

Making Finance Work for Food



Financing the Transition
to a Sustainable
Food System

September, 2021



FINANCE FOR
BIODIVERSITY
Initiative

Prepared in collaboration with the Food
System Economics Commission (FSEC)



Food System
Economics
Commission

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About this report

This is the first Finance for Biodiversity (F4B) report covering the interplay ('nexus') between food and finance. It has been prepared in the context of F4B's collaboration with the Food System Economics Commission (FSEC), and as a contribution to the UN Food Systems Summit, as well as ongoing international climate and biodiversity negotiations.

This report describes the current nexus between the global food and financial systems and explores how the two can be better aligned to deliver an inclusive, healthy, and environmentally sustainable food system. Building on F4B's broader work on nature and finance, it is accompanied by one supporting literature review, based on over 400 sources and outlining the major ongoing debates on the food-finance nexus.

The report was prepared by Simon Zadek, Andreas Merkl, and Felipe Posada, with contributions from Rupesh Madlani, Nicolas Solonakis, and Pippa Wisbey. It has benefited from insights and comments from many colleagues and partners, including Jean-Paul Adam, Alex Barkawi, Tim Benton, Eugenio Diaz-Bonilla, Jason Eis, Marcelo Furtado, Franziska Gaupp, Ravi Kanbur, Per Klevnas, Rachel Kyte, Benoît Lallemant, Justin Mundy, Jeremy Oppenheim, Mattia Romani, Vera Songwe, Johan Swinnen, Bryan Vadheim, Shally Venugopal, and Helena Wright. Our thanks go to FSEC's Principals, Commissioners, knowledge partners, and the Secretariat for their insights and help along the way. The contents of the report, including any errors and omissions, remain the responsibility of the authors.

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About Finance for Biodiversity



F4B's goal is to increase the materiality of biodiversity in financial decision-making and so better align global finance with nature conservation and restoration.

Our work on the food-finance nexus draws from the entirety of our portfolio, which is organised across five workstreams:

Market efficiency and innovation: including a leadership role in the Taskforce on Nature-related Financial Disclosures (TNFD), and support to a number of data and fintech-linked initiatives.

Enhanced liability: focusing on extending the legal liabilities of financial institutions for biodiversity outcomes, such as extended use of anti-money laundering rules.

Citizen engagement: public advocacy and campaigning, and advancing digital approaches to catalysing shifts in citizen's financing behaviour.

Public finance: advancing measures and advocacy linked to stimulus and recovery spending, and the place of nature in sovereign debt markets.

Nature markets: catalysing nature markets by developing new revenue streams and robust governance innovations, including the governance of voluntary carbon markets.

F4B has been established with support from the MAVA Foundation, which has a mission to conserve biodiversity for the benefit of people and nature. F4B's work benefits from partnership with, and support from, the Children's Investment Fund Foundation (CIFF) and the Gordon and Betty Moore Foundation.

For more information and publications, visit www.F4B-initiative.net

About FSEC

The Food System Economics Commission (FSEC), an independent scientific commission, is developing a report to address the economics and political economy of the food system transformation towards sustainable, inclusive, health-supporting and resilient food systems, contributing to achieving the Paris Agreement and Sustainable Development Goals.



Food System
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Commission

For more information, visit www.foodsystemeconomics.org



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Contents

Key Perspectives	5
1 Purpose and Perspectives	7
2 The Inevitable Transition	8
3 Disruptive Transition Scenarios	10
4 Finance Impacts	15
5 Getting Financialisation Right	23
Endnotes	30
References	33

Exhibits

A Getting the Right Financialisation of Food	6
1 Purpose and Premises	7
2 Assumptions on AP penetration	11
3 Disruption Scenarios of Alternative Protein	13
4 The Meaning of Financialisation	15
5 NCREIF Farmland Index - Growth in Market Value and Property Count, 1991-2017	17
6 Spectrum of asset strategies across the global food and agriculture value chain	18
7 Evolution of venture capital investments in AgriTech	18
8 Food System Meets Finance System	20
9 Shaping Global Finance - Emerging Lessons from Recent Practice	24
10 Getting the Right Financialisation of Food	25
11 An Applied Research Agenda	28

Key Perspectives

Today's global food system is unstable and destructive, driving an inevitable transition

It is battered by our changing climate, and is a major contributor to climate change, both through its own carbon emissions and by being the single biggest cause of biodiversity loss. It provides low quality, low paid jobs, and fails in its ultimate purpose of delivering affordable healthy food to all.

The transition must be rapid, fair, and safe

Ensuring a rapid, fair, and safe transition will depend on our actions. We need to move towards a system that produces affordable healthy food in ways aligned to climate and nature goals, whilst avoiding transition risks such as widespread bankruptcy, devastating rural unemployment, and increased food prices, poverty and inequality.

The transition is delayed and diluted by unproductive debate

Resistance to change from those who profit from today's food system, and those rightly seeking to protect the vulnerable, needs to be overcome by recognising the complementarity of apparently competing visions, such as regenerative agriculture and soilless food production, and the relative merits of private and public financing.

Global finance shapes the food system

Public and private financing decisions, including citizens' consumption choices, shape how the food system impacts people and the planet, in determining production systems and technology choices, climate and nature impacts, the economic value created and its distribution, and the quality and cost of food.

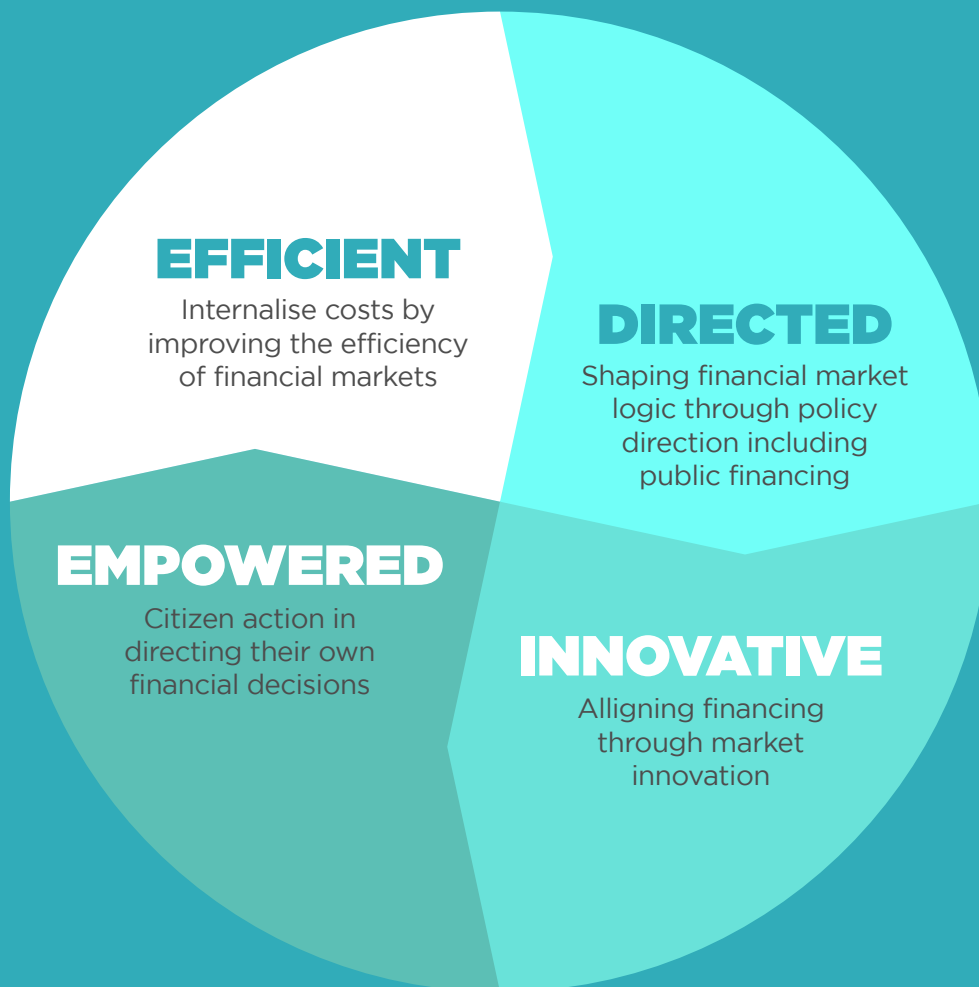
Getting financialisation right is a pre-condition for an effective food system transition

Crowding in deeper levels of private capital, at all stages of the food system, is needed to support the transition. But 'more private finance' alone is an insufficient condition for ensuring that the transition itself is rapid, fair, and safe, or that it will lead to an inclusive, sustainable, healthy food system.

Financialisation can be shaped to support the right transition

It is completely possible to get financialisation right, requiring action across four key fronts in aligning global finance to support the transition to the food system we need, internalising costs, policy action (summarised in Exhibit A).

Exhibit A
Getting the Right Financialisation of Food



The power and impact of financialisation is a choice, with four critical clusters of levers that can shape it to support the food systems that we need.

1. Financial policies and regulation, reinforced by shareholder and public activism, must drive the internalisation of nature and climate impacts into financing decisions, stranding dirty assets and accelerating green-friendly investments, so triggering a shift towards more nutritious food production.

2. Financial innovation, including blended public and private financial solutions, are needed to accelerate investments in, and drive down the costs of, healthy food produced by climate- and nature-friendly forms of farming, using scalable instruments equivalent to the feed-in tariffs used to great effect in catalysing renewables investments.

3. Policy and public finance are needed to protect and retool those whose rural livelihoods are eroded during the transition, providing technology, skill development and capital to enable them to secure decent livelihoods, where possible owning and operating commercially viable regenerative and soilless food production and associated parts of the food value chain.

4. Encourage citizen action as the ultimate owners and intended beneficiaries of the world's finances, including harnessing digital opportunities to empower and nudge citizens' behaviour, as consumers in the adoption of improved, sustainable diets, and also as savers, pension policy holders, and voting tax-payers in ensuring the smarter use of their money.

1

Purpose and Perspectives

Finance for Biodiversity (F4B) has partnered with the Food System Economics Commission (FSEC)¹ to explore the nexus between food and finance. The nexus has been subject to many explorations, past and present². Most focus has been placed on specific topics, such as financing for small farmers, and the cost and impact of agricultural subsidies. Curiously, the data and associated research on overall investment flows into the food system remains patchy at best³.

Broader efforts have tended to focus on estimates of the investments needed to support the transition to a more inclusive, sustainable food system, notably the work of the Food and Land Use Coalition (FOLU) and its partners⁴. In considering the systemic aspects of finance and food, most research to date focuses on the risks and problems associated with the growing role of private finance, or ‘financialisation’, in shaping food system outcomes⁵.

In this paper, F4B seeks to bridge these two latter themes by considering how “*global finance can be shaped to support the transition to an inclusive, healthy, sustainable food system.*” As the first product of the F4B and FSEC partnership, it highlights how global finance shapes the food system, and how the workings of finance can be shaped to accelerate progress in delivering the food system we need.

This interim report is accompanied by a literature review that sets out the results of one of the most extensive review of the food-finance literature undertaken to date.

The next phase of work will seek to quantify the potential impact of such interventions, thereby extending the range of executable policies available at the food-finance nexus.

Exhibit 1

Purpose and Premises

PREMISE 1

Global finance is a significant shaper of today's food system

PURPOSE

“To determine how global finance can be shaped to support the transition to an inclusive, healthy, sustainable food system”

PREMISE 2

Global finance can be shaped to accelerate the desired food system transition

2

The Inevitable Transition

Our food system is simply unsustainable.

Food is more affordable to more people than ever before. Moreover, the food system has, in the main, delivered throughout the extraordinary global disruption caused by the ongoing pandemic⁶. Some sustainable forms of farming have begun to emerge. The vast bulk of the food system is not sustainable⁷, however, measured variously by diminishing soil capacity⁸, escalating obesity and diabetes⁹, deteriorating farmer income¹⁰, rural exodus¹¹, and the food system's negative contributions to climate change and the catastrophic decline in biodiversity, such as insects¹².

Estimates of the annual costs of such negative impacts amount to an astonishing US\$12 trillion¹³. This is more than double the International Monetary Fund's (IMF) estimates of the entire, annual, negative, externalised costs of the world's carbon-intensive energy system of US\$5.3 trillion¹⁴. Moreover, it exceeds estimates of the measured economic value of the global food system of about US\$8 trillion annually¹⁵.

If the global food system was a business or economy in a world where the polluter paid to clean up its own mess, it would be insolvent.

Unsustainability is driving an inevitable transition in the food system.

Such unsustainable impacts and costs are driving an inevitable transition, for better or worse, driven by three meta forces:

- *Health costs and quality concerns.* Pressure on the over-consumption of meat, sugar, and unhealthy ultra-processed foods has been steadily growing across the world¹⁶, crystallised through alternative product offerings, consumer backlashes, regulation, litigation, and other liabilities.
- *Climate change and natural degradation.* Accelerating climate change and consequent extreme weather events, and degradation of natural capital will increasingly interrupt and degrade harvests¹⁷, pushing costs, productivity, supply security, and price volatility in the wrong direction.
- *Access and affordability.* Supply disruptions caused by climate and nature effects are increasingly creating food security concerns and outcomes, and increased food prices, exacerbated by the ongoing effects of the pandemic¹⁸.

Emergent approaches to transitioning are promising but remain small scale.

Responses to this unstable and destructive situation are many and varied. Changes across the spectrum range from growing incidents of food riots, consumer campaigns and farmer demonstrations, to increased food prices, the supply of better-quality food in upper market segments, and the growth of zero hunger initiatives¹⁹.

The most visible face of growing interest in sustainable farming has been in regenerative agriculture, with more recent interest in next generation, industrial farming. This is evidenced by surging investments in soilless farming, including 'alternative proteins'²⁰ (plant-based proteins, cultured meat, myco-protein, and insects) and 'controlled-environment agriculture' (often referred to as 'vertical farming').

Rapid transitioning is necessary but comes with its own risks.

There is broad consensus on the need to transition to a global food system that provides affordable, healthy food for all, is sustainable in terms of net-zero climate and nature positive biodiversity goals (i.e. viable, not only contributing to meeting these goals), and is inclusive in providing decent livelihoods.

Disruptive transformation is a language used widely in the context of urgent climate and other challenges, notably about the clean energy revolution and its spill-over into mobility and the built environment. It is also language used in relation to food, where there is a common cause on the urgency of making large-scale changes. Given the existential significance of food supply and the almost half a billion people gaining livelihood through their involvement in the food system, there are, however, profound concerns as to the potential unintended consequences of encouraging disruptive change.

Driving true and fair costs into the food system's accounts, for example, without mitigating actions, could trigger unintended, and potentially disastrous consequences.

- Political pushback to taxing 'bad' food such as excess sugar and salt has, for example, used the argument that it would most adversely affect food prices for poorer consumers.
- Forcing food producers too rapidly to pay for their climate and nature impacts could lead to bankruptcy and severe food supply disruptions. Recent Dutch farmer demonstrations, for example, have focused on the negative business impact of new climate-related rules governing nitrogen runoff²¹.
- Food security has re-emerged as a matter of national security - after decades of confidence in the international trade system - as a means of ensuring an ample supply of food. Increased crop damage due to climate change and nature's decline, combined with increased geopolitical tensions across the international trade system, could easily translate into food shortages and price spiking for many developing and developed countries²².

The challenge is not whether a massive transition will occur, but when and how it might happen, and its consequences for people and planet.

Polarised debate delays and dilutes a deliberative transition.

Polarised, heated debate sets possible parts of a viable transition strategy against each other. For example:

- Advocates of small and regenerative farming critique leading-edge technologies in soilless agriculture, rather than considering their complementarities²³. For example, Guardian journalist George Monbiot has embraced soilless agriculture - what he chooses to call 'farm free' food production - assuming that it will lead to the widespread destruction of farming jobs, whilst permitting rewilding and carbon drawdown²⁴.
- Private finance is counter-posed to public finance, despite the apparent fact of, and need for, huge flows of private finance, and the need to realign public finance to support the necessary food system transition. For example, Jennifer Clapp and others point rightly to the dangers of allowing the logic of private capital alone to shape the food system²⁵, without noting the critical role it has played, for example, in the clean energy transition.

Such entirely understandable concerns are likely to reinforce policy stasis and fragmentation, limiting domestic and regional coherence, let alone ambitious international cooperation.

Inertia and active resistance to change is resulting from the combined effects of these debates, and the economic fears of incumbent interests and concerns over the welfare of vulnerable small farmers and communities.

3

Disruptive Transition Scenarios

The clean energy transition is an instructive experience.

The most disruptive, scaled, contemporary transition of any core global sector is without doubt the movement from fossil fuels intensive to clean energy. There are lessons to be cautiously drawn from this experience in considering the food system transition, although the food system is arguably more complex and diverse.

The disruptive transition occurring in the energy sector results from a complex interplay between policy, technology, and market innovations. Critically, the energy transition pathway over the past two decades has been multi-tracked, including truly disruptive elements (wind, solar, electric vehicles (EVs)) but also more incremental strategies involving natural gas conversions, internal combustion engine (ICE) fuel standards etc. Although primarily associated with the falling cost of renewables, the scale-up of clean energy was front-loaded and ultimately accelerated by the impact of key energy and climate policies supported by scaling instruments such as feed-in-tariffs and efficiency/portfolio standards²⁶.

On the darker side, there is little doubt that many have, to date, been left behind, despite efforts to advance clean energy for all, such as through SE4ALL²⁷. Indeed, the second generation of policy and market effects, notably incorporating climate risk into investment decisions and instruments such as sovereign credit ratings, are likely to disadvantage further largely poor, climate-vulnerable countries and communities²⁸. Recent moves by the European Commission and others to advance carbon border adjustment tariffs may exacerbate such unfair outcomes without countervailing policy measures²⁹.

Food system transition may have some comparable features.

The food system transition is analogous in some ways. Just as the clean energy revolution aims to deliver universal access to affordable, reliable, sustainable, and modern energy (SDG7), the food system transition also needs to deliver universal access to healthy food produced in a sustainable manner, through the fruits of decent livelihoods. Like the energy transition, the food system transition will involve the scaled application of new technologies. Some of them will be transformative, while others will deliver incrementally, perhaps over the shorter term, through improved health, climate, and nature outcomes such as improving efficiencies in water use, synthetic fertiliser, and pesticides.

Transitioning the food system is also likely to have its darker side. Forcing payments for climate and nature impacts will disadvantage many small farmers, and place commercial business models at risk. Indeed, entire communities and economies dependent on carbon or nature intensive food production may be at risk, at the very least temporarily. Improved food quality may come at a considerable incremental cost, at least to begin with, over today's low cost, unhealthy food supply.

Food technologies may be as important and disruptive as for clean energy.

Soilless farming is likely to play a significant role in the food system transition, including alternative protein (AP) and vertical farming sources (Exhibit 2). Many uncertainties and many differing views exist, mainly because both are early in their technological development and diffusion trajectories. For example, one recent study concluded that every tenth portion of meat, eggs, dairy, and seafood that is eaten around the globe could be made from alternative proteins by 2035³⁰. Yet just months later, Cargill's CEO, David MacLennan, predicted that "...in three to four years plant-based will be perhaps 10% of the [global protein] market."³¹

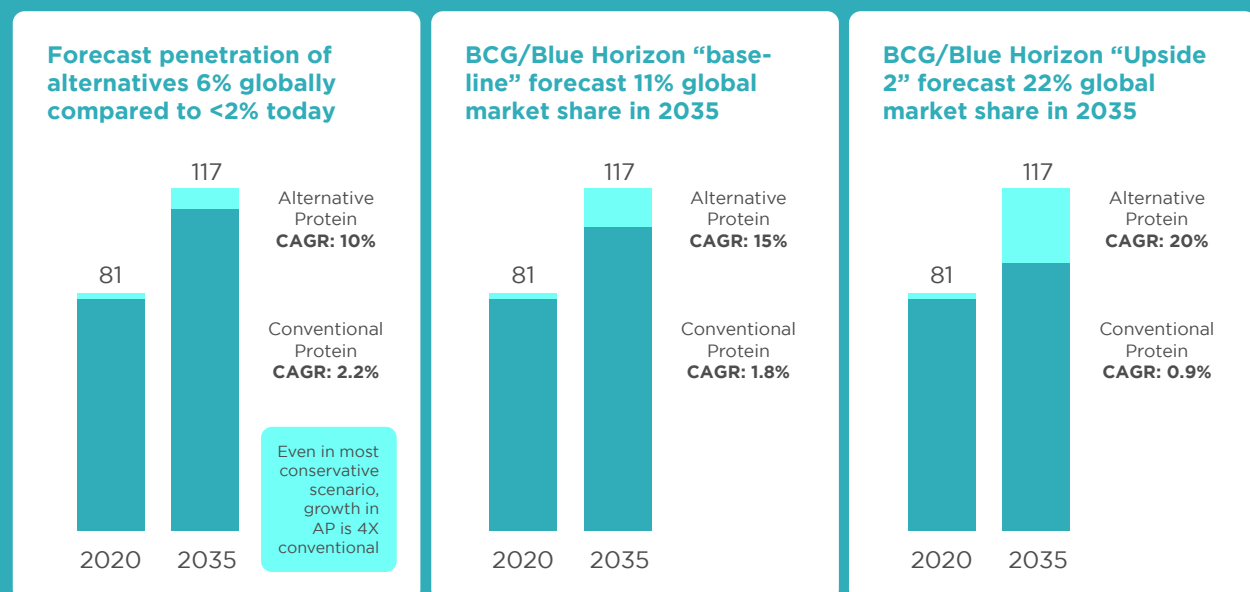
Exhibit 2

Assumptions on AP penetration

Based on BCG/Blue Horizon and amount of protein based on Material Economics modelling.

Protein for Human Consumption – alternative forecasts for scale-up of alternative proteins

Mio. tonne



Vertical farming, likewise, has to date proved commercially viable for high-value luxury items such as basil and marijuana production. Nevertheless, more recent developments indicate an imminent scaling and broadening of application in producing a wide range of organic, low carbon, nature positive food³².



Soilless farming is likely to impact the wider food system.

Clean energy is more than a smarter source of energy in that it is transforming how energy is used, with systemic consequences. Likewise, technology developments are likely to impact the wider food system, both its functional features and dynamics, and its normative outcomes. F4B has explored such systemic effects by working with Material Economics in building a set of sketch scenarios focused on the possible consequences of the growth of so-called ‘alternative proteins’^{33 34}.

Our sketch scenarios highlight the potential for very different pathways in the scale-up of alternative protein. On the low side, it turns out to be a niche phenomenon when set against total growth in demand for meat, seafood, and dairy products. At the other end, inexorable cost and performance reductions, broad consumer acceptance, and policy reinforcement combine to make alternative protein the go-to products for future protein baseload.

There are likely to be major implications for fundamental aspects of the food system’s functioning in moving from the minimalist scenario to the maximalist scenario. For example:

- The cascading impact of the growth of alternative protein on land use, resulting in large-scale land release. Alternative protein is up to 90% more land efficient than beef production, triggering changes in valuations and increased opportunities, for example, for regenerative agriculture rewilding approaches.
- Moreover, although the notion of ‘stranded assets’ used so powerfully in the clean energy space may not be directly applicable for the food system, growth in alternative protein may result in widespread bankruptcies and liability concerns in the incumbent industry, leading in turn to a redirection of capital flows, and new value pools changing the make-up of food system ownership³⁵.

Distinct but similarly disruptive scenarios can be presented for vertical farming, which can produce protein and other vegetable-based nutritional outcomes³⁶. Vertical farming can service alternative protein products, further reducing the need for land in plant-based alternative protein. Moreover, unlike alternative protein, vertical farming has significant locational advantages in being close to the consumer (hence the term ‘urban farming’), opening the way to localised ownership, mirroring approaches taken in the renewables field.

Exhibit 3

Disruption Scenarios of Alternative Protein



Soilless farming may have unintended negative consequences.

Soilless farming, like other aspects of any radical transition, has its darker, unintended consequences. Most obvious is the capital-intensive nature of the disruption, broadly mirroring the clean energy revolution and benefiting those with access to plentiful, cheaper capital. Likewise, although there are many jobs that would be created through a shift to plant-based diets, the higher capital intensity of soilless farming is likely to impact employment intensity or production, and overall employment levels in food production.

The technology cost curves may not 'automatically' deliver cheaper food in the first instance, enabling richer countries to benefit first by being able to afford subsidies (the equivalent of feed-in tariffs for renewables). This could deliver, in the worst case, improved health and climate/nature outcomes for those countries that can pay, closely linked to reduce demand for food supplies from some of the world's poorer exporting countries. Likewise, soilless farming does not automatically deliver lower market concentration, or more citizen and public interest purpose and outcomes. Indeed, capital intensity might tilt the disruptive wave towards greater corporate concentration, potentially undermining progress along the pathway to affordability for all.

That said, there is nothing inherent to the technology that favours venture capital or restrictive intellectual property regimes. It is a matter of public choice³⁷.

Disruption is inevitable, but what disruption, and with what impacts is a policy choice.

It is worth reiterating that today's food system is unsustainable, which means an inevitable transition. Given the system's current stresses, the likelihood is of a disruptive transition. Without actively shaping that disruption, the iconic symbol of the energy transition, 'stranded assets', will seem like a sideshow in comparison.

Polarised views, incumbent concerned interests, and high uncertainty and risks make it difficult to forge collaborative, ambitious action. It is, however, not impossible. For example:

- Compelling economics, once established, conquer all. Clean energy encountered all of these hurdles, and yet is on the path to replace fossil fuels in the next two decades.
- Good policy and citizen action can massively accelerate the commercialisation of new technologies, combining regenerative agriculture, alternative protein, precision agriculture, and soilless food production.
- If executed well, such action could support truly sustainable agriculture, advancing several key objectives including net-zero carbon, nature positive agriculture, more local ownership of production and distribution, shortened supply chains, fewer trading intermediaries, and improved nutritional outcomes³⁸.
- Demand-side disruption could be an essential feature of any transition scenario, from education and information to behavioural nudging to more aggressive incentives such as behaviour-calibrated health insurance³⁹.

Such central, normative scenarios need to be framed by a clearer understanding of winners and losers, potential unintended consequences, and how such risks and uncertainties can best be managed.

For example, the food transition is likely to marginalise or transform some incumbent interests and practices: the big players who benefit from unpriced externalities of industrial agriculture; the small farmers whose practices degrade their natural capital; the consumer who spends as if nature were unlimited; the climate stable; and the waste-free.

New winners will emerge, perhaps data-driven food titans analogous to Google and Apple, taking advantage of captive users, and more distributed and local networks of producers benefitting from the smaller scale economies of locally produced (soilless) food. Some incumbents will adjust, such as large traders who manage to rebuild their supply chains to the diversified offerings of regenerative producers, while others may perish.

Many factors will impact these and other outcomes, with our critical focus on finance's role.

4

Finance Impacts

Financing shapes the food system.

Finance has always shaped the US\$8-10 trillion global food system⁴⁰. Public finance, linked often to policy measures, has flowed to secure public goods, such as food security, and export competitiveness, the protection of farming livelihoods, affordable food and healthy eating, biodiversity protection and addressing climate challenges. The breadth and complexity of public financing belies any simple measure of its scale or impact. More targeted quantification and analysis is sorely needed, to go beyond the impact of agricultural subsidies estimated to exceed US\$500 billion annually⁴¹.

Private finance flows in pursuit of risk-adjusted financial returns, in the main, although there is a steady growth of funds seeking to blend traditional financial with longer-term impact goals, such as Ceres' 'Food Emissions 50' group of investors that aim to accelerate progress towards a net zero future in the food and agriculture sector⁴². It has driven the trade of physical assets such as land and trade finance critical for small farmers and global traders alike. More recently, private equity and venture capital funds have fuelled the agri-tech start-up community, including vertical farming, e-commerce platforms for purchasing seeds and grains, and microbial products to help farmers manage nutrients⁴³.

That finance shapes food system outcomes is a self-evident truth.

Exhibit 4

The Meaning of Financialisation

The meaning of financialisation is contested. In the main, the literature views financialisation as a negative development, despite the clear and accepted need for private capital in underpinning much, if not most, investment. Here we adopt a strictly non-normative definition as concerning an "increasing role of financial motives, financial markets, financial actors and financial institutions⁴⁴.

The food system has always been financialised.

Private finance has almost always been the dominant source of finance of the food system, just as policy interventions supported by public finance have been a key companion of such flows⁴⁵. That said, and despite an extensive literature about private finance and food, it is hard to get a 'bird's eye' view of the relationship.

- Institutional investors, to pension funds and insurance companies, have been the most active investors⁴⁶, followed by banks, sovereign wealth funds, and transnational agribusiness companies themselves⁴⁷.
- Institutional investors, notably pension funds, seem to primarily target farmland⁴⁸, grain and oilseed⁴⁹, row crops & permanent crops⁵⁰, while other investors are more active in the water market⁵¹.
- Banks have been more active in providing trade finance and financing, often with public support providing finance to smaller farmers.
- Private equity has increased its profile in land assets and led the charge in some farming technology areas, notably alternative protein and vertical farming⁵².

Whilst few aggregate estimates of financial flows are available, and illegal flows complicate any assessment, some data is available to help build a picture of the size of the nexus between private finance and food:

- The three largest agrochemical/seed companies were capitalised at about US\$170 billion⁵³, hinting at a total global capitalisation of the agrochemical sector around at least US\$300 billion. Farm equipment manufacturers were capitalised at US\$170 billion⁵⁴.
- Looking at the core of the large-scale commercial food sector, in 2019, the market capitalisation of the 100 largest food-related companies was about US\$1.7 trillion⁵⁵.
- The estimated investable universe of farmland globally is about US\$1 trillion⁵⁶, although it remains owned mainly by non-financial investors⁵⁷.

These high-level numbers suggest that the highest concentration parts of the commercial food system, plus farmland, have an aggregate capitalisation of about US\$3.4 trillion. This is more than the total market capitalisation of the global automotive industry, which is just over US\$2 trillion⁵⁸.

Financialisation of the food system has intensified.

Indications are that the financialisation of food is increasing; for example:

- Ten companies now own half of the world's seed market, and just four agribusiness companies control 90 per cent of the global grain trade⁵⁹.
- Such consolidation trends also concern farmland, about 65 per cent of which is now owned by one per cent of farmers and/or farming businesses⁶⁰.

Investors appear to play a significant role in this increasing concentration:

- The five largest asset managers own, variously, between 10 and 33 per cent of major agribusiness companies⁶¹, reinforcing market concentrations (see Exhibit 6).
- Sovereign wealth funds - public but in the main pursuing the logic of private capital - invested more than US\$100 billion in direct foreign investment since 2008⁶², buying almost 230 million hectares.
- Private equity investors see significant opportunities in local, fresh food in major urban areas (US\$565 million for indoor agriculture in 2020⁶³); in the provision of food security to areas with limited arable land; in the revolution of supply chain efficiencies; and, in particular, the emergence of alternative proteins from plant or fungi (US\$3 billion in 2020⁶⁴) and/or precision fermentation technologies (US\$435 million in 2020)⁶⁵.

These asset managers also play an essential role in the considerable - and ever-increasing - consolidation of the agri-food system⁶⁶, partly through shareholder activism and the pursuit of vertical integration strategies. Two recent examples of this are the DowChemical-DuPont merger in 2015 - mainly driven by an activist shareholder⁶⁷ - and the Bayer-Monsanto merger in 2018, both creating agrochemical giants.

Financialisation of the food system has been profitable.

Attracted by the growth of the middle-class populations and the corresponding demand for protein, the inelastic supply of land⁶⁸, and the currently bullish outlook on agri-tech innovation in both soil-based and soilless applications, investors have used an array of asset strategies in both public and private markets to invest. This is driving up valuations, and investors are being duly rewarded.

Agribusiness in the US is the second most profitable sector, after pharmaceuticals, aided by its receipt of high levels of agricultural subsidies. Equity investors have been rewarded, with the S&P Food and Beverage Index outperforming the S&P 500 for much of the last decade. Investors in commodities and land have similarly enjoyed healthy returns as trading doubled to US\$126 billion⁶⁹ between 2006 and 2011. Land investors have seen the NCREIF (National Council of Real Estate Investment Fiduciaries) US farmland index grow almost eight-fold from 2007 to 2017 (to US\$8.1 billion).

Financialisation's impact on the food system is highly contested.

Just as the growing size of global financial and capital markets has raised concern over the last half a century in many quarters⁷⁰, so too has its growing influence over the shape of the food system and its impacts⁷¹. Much has been said and written about the financialisation of the food system, mostly presented as a critique that has proved compelling to many, whilst to others both contestable and contested. The role of speculation in the food system in commodity markets and commodity index funds is a case in point. Some ascribe the unusual volatility⁷² of food prices in the years before and after the global financial crisis⁷³ to the tenfold increase in agricultural commodities trading between 2000 and 2011⁷⁴, and the 25-fold increase in climate-related investment funds between 2003 and 2008⁷⁵. Others challenge this view, finding no clear link between trading, speculation, and price volatility⁷⁶, claiming instead that increased volumes in globally traded food commodities are due to better market information and diversified hedging options, leading to lower levels of volatility⁷⁷.

Exhibit 5

Spectrum of asset strategies across the global food and agriculture value chain.

Source: Valoral Advisors

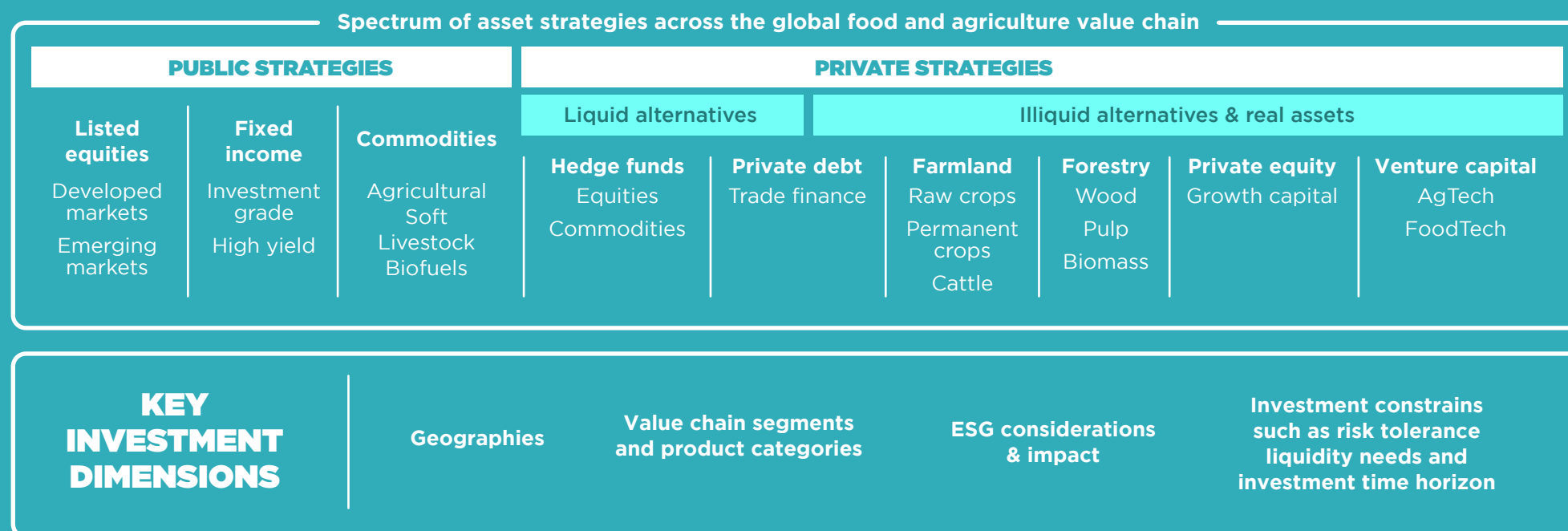


Exhibit 6

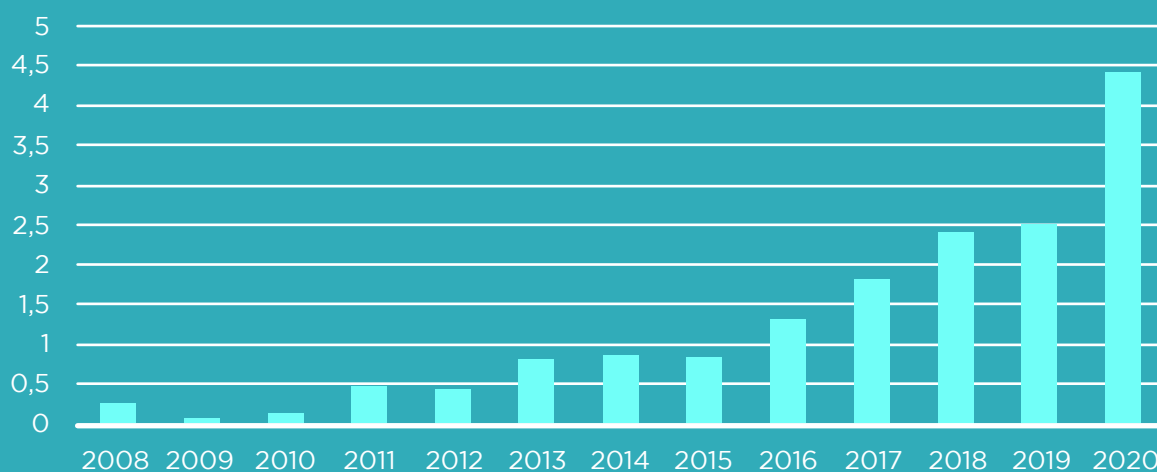
NCREIF Farmland Index – Growth in Market Value and Property Count, 1991-2017.

Source: NCREIF

**Exhibit 7**

Evolution of venture capital investments (in billion USUS\$) in AgriTech.

Source: Bloomberg



The evidence is mixed in part because of diverse circumstances, but also as a result of different analytic approaches, polarised perspectives, and starting points. Properly governed financial markets should direct capital to where it is most profitable. Advocates of ‘more is better’ therefore tend to treat private capital as an ‘essential, benign flow’, and highlight the benefits: increased capital flows; financial market efficiencies in the allocation of scarce capital; private risk capital driving technological innovation and underpinning capex intensive solutions in greening food production.

Such advocates of ‘more private capital is better’ tend to support the crowding in of private capital through the use of public finance as a means of de-risking private investors through risk transfer to the public purse. Such blended financing solutions can of course be important instruments for paying for public goods that the private sector should not reasonably be asked to fund. Yet the broader use of tax-payer’s dollars to de-risk private investors is certainly a hotly contested approach.

Such contestations come from those more broadly concerned about the downside risks of increased financialisation. Most accept that private capital has a legitimate role to play, and should earn a reasonable return in pursuit of productivity, efficiency, and innovation. Yet they point out that strategies to secure such returns are at best uninformed by the long-term consequences of investments on health, inclusion, climate and nature, and at worst profit directly from ignoring such impacts.

Such voices highlight, for example, the dangers of speculative markets, the evidence of noticeable increases in some market segments, and the spread between food, consumer and farm gate prices, suggesting increased oligopolistic behaviour and growing inequalities in the distribution of arising economic value. Importantly, and unlike most advocates of private financing solutions, such voices tend to consider finance not only as a flow but also as a system with its own logic, interests, and rules.

Global finance is so much more than a flow of funds.

The financial system is often understood as comprising the US\$400 trillion or so of financial assets created and allocated through the world’s financial and capital markets. Here, however, like the International Food Policy Research Institute (IFPRI), we take a more expansive approach. Global finance here is taken to include citizen expenditure (every dollar of consumer spending is a dollar invested in the system that produces that product or service); public sector spending, including international development spending and subsidies; and illicit financial flows (see Exhibit 8).

Finance is far more than this expanded lens on the flows of funds. Finance, like food, is a system, and as a system is the heart as well as the lifeblood of the global economy.

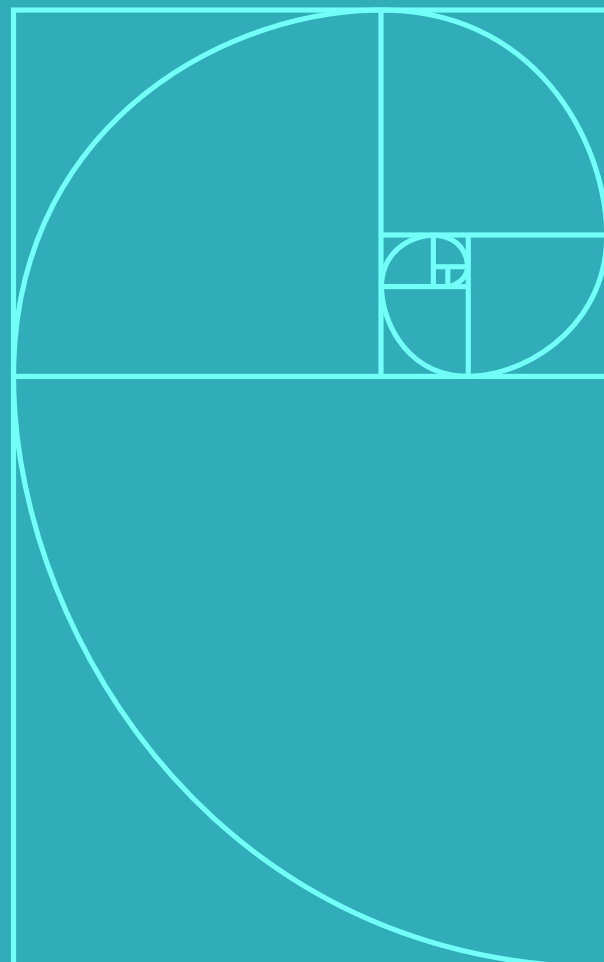
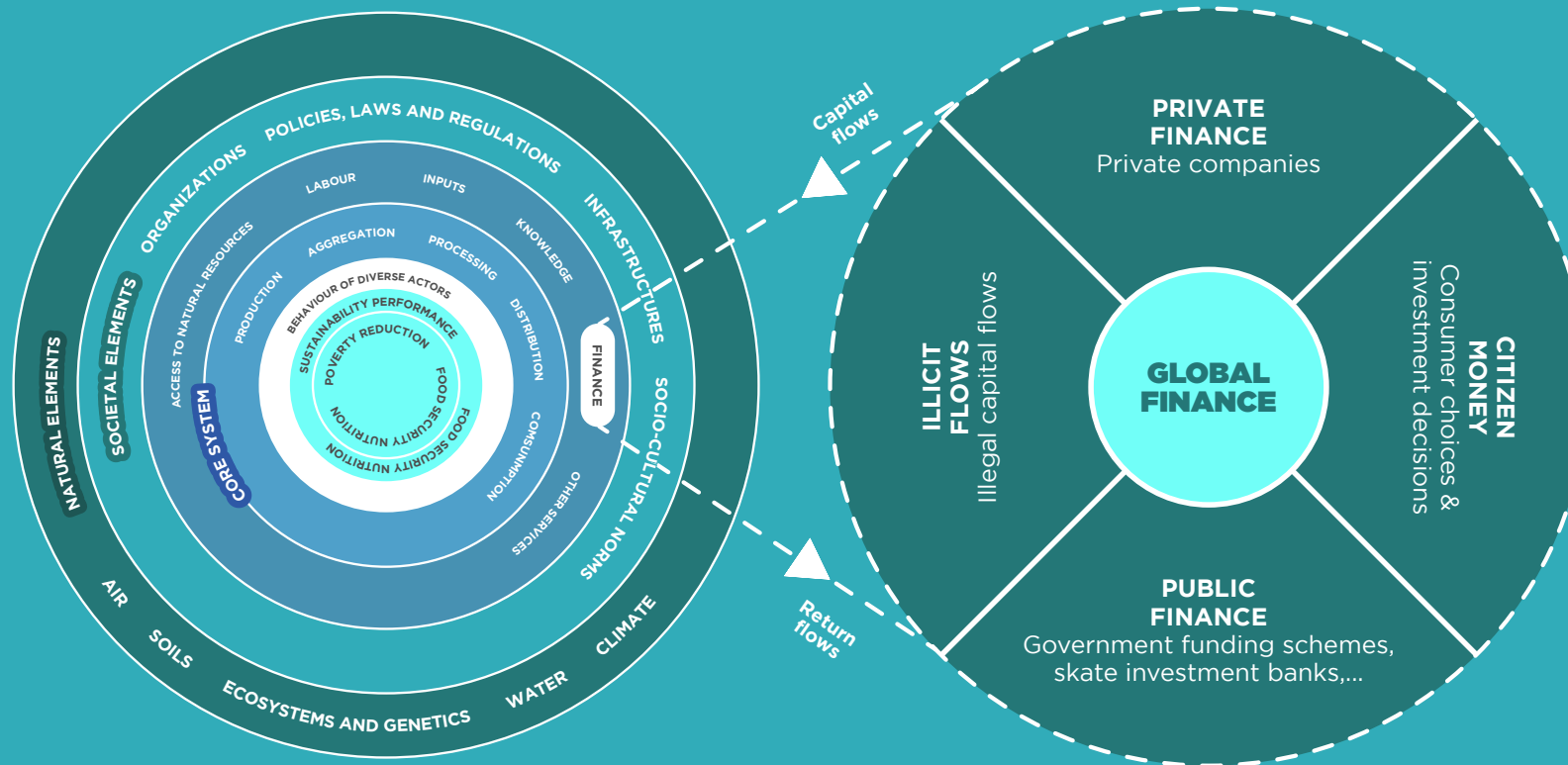


Exhibit 8Food System Meets Finance System⁷⁸**Finance and food are interconnected and inter-dependent systems.**

Financial motives, financial markets, public and private financial actors, financial institutions and financial governance increasingly shape our economic, social, and physical world.

The food system is no exception, shaped by the criteria on which finance is delivered, its scale, form and delivery effectiveness.

Global finance is so much more than ‘private capital flows’

Included are financial markets, flows, actors, markets, rules, and governing institutions.

Public finance, including fiscal flows and central bank operations and balance sheets.

Citizen’s financing as consumers, savers, lenders, insurers, pension policy holders and tax-payers.

Illicit financial flows of every kind.

The finance system includes flows and its users at one end, and capital owners or intermediate representatives of the intended beneficiaries of such flows, such as pension funds and governments at the other. But it is far more than this. The finance system is made of the many instruments and institutional arrangements that direct the mobilisation, creation, and deployment of funds⁷⁹. For example:

- When a banker makes a loan, she or he is influenced by the rules set by the Basel Committee on Banking Supervision (BCBS) as the 'primary global standard-setter for the prudential regulation of banks'⁸⁰.
- When a financial institution lends, invests, moves money or takes in deposits, it is following rules established by the Financial Action Task Force (FATF), the 'global money laundering and terrorist financing watchdog'⁸¹.
- Central banks, financial regulators, stock exchanges, accounting and other standards bodies all influence decisions across the world's financial and capital markets that channel and manage US\$400 trillion of assets.
- The introduction of climate risk assessment in the banking sector ('stress test' frameworks) which allows financial institutions to assess climate risks to support and seize opportunities from the transition⁸³.

It is a similar, albeit different, model for public finance. Here, sovereignty takes precedence, as spectacularly witnessed in the surge of public spending during the COVID-19 pandemic, with an unprecedented increase estimated at US\$15 trillion committed and spent, mainly over 18 months. Here too, both domestic and international rules apply, one way or another. A government-sponsored spending spree may generate inflation, increase its cost of borrowing, and eventually bring it into conflict with the international stewards of good fiscal governance, such as the IMF. Tax raising is a domestic affair but is governed by what citizens will accept. Although the percentages vary dramatically, tax-raising is ultimately tempered by the government's credibility in the eyes of the country's citizens.



Global finance is undergoing disruptive change.

Global finance, particularly private finance, is in a disruptive transition, driven by the intertwined effects of policy and regulatory oversight, digital disruption, and sustainability⁸³. Financial policy and regulatory oversight expanded dramatically in the wake of the global financial crisis of 2008, and has more recently extended to new frontiers such as cryptocurrencies and the flourishing - but until now under-regulated - non-banking financial services. The digitalisation of finance has been underway for several decades, but its emergence as a disruptive force has been more recent⁸⁴. Today, mobile platforms and data analytics are bringing sophisticated financial services to mass markets⁸⁵, and governments are digitalising public finance⁸⁶. In contrast, a third of US public equities trades are executed by computer-driven funds⁸⁷.

Sustainable development has moved into the mainstream of private and public finance, dramatically in areas such as climate and increasingly nature. Sustainability considerations are now omnipresent not only in pre-investment screening but across investment strategies, tools, indexes, disclosure requirements, financial stability considerations, and now form an intrinsic part of annual meetings, litigation, and board composition negotiations.

Such developments are translating into accelerating financial flows. Impact investing has grown rapidly to an estimated US\$715 billion in 2020⁸⁸, environmental, social and governance (ESG)-linked investing has expanded rapidly to an estimated US\$4 trillion⁸⁹, and green 'use of proceeds' bond issuance exceeds US\$1 trillion, involving cumulative growth of 60 per cent since 2015⁹⁰.

Finance as a system can and must be shaped.

These three core drivers - policy or more broadly the governance of finance, digital disruption, and sustainability - are increasingly converging to form a powerful catalyst to return, as Kristalina Georgieva, Managing Director, International Monetary Fund, has remarked "*...the financial services industry to what it is supposed to be - an industry that serves people*"⁹¹.

The opportunity, then, is to shape the financial system in ways that align financial flows with the needs of an inclusive, sustainable food system.



5

The right financialisation is needed

Financing shapes the food system.

The largely polarised debate between advocates and concerned voices about the food-finance nexus is ultimately counter-productive. In getting financialisation right, we need to combine the advocates' embrace of private finance with the critics' systemic approach to shaping the finance system for the public good.

Private capital, at scale, is needed to finance a transition to the sustainable global food system we need. Private capital in its rawest forms, unshaped by public purpose interventions, is, however, unlikely to deliver such a food system, as the critics point out. In most instances, blending public and private finance is a risk transfer to the taxpayer. A subsidy may therefore be relevant in some instances, such as front-loading investment in green technology or lowering the cost of healthy food for all. It may, however, also be comparatively expensive and ineffective as a general instrument, such as how best to encourage private investors to take account of carbon and nature externalities. Other methods, focused less on risk transferring subsidies and more on risk pricing, transparency, competition law, shareholder rights and enhanced liability, to name a few, may be far more cost efficient and effective ways of getting the job done.

Getting financialisation right is about applying what we already know.

Clean energy again provides a productive use case. In the early days of raising awareness about climate and seeking to crowd in private investment into renewables, the assumption was made that private capital needed to be attracted on its own, immutable terms. As one very senior international civil servant remarked in a closed meeting: *"We will provide subsidies to attract private capital, and if they do not come, we will keep on increasing the subsidies until they do."* Fortunately, we have learnt a great deal about how to shape finance since then, and today we are a long way from this 'take it or leave it' view. As Mark Carney remarked during his tenure as Governor of the Bank of England, *"The world needs a new, sustainable financial system to stop runaway climate change."*⁹²

Nudging finance as a system has been a key part of our collective efforts to accelerate the energy transition. The first voluntary, and now increasingly regulated, disclosure requirements of climate-related risks⁹³ are the most obvious. Central banks, first reluctant to engage in what they saw as a policy issue, are now ambitiously incorporating climate into their financial stability analysis⁹⁴. Today, the European Central Bank is leading the way in taking climate impacts, not only climate risks, into their bond purchasing programmes.

More broadly, a new generation of financial instruments has been introduced, such as clean energy feed-in tariffs, low carbon tracking indexes⁹⁵, and climate-sensitive credit ratings⁹⁶. Decarbonisation as a strategic goal has become ever-more crucial for financial institutions, in pursuit of lower risk and higher opportunity investments, in response to pressure from shareholders, consumers, staff, and the broader public, and in recognition that a transition to net zero, and increasingly nature positive, is inevitable.

Shaping global financial to fit the needs of the low carbon, climate resilient transition is a work-in-progress. Shareholders have become an increasingly active source of pressure on the corporate community, mobilising progressive and risk-sensitive investors into action, from set piece coalitions such as the Climate Action 100+⁹⁷ group of institutional investors through to innovative shareholder actions by new activists such as Engine 1⁹⁸. And resorting to the law has grown rapidly, moving investors to re-consider and extend their understanding of climate-related financial risks.

Exhibit 9

Shaping Global Finance - Emerging Lessons from Recent Practice

1

Shaping the financial system is a keystone to any food system transition, rather than seeing finance as a neutral responder to real economy policies and market developments.

2

Financial governance innovation is a key enabler in aligning private finance with food system transition goals e.g. drawing on central banks, financial regulators, standard-setters and stock exchanges.

3

Values ultimately shape finance, with the notable growth in 'impact directed' financing by citizens as consumers, investors, savers, lenders, insurers, pension policy holders and taxpayers.

4

Digitalisation can have catalytic, scaling effects in aligning finance with food system goals, by increasing knowledge, driving awareness, and underpinning financial innovations.

5

Finance interventions have complex consequences, often requiring policy counter-balances, such as the increased cost of capital to climate vulnerable countries.

Much can be done to align global finance with the transition to an inclusive, sustainable food system.

It is premature at this early stage to make specific policy or other recommendations, both because of the initial development of preferred scenarios and because we do not yet have the quantitative analysis of what levers are likely to have what effects. We describe in the last section our plans for future quantitative and case work that could form the basis for a more specific roadmap for nudging the financial system into alignment with the transitional needs of the food system. That said, we can at this stage point to some promising intervention opportunities spread across four dimensions:

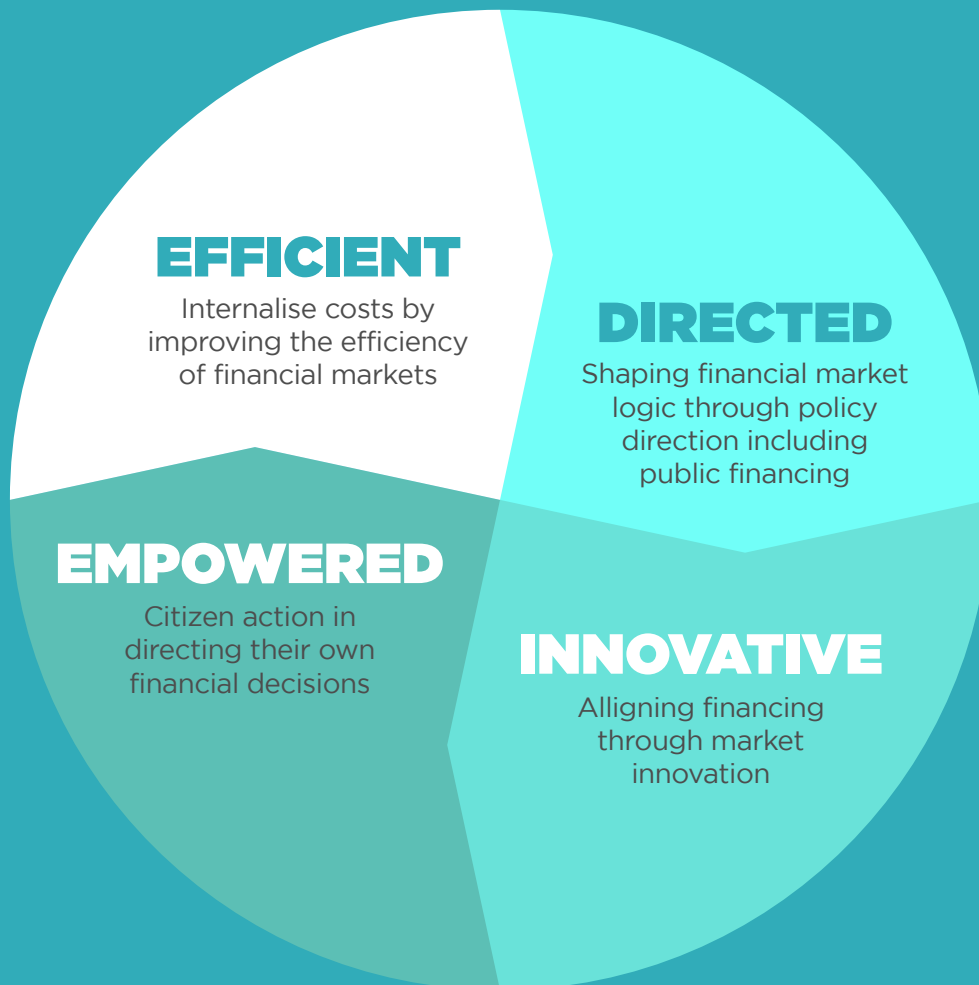
i. Efficient financialisation: *internalise costs through improved financial market efficiency.*

Without policy interventions, financial markets - like most markets - tend to evolve in ways that maximise financial rewards to dominant market actors by enabling them to capture economic value whilst externalising associated costs on to others. For the food system, this includes most obviously climate and nature costs, and also the public costs of unhealthy and unaffordable food, poor wages and squeezed rural incomes.

Although all of these externalised costs are important, the biggest difference in pivoting private investment towards a transition aimed at a greener food system could well result from internalising, and so reducing, climate- and nature-related costs.

Exhibit 10

Getting the Right Financialisation of Food



Significant progress has been made in the last five years in pricing climate risk into private investment decisions in energy and mobility, and increasingly in the built environment and infrastructure. Disclosure of such risks is being increasingly codified and established as part of regulated disclosure requirements, driven by initiatives such as the Task Force on Climate-related Financial Disclosure (TCFD)⁹⁹, and the equivalent work by central banks through the Network of Central Banks for Greening the Financial System (NGFS)¹⁰⁰.

Nature risks particularly relevant to investments in food production have lagged the progress of climate risks, although recent studies have highlighted their scale and impact, from the World Bank's estimates of the nature component of food system externalities to the more recent estimates by Moody's Investors Service of high and medium nature-related risks of US\$8.3 trillion of collective debt¹⁰¹.

The recent launch of the Taskforce on Nature-related Financial Disclosure (TNFD)¹⁰² promises to drive such risks into investment decisions over the coming years, notably for food-related financing.

Such developments are to be welcomed, and need to be accelerated to apply across food-related financing, including indirect but related financing arrangements, such as the place of nature and climate in sovereign debt markets¹⁰³. Said simply, the impact will be to drive up the cost curves of nature and climate unfriendly food production, all the more so when combined with the actual physical impacts on such farming of climate and nature-related events and trends.

That said, there are clearly unintended micro- and macro-distributional consequences, with increases in the cost of capital for nature and climate sensitive food production impacting more vulnerable and often poorer farmers, agricultural communities and countries¹⁰⁴.

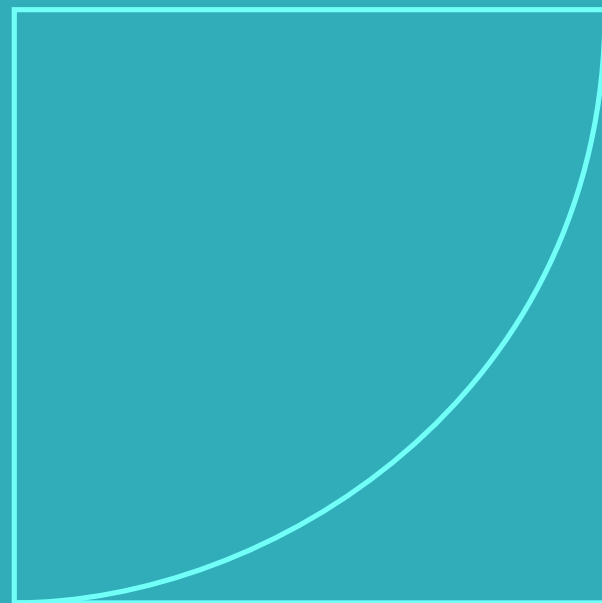
ii. Directed financialisation: *policy, including public finance, to shape financial markets.*

Policy and regulatory levers are the most widely explored in shaping the financialisation of food. These range from the use of public procurement, agricultural and other subsidies, through to innovative approaches to blending public and private finance, taxes, labelling and other public interventions to shape food consumption behaviour, and a multitude of small farmer financing mechanisms. Many, indeed most, of these policy measures therefore in some way impact private financing decisions.

Monetary policy and financial regulatory measures are needed to accelerate the incorporation of nature and climate risks into financing decisions, as alluded to above. There is a growing embrace by central banks of their role in aligning green policy goals with their mandated scope of intervention on financial stability and other regulatory considerations, such as market integrity, and board competencies. Indeed, there is a growing blurring of the historic separation of government policy and financial regulation and monetary policy¹⁰⁵, notably in the context of the climate emergency¹⁰⁶.

Public financing decisions clearly impact as well as complement the flow of private finance through blended financing solutions. But the big public financing numbers are elsewhere. The European Commission's post-pandemic National Resilience and Recovery Plans (NRRPs), for example, represent some of the largest-ever European public financial packages. Yet recent research highlights the NRRPs' shortfalls in supporting a nature-positive recovery, and by implication supporting the transition of the food system to a more sustainable basis¹⁰⁷. The world's 460 public development banks are critical in financing the transition. Yet despite the focus of much of their combined balance sheet of US\$11.2 trillion on agricultural and more broadly land use investments, work by F4B has highlighted that not one of them has publicly committed to disclosed nature stress tests across their entire portfolio¹⁰⁸.

The liability of financial institutions' environmental impacts is generally restricted to the credit risk associated with investment and lending. This means, for example, that major financial institutions are in effect protected against the fact that they may be financing agricultural producers and traders that in turn negatively impact nature. Such protection means that food system actors generating negative externalities often do not face associated increases in their cost of capital. Enhanced environmental liability can make a major difference. A number of countries already have such legislation in place¹⁰⁹. Current developments include explorations of the merits of extending the application of anti-money laundering (AML) regulations to a broader range of environmental crimes, which would make it far harder for agricultural businesses to raise capital if their activities intersected with illegally deforested land¹¹⁰, for example.



iii. Innovative financialisation: *catalysing financial innovations to finance what we need.*

Financial and capital markets are considered to be amongst the most innovative parts of the global economy. There is indeed a continuous flow of new instruments and business models, including a new generation of instruments and tools enabling financing to be better aligned to the needs of small farmers, that also addresses climate risks and sustainability linked outcomes. The Blended Finance Taskforce's '*Better Finance, Better Food*' showcases over 50 new business models and financial solutions which are mobilising capital for sustainable food and land use assets. Many of these use cases remain small in scale and ad hoc, but the Taskforce rightly points to them as having the potential to "*transform global food and land use systems to deliver more equitable and sustainable outcomes.*"¹¹¹

Of particular interest in the food system context is the impact of digitalisation in deepening the integration of the financial and real economy. Digitalisation is ultimately about getting more, better, cheaper, timely data. Nevertheless, the impacts of digitalisation are profound and ultimately systemic¹¹². Such changes are already visible in the food-finance nexus but are still at an early stage. Big data, satellites, and artificial intelligence will reshape the ability to observe, value, and finance every square metre of production, and will transform the measurement and valorisation of today's negative externalities.

Moreover, digitally powered financial innovations can accelerate circular economy approaches by underpinning shared capital and user approaches, enabling industrial level recycling, and optimising processes to reduce cost, waste, and environmental impacts¹¹³. These are as relevant in East Africa, where Hello Tractor provides on-demand access to farming machinery, as in Europe with co-use of cars and bikes, office space, household equipment, and clothing¹¹⁴.

Innovative financing mechanisms, linked to policy interventions and potentially involving blended financing, may be required to accelerate investment in the technology needed to reduce food's climate and nature impacts. The so-called 'feed-in tariff' has been key in advancing the clean energy revolution, provided a mechanism for bringing forward renewables investments, and in rewarding those who invested in distributed renewables, including households and communities. It could be that an equivalent approach might be relevant in accelerating the roll out of alternative protein or vertical farming, or indeed in accelerating the roll out of regenerative agriculture solutions.

iv. Empowered financialisation: citizen action in shaping financialisation.

Citizens' own financial decisions are generally not included in analyses of 'finance', but they should be, as citizens are the ultimate owners and intended beneficiaries of the world's finances. Notably, as consumers, they deploy about US\$45 trillion annually in ways that reward or penalise businesses according to what they want to consume, and increasingly how they want what they consume to be produced and impact communities and the planet. Likewise, their financial decisions as savers, investors, insurers, pension policyholders and taxpayers are increasingly influenced by their sense of the world they want and want their children to inhabit.

Despite the benefits of both private and public intermediation, there is a growing movement for citizens to take greater control over the use of their money. Impact and, more broadly, so-called 'ESG' investing has proliferated in response to demands from high-net-worth pension policyholders, and has grown a broader base of savers that are able to set non-financial as well as financial goals in the use of their money. Such 'investor' choice has extended into middle- and higher-income consumer choices, where spending has acquired investment features as parameters that extend beyond direct consumer interests such as product quality, to include everything from preserving the rainforests to securing child-free production. Digital innovation is also powering new approaches to informing and nudging citizens' financing decisions. One of the unmet challenges to date has been to stem the growing consumption of unhealthy food. It is not that we do not know how to shift eating patterns. The recent UK-focused proposals to tax sugar and salt as was rejected as politically unpalatable, and not ineffective as proposed¹¹⁵. Adopting a different approach, the recently-launched 'Every Action Counts' coalition brings together some of the world's mobile payment platform companies to experiment in building on the Chinese experience of the successful Ant Forest¹¹⁶ app in using fintech channels to nudge citizens' financing decisions on all things green, including food spending patterns¹¹⁷.

Getting financialisation right is a pre-condition for an effective food system transition.

Crowding in more private capital is essential to support the transition. But ‘more private finance’ is an insufficient condition for ensuring that the transition itself is rapid, fair, and safe, or that it will lead to an inclusive, sustainable, healthy food system. Indeed, as we have seen, advancing the wrong forms of financialisation can reinforce current, or create new, shortfalls, and problematic outcomes across our food system. Advancing a timely, effective transition requires that global finance be shaped to ensure that it plays the right role.

The last section clearly demonstrates the many practical possibilities to shape global finance in ways that better align financial flows with the needs of an inclusive, sustainable food system. Indeed, we have illustrated many of the possible approaches with examples of rules, initiatives, coalitions, and individual leaders who are already turning potential into practice.

It is unclear, however, which interventions are likely to be most effective where; and, regarding which normative aspects of the transition, at what cost and with what risks of unintended, undesirable consequences. This is work that remains to do be undertaken, through a combination of analysis, modelling, experimentation, dialogue, and an applied research agenda that F4B, with partners, will progress over the coming period (Exhibit 11).

Exhibit 11

An Applied Research Agenda

The next stage is therefore to test the practical value of these possible interventions. Finance for Biodiversity plans to do that in four linked ways.

1

Emerging practice: *drawing more learning from existing practice relevant to the food-finance nexus.* As the work to date highlights, there is already much work in train, including many initiatives in which Finance for Biodiversity and its partners are directly involved.

2

New horizons: *initiating and participating in specific areas of new horizon knowledge development.* One focus is the possible impacts of alternative protein developments in the broader food system. Another is the exploration of the potential for nudging citizens' food consumption decisions through fintech innovations.

3

Valuing levers: *quantitative modelling to estimate the absolute and relative usefulness of different levers.* The intention is to take some of the explicit and implicit hypotheses set out in this report and subject them to quantified analysis.

4

Case dives: *how might the envisaged levers play out in specific places.* In part, this would emerge from both the first and second workstreams above but envisaged is a more systematic approach in considering the relevance of levers in specific country case studies.

One possible scenario for getting the financialisation of food right.

Despite such uncertainties, however, we conclude by offering one possible, high-level view of some of the main features of a coherent, ambitious game plan for shaping and using global finance to advance an effective transition, involving four inter-linked sets of actions:

1

Financial policies and regulation, reinforced by shareholder and public activism, must drive the internalisation of nature and climate impacts into financing decisions, stranding 'dirty assets', and accelerating green-friendly investments, so triggering a shift towards more nutritious food production.

2

Financial innovation, including blended public and private financial solutions, are needed to accelerate investments in, and drive down the costs of, healthy food produced by climate- and nature- friendly forms of farming, using scalable instruments equivalent to the feed-in tariffs used to great effect in catalysing renewables investments.

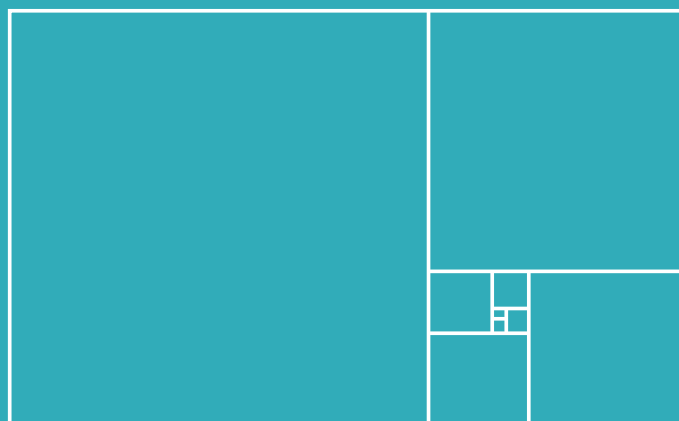
3

Policy and public finance are needed to protect and retool those whose rural livelihoods are eroded during the transition, providing technology, skill development and capital to enable them to secure decent livelihoods, where possible owning and operating commercially viable regenerative and soilless food production, and associated parts of the food value chain.

4

Encourage citizen action as the ultimate owners and intended beneficiaries of the world's finances, including harnessing digital opportunities to empower and nudge citizens' behaviour, as consumers in the adoption of improved, sustainable diets, and also as savers and pension policy holders and voting tax-payers in ensuring smarter use of their money.

Time will tell whether or not this scenario translates usefully into practice. What is certain, however, is that shaping global finance in pursuit of sustainable development is no longer an unexplored territory. Moreover, although much has been written and actioned about the food-finance nexus, such an approach has not been systematically applied to the matter of food, resulting in many avenues remaining under-explored and under-exploited. Our hope is that this work will stimulate debate, and encourage others to engage more systematically and ambitiously in shaping the food-finance nexus to deliver the food system we need.



Endnotes

¹ <https://www.foodsystemeconomics.org/>

² F4B. (2020).

³ Ouma (2014); Will et al. (2016); Yadav & Singh (2019)

⁴ FOLU estimates 300\$ billion a year in the Blended Finance Task Force: 'Better Finance, Better Food', BFTF, 2020

⁵ Clapp, J. (2021)

⁶ FAO et al. (2021)

⁷ Benton et al. (2021); See also: Carolan, M, S. (2011)

⁸ FAO, (2015)

⁹ Harvard Gazette, (2012)

¹⁰ Although trends might be different depending on location (developing countries/developed economies) and size and type of agrarian practices (conventional, precision or organic farming / latifundia vs smallholding), there is scattered evidence showing decreasing real net farm income in the several countries of the global North (e.g., Starmer et al., 2006 (US)).

¹¹ Johr, H. (2012)

¹² Hallmann et al. (2015)

¹³ This is the conservative estimate by the WB (<https://blogs.worldbank.org/voices/do-costs-global-food-system-outweigh-its-monetary-value>). A more pessimistic assessment from FOLU yields the value of 12 trillion US\$ (FOLU 2019, p. 12).

¹⁴ IMF Working Paper by Coady et al., (2015)

¹⁵ Birch, A. J., & Robinson, R. (1943).

¹⁶ Knorr & Watzke H., (2019)

¹⁷ For climate change: Tebaldi & Lobell (2008); Ortiz-Bobea et al. (2021) contra Kukal & Irmak (2018); Zimmermann et al., (2017). For soil depletion: Calzadilla & Carr (2020).

¹⁸ FAO et al. (2021)

¹⁹ Such as the Zero Hunger Alliance, championed by IFPRI; see: Diaz-Bonilla, (2021)

²⁰ The Good Food Institute (2020)

²¹ NL Times, (July 7, 2021).

²² Eiran (2021)

²³ A report by The International Panel of Experts on Sustainable Food Systems (IPES-Food) on The Long Food Movement, for example, offers a dystopian technological vision of an agribusiness-led scenario, where "...advances in digitalisation, automation, synthetic biology, and molecular technologies promise to take the risks – and the people – out of food systems" and where an "internet of farming things, such as robotic tractors and spraying/surveillance drones" is controlled by "bio-digital mega-corporations, data platforms and private equity forms" which embark on "a new wave of land, ocean, and resource grabs" and create "new veneers of sustainable and ethical consumerism, leaving citizens to make sense of increasingly opaque supply chains and a dizzying array of claims."

²⁴ Monbiot, G. (2020, January 8)

²⁵ Clapp, J. (2021): 404-408.

²⁶ Alizamir et al. (2016); Deutsche Bank (2012)

²⁷ Sustainable Energy for All. (2020)

²⁸ Buhr et al. (2018)

²⁹ European Union, (2018)

³⁰ Boston Consulting Group (2021)

³¹ Reuters, June 4, 2021.

³² Kurt & Bruce, (2017)

³³ Alternative Proteins are proteins produced from alternative sources designed to replace natural or conventional proteins such as meat (beef, pork and others), poultry and eggs. Methods of producing APs include (i) plant-based substitutes, (ii) insect-based substitutes, (iii) precision fermentation, (iv) microbe fermentation and cultured, and (v) lab-grown meat. From 'The Alternative Protein Disruption: Scenarios for food system impacts' by Material Economics and F4B, (2021)

³⁴ This work has been developed with Material Economics, and is covered in more depth in a separate companion publication released alongside this one: 'The Alternative Protein Disruption: Scenarios for food system impacts' (2021)

³⁵ For example, "Two major US dairy producers, Dean Foods Co. and Borden Dairy Co., filed for bankruptcy in November 2019–2020 respectively, citing a decline in dairy consumption alongside rising demand for non-dairy alternatives as major headwinds." Source: <https://www.fairr.org/article/appetite-for-disruption-a-second-serving/>

³⁶ This paper has benefited from technical contributions from the vertical farming company, OneFarm.

³⁷ Dutkiewicz, Jan and Gabriel N Rosenberg (2021): "Those who want cellular agriculture to live up to its lofty potential shouldn't just be worried about the malignant influence of capital – they should be finding practical ways to limit it. What's needed is the political vision and energy to liberate this technology from the grips of corporate stakeholders, and to use it for the radical project of improving the human and animal condition around the world"

³⁸ Muller. et al., (2017)

³⁹ Ceres Project, (2020)

⁴⁰ World Bank, (2017)

⁴¹ OECD, (2020)

⁴² <https://www.ceres.org/initiatives/food-emissions-50>

⁴³ Hall, (2020)

⁴⁴ Epstein, (2005), p.3; followed by: Hartmann et al., (2021), p.123; Clapp, (2014), 798-799; Brooks, (2016), p.772,

⁴⁵ With obvious exceptions being in those countries where agriculture has been or is state or in some other way commonly owned.

⁴⁶ Clapp, (2014)

⁴⁷ Ouma et al., (2018)

⁴⁸ Larder et al, (2018), p. 410; Gillam, (2009); McMichael, (2012), p. 690

⁴⁹ Gattuso et al., (2015)

⁵⁰ FarmFolio, (2020)

⁵¹ Larder et al, (2018)

⁵² FAIRR, (2019)

⁵³ Statista, (2019)

⁵⁴ Deere market cap 2006-2021 | DE. (2021). Macrotrends | The Long-Term Perspective on Markets. <https://www.macrotrends.net/stocks/charts/DE/deere/market-cap> <https://www.macrotrends.net/stocks/charts/DE/deere/market-cap>

⁵⁵ Ib

⁵⁶ Wheaton, B., & Kiernan, W. J. (2012). Farmland: An untapped asset class? Quantifying the opportunity to invest in agriculture. Food for Thought: Macquarie Agricultural Funds Management Newsletter. Retrieved from: <http://www.macquarie.com/dafiles/Internet/mgl/com/agriculture/docs/food-for-thought/food-for-thought-dec2012-us.pdf>.

⁵⁷ Global AgInvesting, Sectors to watch in 2019, (2019). <https://www.globalaginvesting.com/ag-sectors-to-watch-2019/>

⁵⁸ Companies Market Cap, "Largest automakers by market capitalization". <https://companiesmarket-cap.com/automakers/largest-automakers-by-market-cap/>

⁵⁹ Gladek et al. (2017)

⁶⁰ Bormann, F. H., & Likens, G. E. (1967)

⁶¹ Alexander et al., (2019)

⁶² Daniel (2012); Lawrence et al. (2015), pp. 317 sqq.

⁶³ Hall, (2020)

⁶⁴ GFI, (2020)

⁶⁵ \$1.5 billion invested in alternative proteins in 2020, including a record \$435 million in the next pillar—fermentation - The Good Food Institute, (2020)

⁶⁶ On which see: De Schutter, (2010); Reardon & Timmer, (2012), pp. 14.8 sqq.

⁶⁷ France-Presse, A. (2018, April 11)

- ⁶⁸ Clapp, (2014); Lawrence et al. (2015), pp. 314-321; Clapp & Isakson (2018), pp. 439 sqq.
- ⁶⁹ Clapp & Isakson (2018), p.440 ; Lawrence et al. (2015), pp. 315-316; Williams (2014), pp. 403 sqq.
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- ¹⁰⁵ Barkawi and Zadek (2021)
- ¹⁰⁶ This is exemplified by the recent speech by the Governor of the European Central Bank, Christine Lagarde, where her advocacy of carbon prices bridged her duties as Governor and broader political role Lagarde (2021)
- ¹⁰⁷ Vivid (2021)
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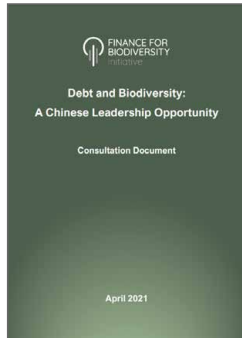
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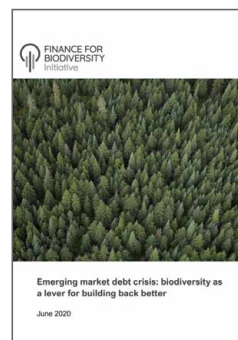
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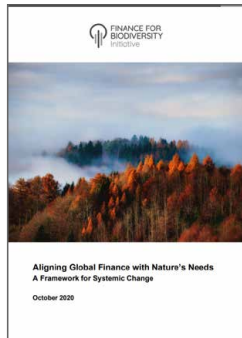
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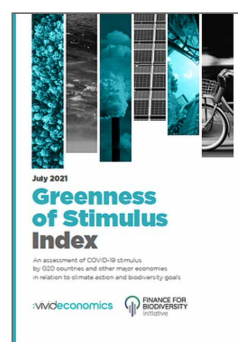
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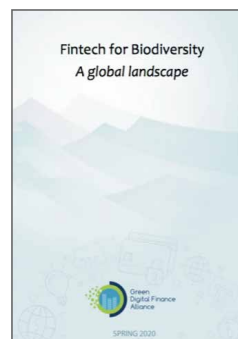
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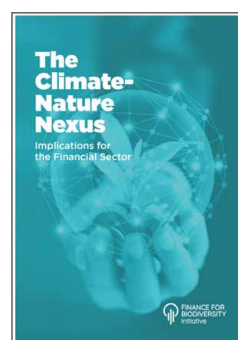
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