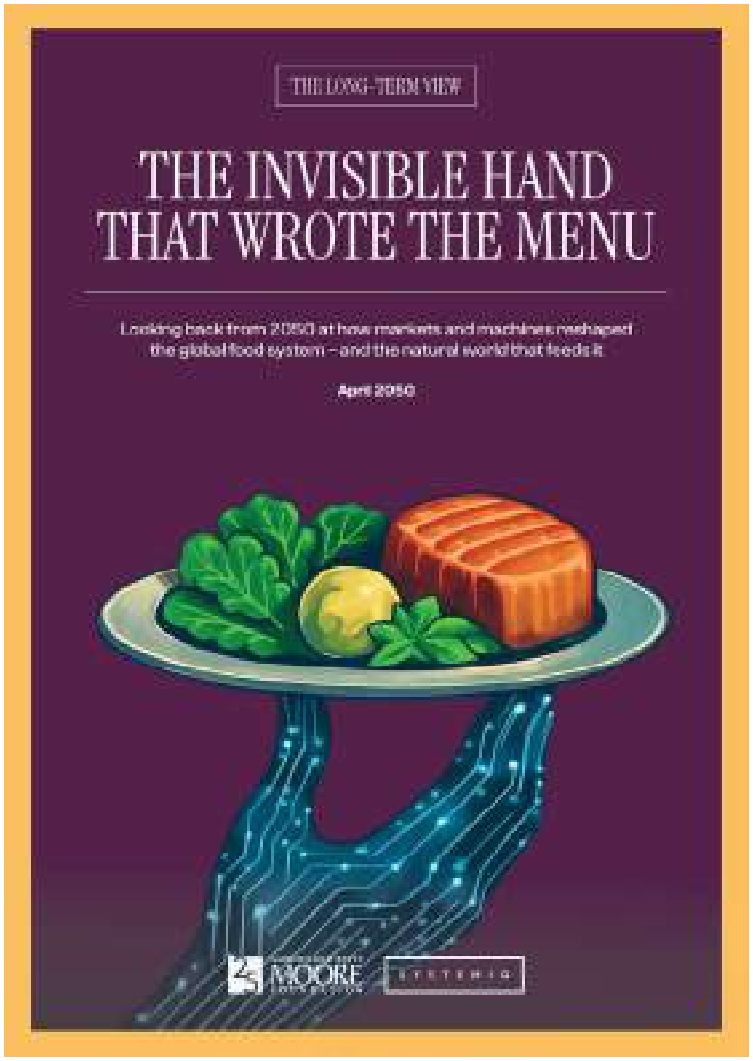
Annex I: Four plausible scenarios



1: The Invisible Hand That Wrote The Menu

Looking back from 2050 at how markets and machines reshaped the global food system – and the natural world that feeds it

A QUARTER century ago, the global food system teetered on the edge of fragmentation. Trade wars, climate shocks, and public health crises were mounting, and calls for state-led reform grew louder. But governments hesitated. What followed instead was a cascade of market-driven adaptation – led not by ministries, but by megafirms, startups, and algorithms. This is the story of how technology and private capital reengineered how the world grows, moves, and eats its food.

The turning point came in 2033, when joint breakthroughs in ultra-efficient solar cells and low-cost battery storage sent energy prices into freefall. What followed was more than a green energy revolution – it was a reshaping of food systems from the grid up. Technologies like bioreactors, indoor farms, water desalination, and AI-managed precision agriculture, long constrained by energy costs, became scalable and profitable. But the clean energy surge had a shadow: soaring demand for critical raw minerals drove rapid expansion of mining in poorly regulated regions, bringing new deforestation and labour abuses even as rising circularity softened some of the damage. The transition powered new tools – but it was far from clean or fair for everyone.

At the same time, AI was driving a transformation of its own. Behind the scenes, AI evolved from a tool of optimisation into a discovery engine. It mapped the genomic architecture of seeds, microbes, and ingredients; accelerated protein discovery and strain design; and collapsed the timelines for seed improvement and product development from years to weeks.

40%

of China's protein demand came from domestic alternative sources by the mid-2040s.



What changed was not the system's logic, but its tools.

With abundant energy and AI, vertical farms and bioreactor-based production flourished, especially in climate-vulnerable and densely populated countries. China led the way, investing heavily in alternative feeds, fermentation technologies, and cultivated meats to reduce import dependency. By 2050, it met 50% of its protein demand from domestic alternative sources – cheap, shelf-stable, and algorithmically optimized.

Land-based farming adapted too. Precision agriculture, powered by AI and cheap renewable energy – much of it generated directly on farms through agri-PV – along with green ammonia fertilizers, became standard across industrial farms. Automated machinery, gene-edited crops, and sensor-rich soil management stabilized yields despite escalating climate shocks. Yet these gains skewed to those who could afford them. Smallholders were squeezed. Land was consolidated. But not all resilience came from money and machines. A parallel shift unfolded as elements of agroecology – once dismissed as fringe – were co-opted and scaled by mainstream producers. Intercropping, diversified rotations, and low-input systems gained traction, not from consumer pressure or romantic ideals, but because they helped farms hedge against volatile weather and input costs. Paired with AI-driven planting tools and hyper-local weather prediction, this "agroecology lite" became a quiet engine of adaptation. Purists called it greenwashing. Investors called it smart risk management. The soil, at least, seemed to benefit.

The seas followed a similar pattern. With wild fisheries increasingly unstable, aquaculture expanded, supported by AI-driven monitoring, automated husbandry systems, and cheap renewable energy. Innovation in feeds – from plant-based ingredients to insects, microalgae, and microbial single-cell proteins – steadily reduced reliance on wild fish inputs. But as on land, the gains flowed mainly to large operators, deepening the divide between industrial aquaculture and struggling coastal fisheries.

Ultra-processed foods (UPFs) continued to dominate – but evolved. A new wave of "premium UPFs," tailored to obesity drugs and hyper-personalized nutrition plans, flooded wealthy markets. GLP-1-friendly product lines became a staple. In affluent segments, consumers exercised choice as an expression of optimisation and identity; elsewhere, "choice" was largely shaped by price and promotion – with the most affordable calories still the least nutritious.

Animal protein demand kept rising with incomes. Intensive livestock systems grew more efficient and tightly monitored, reducing antibiotic use and disease outbreaks. Cheap renewable energy also lowered production costs for precision-fermented feed ingredients, making amino acids and microbial proteins competitive with soy and fishmeal. Alternative proteins, especially cultivated meat and fish analogues, met much of the new demand. Technology helped contain risk – but did not erase it.



Climate shocks persisted. The "double drought" of 2034, which hit the US Midwest and China simultaneously, was a turning point. Markets adjusted. Indoor farms scaled. Bioreactors surged. Global trade shifted – from grains and oilseeds to bioreactor feedstocks and data. Countries with abundant renewable capacity became exporters of green ammonia, biomanufactured inputs and ingredients, and produce grown in controlled environments – new pillars of food security built directly on cheap power. Supply chains bent, but did not break.

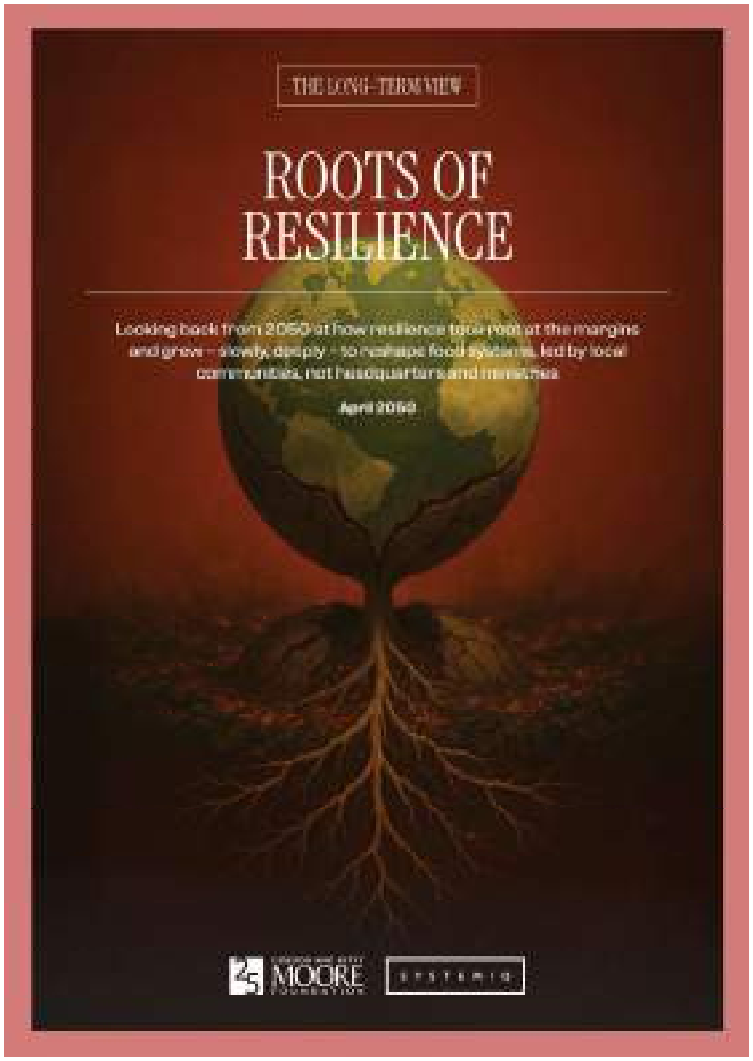
Control of the system shifted, too. Big Ag faded from headlines. In their place: Big Tech found its way into food – firms that own the data, algorithms, and IP behind modern food production. They do not just sell and ship food – they design it, optimize it, and often, own its means of creation. Their data platforms helped strengthen traceability and claims verification, though rapid advances in AI simultaneously made fraudulent claims easier to generate and harder to detect.

As AI expanded what firms could quantify, natural capital began to be priced and managed like any other asset class. Companies invested in mangroves, wetlands, and other ecological buffers that reduced climate risk to their supply chains – often more cheaply than man-made defences. But the same metrics that made nature investable also narrowed how it was valued: what was easy to measure was what attracted capital. As demand for bioresources grew – whether for feedstocks, biomaterials, or bioenergy – investment tilted toward projects that maximised carbon or harvestable volume, not ecological integrity. Some countries used the bioeconomy boom to restore degraded land and bring it back into production, meeting rising demand without expanding into intact ecosystems. But where governance was weak and 'sustainable biomass' loosely defined, it instead drove monocultures, habitat loss, and growing strain on water and soils.

Governments, for the most part, remained on the sidelines – reactive rather than directive – with domestic policies continuing the short-termist logic of servicing markets rather than reshaping them. Some embraced progressive tech policies like CRISPR for drought-resilient crops or strain development for biomanufacturing, but these moves reinforced market-led trajectories rather than redirected them. Multilateral treaties on climate and nature resurfaced in speeches and summits – but with little enforcement, they served more as symbols than systems. A few exceptions emerged where corporate and geopolitical interests aligned, such as the Global Alliance to End Wildlife Crime – but these remained the exception, not the rule.

By 2050, food is smarter, faster, and more efficient. But not fairer and not evenly resilient. Environmental concerns matter – but mostly as a hedge against disruption. GHG emissions and land conversion are lower than they were in the 2020s, tempered by synthetic and indoor production, but still beyond planetary boundaries, while oceans remain depleted. As climate volatility intensified, markets adapted with technology, yet the resilience this created remained uneven, leaving many beyond the reach of the invisible hand. Billions still eat what they can afford, not what they need. The system adapted but the outcome is not optimal. The invisible hand stayed in charge – steady as ever, for better or worse.





2: Roots of Resilience

Looking back from 2050 at how resilience took root at the margins and grew – slowly, deeply – to reshape food systems, led by local communities, not headquarters and ministries

THE 2020s and 2030s left deep scars. Record-breaking heatwaves scorched nearly every corner of the globe. Wars dragged on for years, prolonged by the vanity of ageing leaders clinging to legacy. Cuts to subsidies and food aid during the 5-year Long Recession sparked protests that swept from the US to Brazil, from the EU to India. Farmers blocked highways from Punjab to Paris. Youth strikers demanded more than targets; they demanded a seat at the table. While the world reeled from climate and public health shocks, migration, political volatility, and inflationary waves, something deeper was also taking hold.

Like root systems, change often begins out of sight. Roots spread slowly, underground, and unnoticed. But they do more than hold up trees – they link species and feed ecosystems. In that way, they are not unlike communities. As markets promised abundance but delivered hunger, and governments promised stability but preserved inequality, the roots of change kept growing and communities moved from coping to creating. They did not topple institutions – they grew around them. The roots of change rerouted trust and power – and became conduits of resilience. What slowly took place was not quite a revolution. It was a quiet contagion.

In the late 2020s, in Ukraine – its farms bombed, its ports blockaded – life pushed back through the soil. With centralized institutions weakened, a different kind of rebuilding took hold. Farmers shared soil data and cropping strategies through open-source platforms, building a peer-to-peer web of agroecological learning. Community-owned solar-powered cold-chain and distribution hubs emerged in repurposed railway depots and warehouses, serving as the connective tissue between small farms and urban dwellers. Ukraine did not rebuild what was lost – it grew something different. The world took note.

Born in the wake of the Long Recession of 2029-2034 and inspired by Ukraine's reinvention, local food movements emerged between young farmers and urban youth from Brasília to Bangkok, Nairobi to New Orleans.



They were not just protesting; they were redesigning. They built regional co-ops and launched digital markets linking producers and eaters directly. This was not charity or boutique organics – it was a deliberate effort to make local food the backbone of daily diets. Meanwhile, the global AI boom had hollowed out many white-collar roles, pushing people toward work algorithms could not replace. More hands turned to the soil and the water – a return to crafts of farming that AI could guide but never perform. By the time COVID-37 shuttered global supply chains for months, many networks were already in place. While supermarket shelves emptied, these hubs fed cities and safeguarded culturally rooted foods. The pandemic did not create the movement, but it proved it.

Thereafter, like the hidden filaments of a mycelial network, three strands of change spread beneath the surface – one carrying voice, the second carrying knowledge, the third carrying culture.

The first strand reshaped governance itself. After COVID-37, the state did not disappear – but in many places, it learned to listen differently. Governments shifted toward more open, place-based governance. Citizens' assemblies from Wales to West Bengal rewrote regional food and nature strategies. In Pará and Palawan, young farmer and fisher cooperatives and local ecologists sat with regional authorities to co-write resilience plans rooted in place. Finance gradually localised: solidarity lending circles and community-based insurance schemes resurfaced as practical tools for sharing risk as large finance and insurance institutions withdrew. Yet these mechanisms still faltered when entire regions were hit at once, prompting some national or bioregional governments to step in as backstop reinsurers to spread losses across communities. Governance took root locally, braided from the resources and reach of the state with the trust and knowledge of communities.

The second strand rewired knowledge. Technology and intelligence no longer flowed only from corporate R&D labs, but from collective, decentralized peer-to-peer exchange. Growers trained AI tools on their own weather logs, soil tests, and reef biodiversity surveys. These were pooled into open "nature intelligence" platforms that did not just boost yields – they accelerated the shift to agroecology and guided nature restoration projects that brought back seagrass meadows, oyster reefs, wetlands, and pollinator corridors.

The third strand renewed food culture. Agriculture and diets returned to their roots in meaning and place. As global staples faltered in fractured supply chains during COVID-37, local foods endured: Sahelian millet, Appalachian beans, Andean tubers. Kelp forests and oyster beds tended by coastal cooperatives. They fed bodies and identity. As conglomerates lost influence, marketing budgets shrank and shelf-space battles faded. Availability, seasonality, and proximity shaped diets more than promotions. Choices narrowed within places – fewer imported staples, fewer out-of-season luxuries – but diversified across places as distinct regional food systems re-emerged. Much of the shift was born of necessity after repeated supply disruptions, but it hardened into preference: consumers rewarded what their regions could grow or harvest, redirecting demand and capital toward local producers. Demand no longer flowed primarily through global brands, but through networks of trust, proximity, and shared stewardship. Food became less a commodity, more a commons.

Across regions, the three strands met in a single challenge: living within the limits of local bioresources. Communities set rules on harvesting, water use, and rotational grazing; growers shared data to judge what ecosystems could regenerate; and diets shifted toward what local soils, forests, and waters could reliably provide. Organic waste, seaweed, and fishery byproducts were cycled back into farms and ponds, turning necessity into circularity. Resilience took shape through these trade-offs – messy, negotiated, and grounded in place.

But the pattern was not even. Community-owned microgrids, powered by wind, water, sun, and biodigestion kept the lights on in many places – but capacity was finite, and energy rationing became part of daily life, limiting energy-intensive industry. Remote rural areas stayed isolated by patchy connectivity and poor roads. Few regions could sustain the scale needed for cheap meat or lab-grown analogues; most met their protein needs with local pulses, nuts, small pelagic fish, or bivalves.

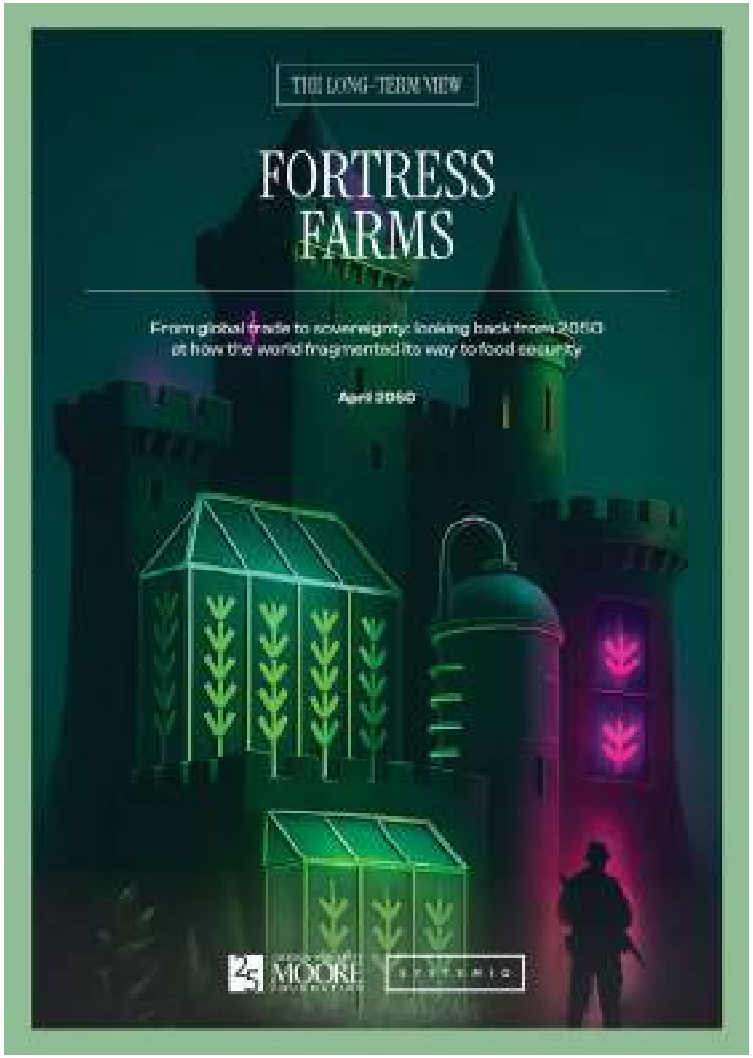


Diets narrowed in choice but shrank in carbon footprint. But as production localized, ecological pressures surfaced: reduced efficiency and the drive for self-sufficiency left too little land truly untouched, with lower yields pushing cultivation into nearby high-biodiversity areas. Where climate stress stripped resources and trust, forests fell to fire and chainsaw, and armed groups moved in. And with limited global coordination, pests crossed borders unchecked, while droughts in one region emptied rivers, driving price spikes and migration in another. In some regions, "local" hardened into exclusion, turning self-reliance into a gate that shut out migrants and the displaced. Climate and water stress pushed tens of millions from their homes – farmers from salinized deltas, herders from desertifying rangelands, coastal families from flooded plains. Many found no durable resettlement, lingering in vast, under-resourced camps in border regions and peri-urban settlements where food security remained precarious. Yet even there, displaced communities improvised: container gardens, cooperative kitchens, small-scale aquaculture, and informal markets stitched together fragile forms of resilience. Migration became not a temporary shock but a structural feature of the food system reshaping demand, labour availability, and political stability across regions.

In some places, adaptation to climate change was forced – through displacement and loss. In others, it was deliberately built through local governance seeking to strengthen resilience. Diets shifted accordingly: in richer regions consumption still strained land and climate, but across much of the world food systems settled into lower-impact patterns out of necessity. Choice narrowed within places, yet diversity expanded across them. The result was a system that traded efficiency for local resilience.

By 2050, the world looked less like a machine and more like a living mosaic – mycelial threads binding diverse pieces into something whole. Food systems not uniform, but relational. The roots of resilience were not laid in policy halls or P&L statements, but in networks grown from the ground up. Trust, renewed. Power, re-patterned. Governance, re-routed. It was not the future we planned for, but one we learned to cultivate.





3: Fortress Farms

From global trade to sovereignty: looking back from 2050 at how the world fragmented its way to food security

THE fracture began not so quietly, with Trump, tariffs, and tempers. By 2035, it was official: the era of global food trade was over. Trade routes dried up. Multilateralism broke down. And when two large agri-commodity trading companies filed for bankruptcy in 2036, it marked the symbolic death of the global agribusiness age.

What rose in its place was a world of food fortresses – state -managed, innovation-driven, and fiercely inward-looking. In the face of climate shocks, export bans, and geopolitical mistrust, governments took charge of feeding their own. Innovation did not slow, but it splintered. Sovereign food tech became the new space race.

China went furthest – and fastest. What began with US-China trade frictions and price disputes with Brazil in 2025 gradually forced Beijing to diversify away from its two dominant suppliers. After innovation in the private sector, with China's largest pig farming companies adopting and proving low-soy feeds, Beijing had its first clear proof that domestic innovation could meaningfully reduce dependence on imported soy. This led China to rethink its entire protein strategy, from how it fed herds to how it fed people. China's 15th Five-Year Plan (2026-2030) and the accompanying subsidies, low-interest loans, and public R&D, super-charged the shift. China's protein production transformed far faster than the rest of the world expected, echoing the country's earlier breakthroughs in solar PV and electric vehicles, and sending shockwaves through global supply chains. The breakthrough in biomanufacturing quickly rippled outward – from livestock feed to agri-inputs to alternative meat. China's push for sovereignty was more aggressive and abrupt than anywhere else, but its logic soon spread as governments everywhere lost confidence in global cooperation amid the geopolitical turmoil of the 2020s and 2030s.

Elsewhere, the transition accelerated in different ways. In the US, agricultural policy swung decidedly protectionist, with federal support for vertical farms, solar-powered irrigation



systems across the Southwest, and AI platforms that accelerated the discovery of novel proteins and metabolic-support ingredients tailored to the country's growing GLP-1 user base.

In Europe, demographic pressures and ecological strain pushed transformation even further. Losing farmers to retirement and confronting persistent labour shortages, the EU expanded indoor horticulture and robot-enabled aquaculture and agroforestry, subsidising food production grown with AI and renewables. At the same time, rising food insecurity and environmental decline led Brussels to legislate reductions in animal protein and scale up regional agroecological landscapes. Legumes became central to northern European rotations, supporting dietary shifts and reducing import dependence. Strict quotas and marine reserves enabled the gradual recovery of regional fisheries. By 2050, Europe fed itself more sustainably, rebuilding pockets of ecological capital along the way.

In the Global South, the picture was more uneven. Where expensive technologies failed to reach, agroecology took root – not as a nostalgic return, but as a pragmatic response to volatile weather, rising input costs, and institutional gaps. From West African farmer cooperatives to Andean agrobiodiversity farmer peer-to-peer hubs, local knowledge networks revived polycultures, soil regeneration, and seed sovereignty, increasing food security without relying on costly tech stacks.

When the world split, capital split with it. International lenders fled volatile farm and fisheries portfolios, and reinsurers priced climate shocks out of reach. Governments filled the void. State banks channelled cheap credit to strategic local crops and biomanufacturing inputs, while parametric insurance schemes replaced global risk pools. These programmes kept producers afloat but created stark divides: wealthier states built robust risk-pooling systems, whereas lower-income countries relied on thin public budgets or compulsory self-insurance tied to state procurement. Food security became as much a fiscal feat as a technical one.

Across all regions, public health became an unavoidable pressure point. With ageing populations, shrinking labour pools, and rising obesity- and non-communicable-disease-related costs eroding productivity, governments could no longer treat nutrition as a secondary concern – it became a strategic economic variable. In the US, employers began covering GLP-1 drugs to protect workforce capacity as talent shortages deepened, and the medications reshaped food demand: diets shifted toward high-protein, low-calorie, low-sugar foods that supported weight loss and metabolic stability. AI discovery engines designed novel proteins, flavours, and metabolic-support ingredients optimised for GLP-1 users, while marketing increasingly flowed through AI health advisors rather than traditional advertising. China quietly restricted unhealthy UPFs and redirected subsidies toward reformulated, lower-calorie lines to curb escalating healthcare burdens. Alarmed by The Lancet's UPF 2025 series, Europe and Brazil tightened labelling rules and taxed high-sugar products, driving a gradual decline in UPF consumption and production. In a world where each region depended more heavily on its own people to sustain its economy, keeping populations healthy became as important as keeping supply chains functioning.

As regions diverged in their agricultural strategies, one force cut across borders more than any other: the rapid spread of cheap renewable energy. A technological breakthrough in 2033 made solar power and battery storage inexpensive, modular, and easy to deploy. Instead of restoring global integration, it enabled countries to double down on self-reliance in food. Saudi Arabia and the UAE built desalination-powered food zones – vast indoor farms cooled by solar energy and irrigated from the sea. In East Africa, decentralised microgrids powered climate-controlled greenhouses and aquaculture systems less vulnerable to weather extremes, local fertiliser production, and small-scale processing hubs.

Yet this transition came with its own dependencies. The surge in solar, battery, and electrolysis technologies drove unprecedented demand for lithium, nickel, copper, and rare earths. Not all nations could meet their critical-mineral needs at home, keeping trade alive even as food routes collapsed. But the drive to



reduce import dependence also pushed some governments to open up ecologically sensitive regions for mining, extending the footprint of sovereignty into high-biodiversity frontiers.

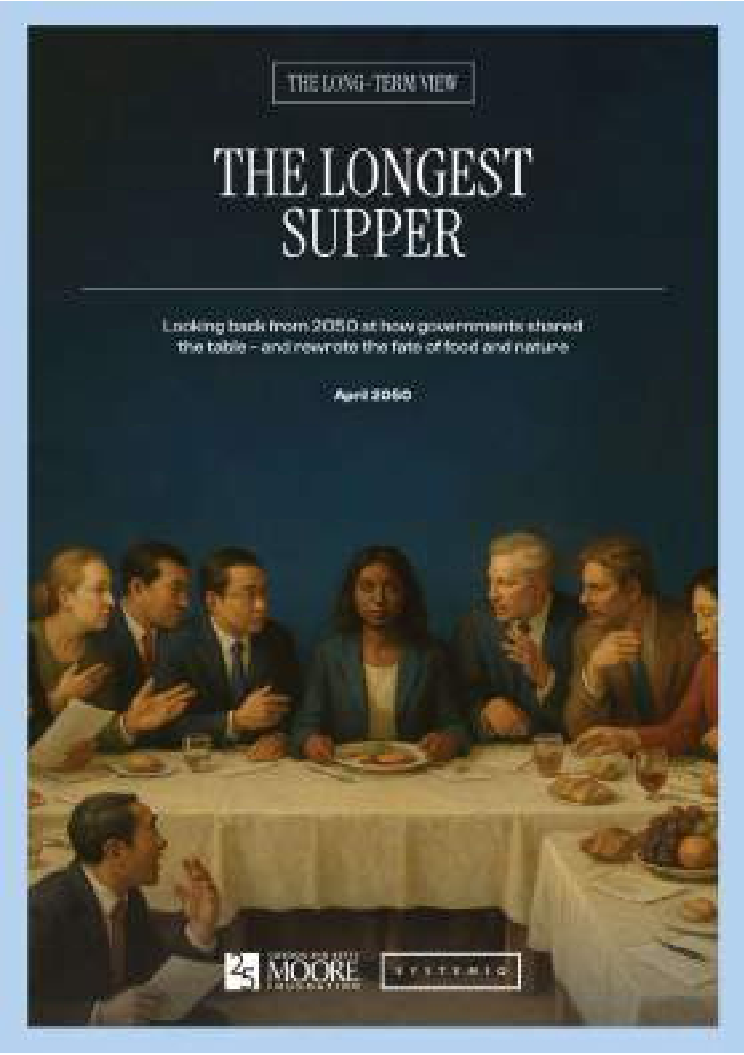
But critical raw minerals were only part of the picture; the struggle to manage land and bioresources under fragmentation proved just as consequential for nature. Despite policies to curb obesity and overconsumption and the rise of more efficient protein systems, many governments still leaned heavily on their land and seas to supply bioresources – food, feedstocks, fibres, fuels, and materials – needed for domestic sovereignty. In regions with weak governance or limited capacity, this led to intensified expansion into high-biodiversity landscapes and seas, and the steady erosion of ecosystems that once depended on shared stewardship. And without global standards or trusted reporting, private nature finance flowed toward jurisdictions with the cleanest data and strongest enforcement, not toward the biomes most at risk. As a result, while some ecosystems thrived, vast transboundary systems such as the Congo Basin and the high seas continued to degrade in the absence of coordination. The world ended up with pockets of well-funded restoration surrounded by regions still in decline.

Climate and water stress proved among the most destabilizing forces of all. As degraded soils, collapsing fisheries, and depleted aquifers rendered once-productive regions unviable, tens of millions were displaced. Rather than renewing multilateralism, these movements deepened fragmentation. Borders tightened, asylum narrowed, and food security policy fused with national security doctrine. Camps and informal settlements swelled at frontiers, while selective labour migration became a strategic tool for wealthier states. Mobility did not reconnect the world – it reinforced the fortress.

As governments turned inward in the 2020s, many leaned on short-term fixes to secure food supplies. They converted more land to agriculture and intensified input use. Over time, as they realised the negative impacts of these fixes, longer-term strategies began to take hold in some countries, from resilient and climate-smart farming systems to protein diversification that reduced pressure on land.

By 2050 the system is somewhat less carbon-intensive than it was in the 2020s, but it remains beyond ecological limits and its impacts are felt unevenly. The food system is indeed more resilient in some places, more precarious in others. The world feeds itself – but not together. Food is safer, more local, and tightly managed. But innovation without cooperation has a cost: duplication, exclusion, and chronic inefficiency. And like all fortresses, today's food systems offer security – at the cost of unity. Defended, but divided.





4: The Longest Supper

Looking back from 2050 at how governments shared the table – and rewrote the fate of food and nature

THE world did not unite over values. It united over fear. In the late 2020s and early 2030s, a series of overlapping shocks – crop failures in the US Midwest and China, heatwaves in Australia, India, and Europe that killed both people and livestock – forced the world's hand. Grain shortages from 2029 to 2033 triggered mass migration but also the largest coordinated food aid deployment of the modern era. The machinery of multilateralism, long dormant, began grinding back into motion.

From that chaos emerged the architecture of today's food system – one no longer driven solely by market logic or national silos, but by a renewed effort at coordinated government leadership. Slowly, new regional and cross-regional blocs formed or solidified. An early hint of what was possible had come even before the grain crises fully broke: at COP30, when the Tropical Forests Forever Facility (TFFF) – launched just as global cooperation was fraying – nonetheless managed to unite more than 50 forest countries behind a long-term, performance-based conservation fund. At the time, it looked like an outlier; in hindsight, it was a precursor.

In the years that followed, cooperation widened. The African Food Compact, the South Asia Resilience Alliance, and the Brazil-China-EU Healthy Diet Accord – later championed by the G20 – created platforms for collective action. The UN's World Food Convention of 2035 laid the groundwork for a new global food governance framework, spawning the Food Systems Stability Board (FSSB) – loosely modelled on its financial counterpart from 2009. The FSSB took on the unglamorous but essential task of monitoring systemic risk. It tracked climate shocks, price volatility, trade restrictions, and supply chain concentration – then issued early warnings and convened governments to act. By 2045, its dashboard had become a quiet reference point for sovereign lending, trade terms, and even private investment strategies.

Private capital and innovation did not vanish – but were recalibrated. Guardrails emerged across jurisdictions, targeting monopolies in AI and data, seeds, and junk foods.



New frameworks made it so that if a technology could not reach the bottom 50%, it could not scale rapidly. As a result,xxxxgene editing and synthetic biology advanced – but under tight scrutiny, and far slower than private investors had hoped.

Multilateralism did not just resurface – it restructured. The IMF began tying access to finance to subsidy

repurposing plans, encouraging governments to phase down harmful support and scale up regenerative production and sustainable use of marine resources. The World Bank updated its lending frameworks: countries with credible plans for subsidy reform, or deforestation-free and overfishing-free commodity supply chains gained preferential terms. Meanwhile, concessional climate finance – through institutions like the Green Climate Fund – became a key channel for supporting food system transformation in climate-vulnerable countries, linking finance access to progress on nutrition, resilience, and emissions. Concessional capital was essential while markets ignored the value of natural and human capital; but once these were embedded in trade rules and investment decisions – because they proved critical to supply-chain resilience – commercial lenders could finally price them in, allowing sustainable commodity finance to become an instrument of change at scale.

Countries of the African Food Compact, for example, made agroecology a pillar of their investment strategies, recognizing its potential to reduce input dependency, build drought resilience, and strengthen rural livelihoods. By 2045, agroecological systems covered 1/3 of the region's agricultural land, supported by public extension services and farmer peer-to-peer learning networks.

Technology found new purpose through public coordination. Instead of billion-dollar food tech unicorns, the real breakthroughs came through global cooperative innovation. The innovation curve is gentler, but broader. A global infrastructure of open-access food and climate data helped farmers and fisheries adapt to shocks and enabled real-time supply chain transparency. Carbon pricing, deforestation disclosure, and nutrition standards became embedded in trade agreements and upheld through reformed World Trade Organization rules. It did not end trade – but it changed the rules. A new level playing field emerged, rewarding low-carbon, regenerative producers.

But the new architecture of rules and data needed something more: resources to help farmers actually meet the standards being set. What began in late 2020s as a small export levy on selected commodities in Latin America – a so-called "1% Fund," modelled loosely on levy structures long used in sectors like steel and mining – slowly expanded across major exporting regions and, by the 2040s, had become a standard fixture of global commodity governance. Its logic was disarmingly simple: Codex Planetarius, a new set of minimum environmental standards modelled on Codex Alimentarius, could only work if the farmers at the bottom of the performance curve had the means to improve. The levy created a pooled transition fund that channelled resources to the highest-impact 20% of producers – those driving most soil degradation, water pollution, deforestation, and overfishing but also the least able to bear the cost of compliance. It was not a race to the top, but a slow, collective climb toward a shared environmental floor. Over time, the mechanism helped previously excluded food producers adopt basic digital monitoring, regenerative practices on land and at seas, and low-cost inputs, reducing systemic risk without collapsing local livelihoods.

One of the system's quiet enablers was energy. Breakthroughs in solar and battery storage in the early 2030s brought abundant, cheap power – used not just for mobility and computing, but for farming. Across the Middle East and North Africa, solar-powered desalination corridors enabled regional food independence. In Sub-Saharan Africa, decentralized microgrids powered controlled-environment agriculture and aquaculture, green fertilizer production, and local processing hubs. Energy abundance helped lift long-standing infrastructure constraints and buffer food production against climate volatility – once governance and coordination caught up.

But abundant clean energy brought new pressures – and early missteps. The first wave of mineral demand triggered rushed extraction, including destructive deep-sea mining projects that governments later admitted had caused irreversible ecosystem loss. At the same time, rising demand for biomass as fuel for cars and aviation, and as feedstock for plastic alternatives, pushed some regions into overharvesting and land conversion. Only after these failures did coordination catch up. In the late 2030s, governments finally converged on a set of shared rules: mineral recycling mandates and coordinated stockpiles to ease supply volatility, and global biomass standards that



prioritised residues and the ocean bioeconomy to limit expansion into intact ecosystems. These measures did not erase earlier damage, but they prevented cascading crises and brought both mineral and bioresource use back within ecological limits.

Nature governance followed similar patterns – slow to start, and only taking shape once crisis finally forced clarity. A 2039 international ruling that held a deep-sea mining consortium liable for ecocide in the Arctic catalysed a wave of reform. Through the 2040s, more than fifty countries granted legal rights to key ecosystems and agreed on shared definitions to recognise those rights across borders. This enabled coordinated restoration funding, nature-as-infrastructure investment, and formal roles for Indigenous and local guardianship. But progress remained uneven. Several major economies still reject ecocide statutes, allowing firms to operate under weaker rules, and court-ordered remediation rarely covers the full cost of damage.

Ultimately, building a more coordinated system did not make its trade-offs disappear. The objectives were never simple. Governments aimed to balance food security, health, and environmental sustainability – but trade-offs were inevitable. Citizens pushed back when some foods became pricier. Over time, governments responded not only by shifting subsidies, but by reshaping the food environment itself. Advertising restrictions on unhealthy products tightened; reformulation standards steadily reduced harmful ingredients; public procurement and fiscal policy made plant-forward, climate-smart options the default in schools, hospitals, and urban retail. Ultra-processed foods did not disappear, but most were reengineered to compete on nutritional performance rather than indulgence alone. Today, healthier and lower-carbon foods are often simply cheaper. Consumer choice did not vanish – but it operates within guardrails designed to align individual incentives with collective goals.

By 2050, the global food system is more cohesive – and arguably more just. But it is not utopia. While climate shocks were the catalyst for coordination, they still test its limits. Shared rules, standards, investment, have gradually bent the trajectory of emissions, deforestation, and ecosystem decline, though recovery came slowly and never fully outran the damage already set in motion. Bureaucracy lagged behind urgency.

When everyone has a seat at the table, the meal is slow to serve. Consensus fed fairness, but starved speed. Still, the meal – however delayed – is finally being shared. The world eats more equally. Just not more easily.

