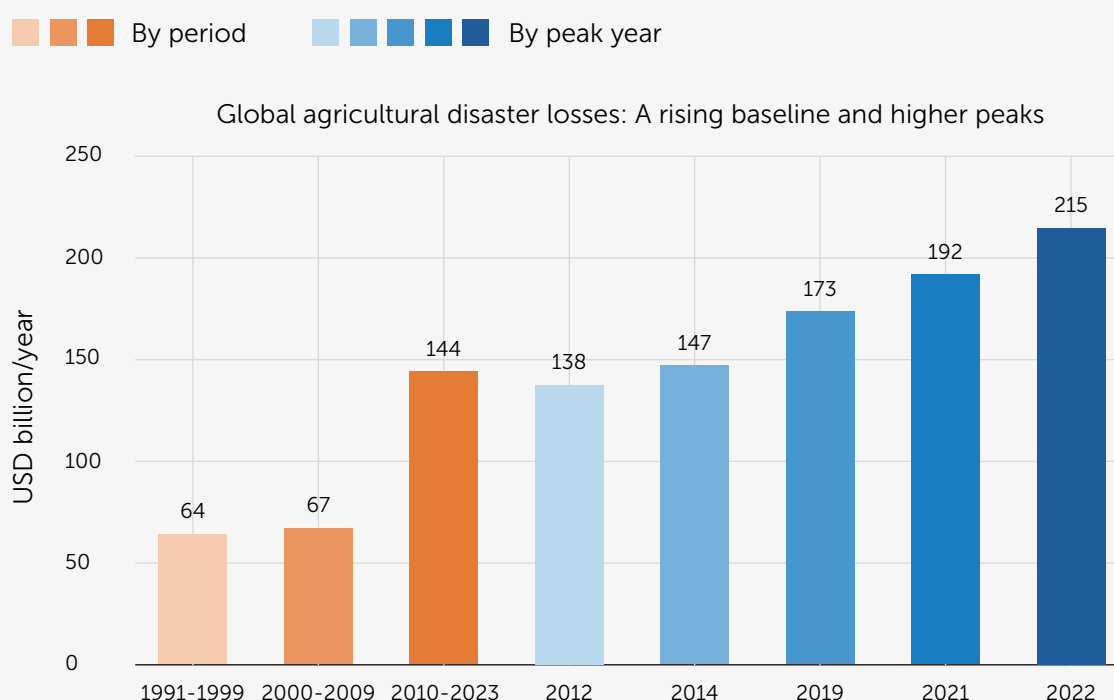
Food systems face an unprecedented convergence of risks that are intensifying in both frequency and severity. Climate-related disruptions, geopolitical conflicts, weakening of governance systems, all create a VUCA world – a Volatile, Uncertain, Complex, and Ambiguous world where the cascading impact on value chains due to disruptions becomes increasingly difficult to predict. Climate and related risks are among the most amenable to intervention: their impact can be mitigated through deliberate investments in resilience, making them a critical entry point for safeguarding the continuity and stability of food systems.

Food systems are highly vulnerable to climate change – while also contributing to it – and the scale of loss is already being realized.¹ According to the Food and Agriculture Organization of the United Nations (FAO), disasters have cost global agriculture an estimated \$3.26 trillion over a 33-year period, of which close to \$2.9 trillion is attributable to climate-related hazards.² European agricultural production faces losses of roughly €28.3 billion annually (\$31.9 billion) as a result of extreme weather events.^{3,4} All of these figures reinforce that losses in agricultural production represent a non-trivial proportion of annual output by the sector. Beyond direct production losses, there are broader hidden costs that the food system itself imposes; the Food System Economics Commission (FSEC) argues that “our food systems are destroying more value than they create”, imposing hidden environmental, health, and social costs estimated at \$15 trillion annually.⁵

Material risks are compounding as much as they are recurring. Global agricultural disaster losses have escalated sharply by decade (Figure 1). The rising baseline is only half the picture; rising individual year spikes (Figure 1) show how there is a rising floor and a rising ceiling.⁶ In 2025, global insured natural catastrophe losses reached \$107 billion, exceeding \$100 billion for the sixth consecutive year running, while total economic losses that year were roughly double, at \$220 billion⁷ - meaning that insurance covered less than half the true cost. Rather than a temporary spike, the persistence of these elevated costs shows a structurally higher baseline for material risk. Assets such as infrastructure and transport networks are also becoming harder to insure due to climate change,⁸ increasing exposure to supply chain disruptions for essential commodities and consumer goods, including crops and food items.

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- 1 Aurora Matteini and Derek Baraldi, “Why food finance must be on the table in the face of rising climate risks,” World Economic Forum, August 6, 2025, <https://www.weforum.org/stories/2025/08/food-finance-climate-playbook/>.
 - 2 Food and Agriculture Organization of the United Nations (FAO), *The Impact of Disasters on Agriculture and Food Security 2025* (Rome: FAO, 2025), <https://doi.org/10.4060/cd7185en>.
 - 3 Tomas Spragg Nilsson, “Extreme weather events already cost agricultural production €28+ billion per year – EU must move to climate-friendly agriculture,” CAN Europe, May 23, 2025, <https://caneurope.org/news/extreme-weather-events-already-cost-agricultural-production-e28-billion-per-year-eu-must-move-to-climate-friendly-agriculture/>.
 - 4 Kate Abnett, “Extreme weather costs EU farmers 28 billion euros a year, EU says,” Reuters, May 20, 2025, [https://www.reuters.com/sustainability/cop/extreme-weather-costs-eu-farmers-28-billion-euros-year-eu-says-2025-05-20/#:~:text=BRUSSELS%2C%20May%2020%20\(Reuters\).analysis%20published%20on%20Tuesday%20showed](https://www.reuters.com/sustainability/cop/extreme-weather-costs-eu-farmers-28-billion-euros-year-eu-says-2025-05-20/#:~:text=BRUSSELS%2C%20May%2020%20(Reuters).analysis%20published%20on%20Tuesday%20showed).
 - 5 Caterina Ruggeri Laderchi et al., *The Economics of the Food System Transformation*, Food System Economics Commission (FSEC), 2024, https://foodsystemeconomics.org/wp-content/uploads/FSEC-Global_Policy_Report.pdf.
 - 6 Food and Agriculture Organization of the United Nations (FAO), *The Impact of Disasters on Agriculture and Food Security 2025* (Rome: FAO, 2025), <https://doi.org/10.4060/cd7185en>.
 - 7 “2025 marks sixth year insured natural catastrophe losses exceed USD 100 billion, finds Swiss Re Institute,” Swiss Re, December 16, 2025, <https://www.swissre.com/press-release/2025-marks-sixth-year-insured-natural-catastrophe-losses-exceed-USD-100-billion-finds-Swiss-Re-Institute/f710c271-58c8-4c48-9004-05203634d1e0>.
 - 8 Alastair Marsh, “Climate change keeps adding to the list of uninsurable assets, Allianz executive says,” Los Angeles Times, July 22, 2026, https://www.latimes.com/environment/story/2026-07-22/climate-change-adds-to-list-of-uninsurable-assets-allianz-executive-says?_sp=00f92f48-8661-46f5-990e-35f2efdae1e9.

Figure 1. Global agricultural disaster losses by period and by peak year (1991-2023). Period bars show the average annual loss, peak bars show single-year actuals.



Source: FAO, *The Impact of Disasters on Agriculture and Food Security 2025*.

Cost of inaction is more expensive

There is a missing business case for resilience investments despite evidence that the cost of inaction in many cases exceeds the proactive investments required. A 2025 study by Boston Consulting Group, Cambridge Judge Business School, and University of Cambridge's climaTRACES Lab finds that on the world's current trajectory, warming of 3°C by 2100 will slash cumulative economic output between now and 2100 by 15%-34%. In contrast, investing just 1%-2% of the same cumulative global GDP by 2100 could curb the temperature rise to below 2°C and limit adverse effects, while still leaving some unavoidable residual climate damage. This net cost of inaction is a staggering 11%-27% of cumulative GDP from now till 2100.⁹ To put in perspective, the average of this range could fund other global priorities such as healthcare many times over in the same period.

The same logic holds at the level of an individual firm, where frequent and cascading supply chain disruptions already translate into material losses. For instance, the 2014-15 and 2015-16 droughts in Brazil reduced coffee production and led to a price increase of over 50% and

⁹ Amine Benayad et al., *Too Hot to Think Straight, Too Cold to Panic Landing the Economic Case for Climate Action with Decision Makers*, (Boston Consulting Group, University of Cambridge climaTRACES Lab, and Cambridge Judge Business School, March 2025), <https://web-assets.bcg.com/93/51/1389e6b74f1d82a1c03e9144222f/why-investing-in-climate-action-makes-good-economic-sense-dec2025.pdf>.

40% for arabica and robusta respectively, with Nestlé estimating a potential cost impact of CHF 0.8 billion to CHF 1 billion (approximately \$925 million to \$1.15 billion) if the frequency and severity of droughts in these coffee regions increases.^{10,11}

The World Economic Forum warns that capital markets are likely to adjust company valuations based on early signs of transition risks even before they fully materialize, leading to vulnerabilities a lot sooner than companies themselves might estimate.¹² The same research points to a clear upside; companies already investing in climate adaptation and resilience report that they could yield \$2-19 in avoided losses for every dollar spent. Inaction, in other words, is rarely the cheaper option in the long term.

Three interconnected constraints on resilience investments

While the economics favour acting to mitigate material risks and invest in resilience, there are still inadequate efforts on this front. The need for a credible business case for resilience is underpinned by three interconnected problems; an absolute underfunding of resilience investment, a structural under-representation of private capital, and misallocation of the finance that does flow.

According to the United Nations Environment Programme (UNEP), finance flows into Nature-based Solutions (NbS) were a mere \$220 billion in 2023, and that annual financing for NbS would need to increase 2.5 times to \$571 billion by 2030 to meet global biodiversity, climate and land restoration goals. Moreover, resilience investments currently see a disproportionate reliance on public funding. Roughly 90% of the investments came from the public sector with only around 10% from the private sector,¹³ this despite separate research showing that a nature-positive economy could unlock an additional \$10.1 trillion in business value annually in 2030.¹⁴ In contrast, \$7.3 trillion went to nature-negative activities.¹⁵ There is a clear need to build the business case for investors, supported by public non-return or low-return seeking capital, to strengthen the resilience of supply chains businesses depend on for the continuity of their operations.

Where the gap lies: A missing translation

We define resilience as the capacity of a system to anticipate and absorb shocks and continue delivering value. Our hypothesis is that there exists a strong and clear business case for resilience investments. The evidence above shows that the private sector already bears the brunt of cascading, material supply-chain risks that threaten their business continuity – and

10 Nestlé, "Nestlé - Climate Change 2019" (answers to CDP climate questionnaire, 2019), <https://www.nestle.com/sites/default/files/2020-01/nestle-answers-cdp-climate-2019.pdf>

11 World Economic Forum, in collaboration with Boston Consulting Group, *The Cost of Inaction: a CEO Guide to Navigating Climate Risk* (December 2024), https://reports.weforum.org/docs/WEF_The_Cost_of_Inaction_2024.pdf.

12 World Economic Forum, in collaboration with Boston Consulting Group, *The Cost of Inaction: a CEO Guide to Navigating Climate Risk* (December 2024), https://reports.weforum.org/docs/WEF_The_Cost_of_Inaction_2024.pdf.

13 United Nations Environment Programme, *State of Finance for Nature 2026: Nature in the Red* (UNEP, January 2026), <https://www.unep.org/resources/state-finance-nature-2026>.

14 World Economic Forum, in collaboration with McKinsey & Company, *Finance Solutions for Nature: Pathways to Returns and Outcomes* (September 2025), https://reports.weforum.org/docs/WEF_Finance_Solutions_for_Nature_2025.pdf.

15 United Nations Environment Programme, *State of Finance for Nature 2026: Nature in the Red* (UNEP, January 2026), <https://www.unep.org/resources/state-finance-nature-2026>.

that there is value to be captured, not only losses to be avoided, in addressing it. Why, then, does private funding remain so underrepresented and misallocated?

The answer lies in the absence of a **validated pathway connecting ecological and social outcomes to the financial metrics that drive corporate capital allocation**. A rich literature documents the impact of resilience interventions at farm and landscape level (For instance, see: (Colombi, Martani, & Fornara, 2025)¹⁶, (Almeida et al., 2018)¹⁷, (Barbosa et al., 2026)¹⁸), and a separate rich body of work maps the finance mechanisms and de-risking tools available to unlock and scale up capital for sustainable food-producing systems (see: (World Economic Forum & Bain & Company, 2026)¹⁹, (World Economic Forum & McKinsey & Company, 2025)²⁰, (Thomas Kerr & Varun Shankar, 2026)²¹). What remains missing is the link between the two: what brings investors to the table in the first place. Without this translation, resilience investment stays a sustainability narrative rather than being seen as what it is: a business continuity concern and a capital allocation decision with a quantifiable return. Closing this gap requires two complementary constructs: a theory of change describing where value accrues, and a causal mechanism describing how it gets there.

The Layered Returns Framework (LRF)

The Layered Returns Framework (LRF) captures the idea that returns from a single intervention accrue to multiple stakeholders beyond the primary beneficiary – that the returns are ‘layered’. Consider a smallholder coffee cooperative that adopts regenerative practices improving water availability and quality. There is direct financial benefit to the farmer as yields and incomes stabilize, and to the lender who sees a lower probability of default. Traders and processors benefit from more reliable volumes and quality of beans. All corporate entities working along the supply chain can report enhanced ecosystem services as progress against their sustainability commitments. Reduced public health costs from less water-borne diseases benefit governments and local communities. Each actor alone would have a weaker case for funding the intervention, while the risks are shared. This is the gap the LRF intends to close.

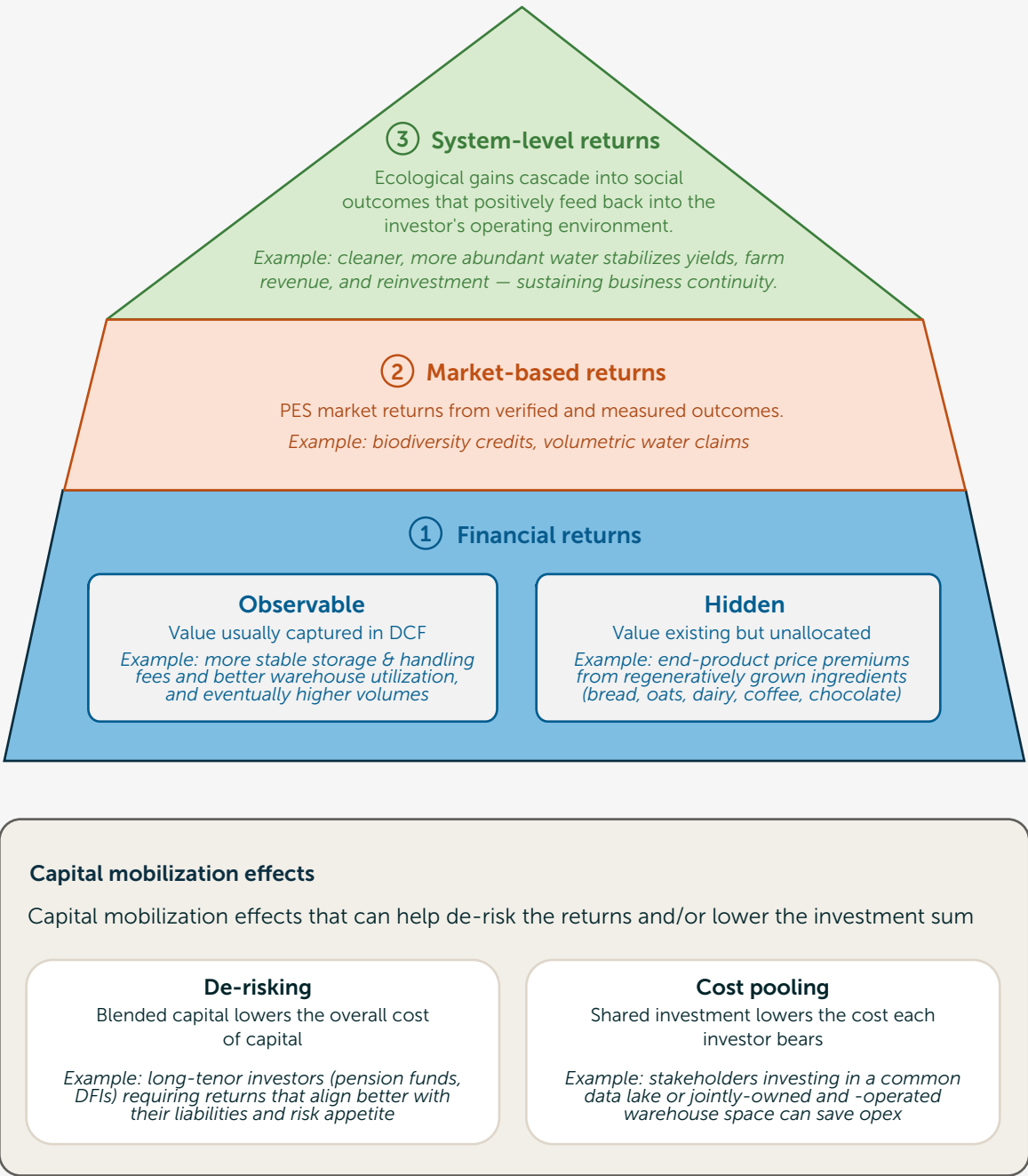
By quantifying returns across multiple layers, the framework also captures the indirect benefits that accrue to the primary investor. For example, when a supply chain operator invests in its own infrastructure, it generates direct financial returns through warehousing and handling fees. At the same time, the investment delivers wider benefits to other stakeholders:

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- 16 Greta Colombi, Enrico Martani, and Dario Fornara, “Regenerative Organic Agriculture and Soil Ecosystem Service Delivery: A Literature Review,” *Ecosystem Services* 73 (March 31, 2025), [10.1016/j.ecoser.2025.101721](https://doi.org/10.1016/j.ecoser.2025.101721).
 - 17 Wilk Sampaio de Almeida et al., “Effect of Soil Tillage and Vegetal Cover on Soil Water Infiltration,” *Soil and Tillage Research* 175 (January 2018): 130–38, <https://doi.org/10.1016/j.still.2017.07.009>.
 - 18 Julierme Zimmer Barbosa et al., “Deep-Rooted Tropical Grasses as Preceding Crops Boost Soil Health and Soybean Yield in Brazil—A Meta-Analysis,” *Agronomy* 16, (April 1, 2026), <https://doi.org/10.3390/agronomy16070751>.
 - 19 “The Playbook of Financing Solutions,” World Economic Forum in collaboration with Bain & Company, <https://initiatives.weforum.org/financing-transition-community/case-studies>.
 - 20 World Economic Forum, in collaboration with McKinsey & Company, *Finance Solutions for Nature: Pathways to Returns and Outcomes* (September 2025), https://reports.weforum.org/docs/WEF_Finance_Solutions_for_Nature_2025.pdf.
 - 21 Thomas Kerr and Varun Shankar, *Unlocking Capital for Climate Resilience: Private Sector Action in Finance* (World Bank, March 2026), <https://documents1.worldbank.org/curated/en/099514103262636082/pdf/IDU-6ff8a8a7-95d0-463f-abda-6215df860f8a.pdf>.

farmers can safely store their harvests, reduce post-harvest losses, and rely on secure offtake arrangements. These improvements increase farm incomes, enabling farmers to re-invest in their practice. In turn, this strengthens the resilience and productivity of the landscape, creating a virtuous cycle that ultimately also benefits the original investor through a more stable and sustainable supply chain.

Figure 2. Layered Returns Framework (LRF)

Example: Regenerative agriculture programs



DCF: Discounted Cash Flow; PES: Payment for Ecosystem Services; DFIs: Development Finance Institutions; opex: operating expense

The LRF (Figure 2) therefore identifies value across three vectors — financial, market-based, and diffuse system-level returns — accruing not only to the investor but to a wider set of landscape stakeholders: governments, utilities, insurers, conservation agencies, and institutional investors.

This does two things at once. It expands the pool of monetizable value beyond the direct investor's cash flows, and it identifies capital suited to that expanded value: stakeholders such as pension funds, life insurers, and development finance institutions are not non-return-seeking, but their liability profiles — long-dated, predictable obligations — make lower, more stable, longer-duration returns genuinely attractive rather than concessionary. These align well with the payback period of investments in landscape resilience that typically lie beyond those of capital expenditure (capex) closer to the core of a business.

The framework therefore identifies not just who benefits, but how that distribution of benefit can be converted into capital suited to it. This distinction, and its fuller implications for risk, we return to below.

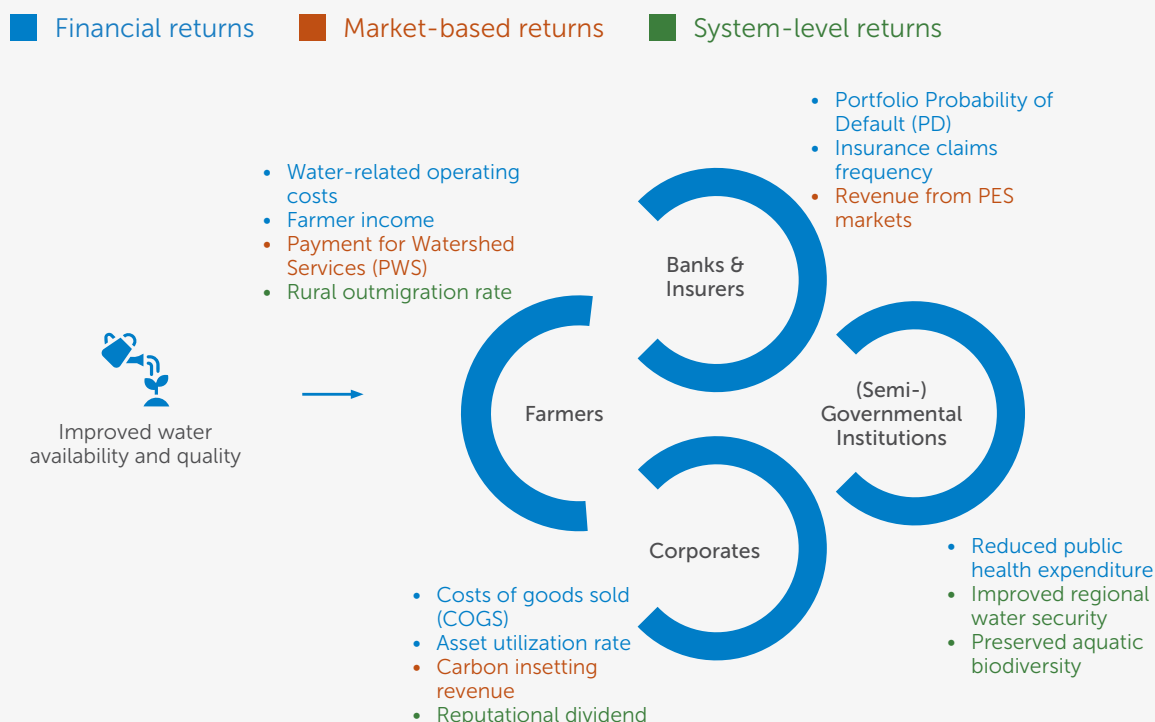
Transmission mechanism

Where the LRF specifies which stakeholders benefit and through which return vector, the transmission mechanism specifies the causal chain by which an intervention or disruption propagates to each stakeholder's relevant metric — for instance, how high yield variability negatively affects farmer income predictability, which in turn erodes working-capital buffers and raises probability of default for lenders. This is what makes the LRF's monetization claims credible: a layered return cannot be monetized without first evidencing the causal path that produces it.

The two constructs come together in a single, practical way; rather than valuing an investment only by the cash it returns to the investor, we widen the calculation to include the monetized benefits flowing to every identified stakeholder, and we adjust the required rate of return to reflect the fact that some of that capital is patient or comes at a lower cost.

The transmission mechanism supplies the substance of that calculation — which outcome maps to which metric, for which stakeholder — while the LRF supplies its structure — multiple beneficiaries, multiple types of capital. Neither construct is simply an illustration of the other, but together they turn a standard investment appraisal into one that reflects the full landscape of value creation. In this way, the transmission mechanism defines the causal pathway and supports the LRF by making the outcomes more tangible. It translates the results, where possible, to financial metrics that can be reflected in the profit and loss statement (P&L), balance sheet, or portfolio health. This allows benefits to be directly compared with upfront costs, enabling a fair evaluation alongside other capital expenditure requests on the CFO's agenda, thereby strengthening the case for resilience investments as a capital allocation decision. Using water availability and quality improvement as an illustrative example, Figure 3 presents the indicative metrics corresponding to each layer of returns.

Figure 3. Transmission mechanism



Note: This illustration is indicative and non-exhaustive, mapping a couple of relevant metrics for select stakeholders in the supply chain. In reality, more stakeholders are involved, and several additional metrics – across all return layers – contribute to the business case for resilience investments. It is recognized that quantifying every return may not be possible, particularly the system-level returns. This is where non-return or low-return seeking beneficiaries – governments, NGOs, and others – can play a role. The layered returns framework offers a coherent narrative to bring these diverse stakeholders together to mitigate the most material risks.

Inherent tensions in resilience financing

Short- versus long-term investment horizons, and risk versus reward

Two tensions recur. Temporally, resilience investments tend to pay off beyond the cycles of conventional capex, risking disengagement from CFOs and shareholders accustomed to shorter horizons. On risk and reward, a naïve reading of return figures is misleading: a higher return achieved at materially higher risk is not necessarily preferable to a lower, more stable one – the same insight that underlies the Sharpe ratio in portfolio theory, where return is only meaningful relative to the risk taken to achieve it.

The LRF bifurcates the return layers by type (financial, market-based, and system-level). However, there is recognition that different stakeholders may sit at different points in regard to tenor, and that risk appetite can be variable within the different layer types. Certain landscape investors and stakeholders – pension funds, life insurers, Development Finance Institutions (DFIs) – are natural buyers of lower but more consistent, longer-duration returns, since these match the profile of their own liabilities. Their participation therefore lowers the risk profile of the investment, not merely its blended cost of capital. This reframes what might look

like a concession as, in fact, a good match between the investment return profile and these investors' own institutional needs.

This carries a design implication; rather than treating such capital as something to attract once an intervention has already been selected, first investors should involve these actors during intervention design itself. This may mean favouring interventions with broad, system-level appeal over those narrowly attractive to a single beneficiary. The operative question for an immediate beneficiary becomes: what would make a lower but far more stable and predictable return acceptable? The answer the LRF supplies is a lower risk profile, achieved by co-designing for participation from investors whose own liability structures reward exactly that trade-off, as well as a better investment case by financializing additional returns at higher layers that indirectly benefit first investors.

Durability

The investments examined by the LRF typically involve shared risks, where a single investor is called upon to mitigate risks whose benefits accrue to multiple stakeholders. This creates a tension; although returns are distributed and risks shared, the investment case must still stand on its own within a conventional capital allocation process. Ultimately, this points to a single test of durability: resilience investments should compete for capital on the same terms as conventional capex – e.g., a new processing line – rather than relying on separate corporate social responsibility (CSR) or grant budgets that can lapse.

Meeting this test requires identifying value the direct investor recovers through channels a standard appraisal typically misses. First, returns that go unmeasured, including both direct and indirect benefits: Scope 3 value captured through emissions reduction by a consumer-facing division rather than the financing business line, or secondary returns from warehouse investments as farmers can safely store their crop, reduce post-harvest losses, and secure offtake, creating a virtuous circle through improved farm income, in addition to primary returns from storage and handling fees. Second, further returns can be monetized through the Payment for Ecosystem Services (PES) market where measured and verified outcomes exist. Third, system-level returns: e.g., cleaner water reduces public health costs, benefiting governments, utilities and the communities investors operate in. Fourth, a de-risking effect arises through participation from investors with varying risk appetites, tenor preferences, and liability structures.

Together, these four elements resolve the tension: they turn distributed, shared-risk returns into a comprehensive and robust business case able to stand on its own.

Table 1. Inherent tensions in resilience investments

Tension	The Conventional Problem	How the LRF reframes it
Short-vs-long term horizon	Payoffs fall outside conventional capex cycles	Liability-matched investors (pension funds, insurers, DFIs) are natural buyers of long-duration returns
Reward-vs-risk	Higher return looks better than lower, regardless of risk taken	Stability-seeking capital lowers the investment's actual risk, not just its blended cost
Durability	Resilience investment often relies on CSR or grant budgets that can lapse	Value is captured directly by the investor and can compete in capex decisions — unmeasured benefits, cross-business gains, de-risking

Limitations

The LRF is an allocation framework rather than a valuation model that guarantees precision. There are limitations and obstacles – transaction costs, overcoming free-rider dynamics, and attribution difficulties, among others. Where several interventions or beneficiaries operate in the same landscape, the transmission mechanism's causal pathway becomes harder to isolate for any one of them. Convening a larger group of heterogeneous beneficiaries becomes as much a coordination and narrative challenge as an economic one. These limitations do not invalidate the framework's core logic, rather, they point to the institutional conditions and support it needs to function as intended. The Layered Returns Framework supplies the very logic and cohesive narrative needed to get disparate beneficiaries into the same room around a risk they already share.

Conclusion and next steps

The evidence assembled here supports a specific diagnosis: the business case for resilience investments in food systems is not economically weak, but incomplete on the translation from ecological and social outcomes to relevant financial metrics. The Layered Returns Framework and the corresponding transmission mechanism are designed to close exactly that gap – identifying who benefits from a resilience investment, through which return vector, and how that distribution of benefit can be converted into capital suited to it.

The next step is empirical; applying the transmission mechanism to a specific commodity-origin, quantifying how risks propagate through the supply chain and identifying the return vectors for the different beneficiaries if the risk is mitigated. If this translation is achieved successfully, resilience investment stops being a sustainability narrative in search of a grant and instead becomes seen as what it fundamentally is: a strategic capital-allocation decision that generates measurable value and safeguards long-term business continuity.

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At the Erasmus Commodity & Trade Centre, we combine our proprietary risk-identification methodology with a scenario-based quantitative framework to translate supply chain risks into investor-relevant financial metrics. This makes the value of risk mitigation tangible, turning the Layered Returns Framework into a commodity- and origin-specific investment case. If you would like to learn more or explore potential applications, we would be pleased to hear from you.

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Authors

Robert Horster is Senior Researcher, Erasmus Commodity & Trade Centre. Navya Kumar is Researcher, Erasmus Commodity & Trade Centre.

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Website

<https://www.eur.nl/en/erasmusctc>

Contact

commoditytrade@ese.eur.nl

Reference as

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