

# Growing Better:

## Ten Critical Transitions to Transform Food and Land Use

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The Global Consultation Report  
of the Food and Land Use Coalition

September 2019

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The  
Food and Land Use  
Coalition

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## FOLU Core Partners



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**Cover image:**

Tilahun Gelaye grows a number of crops including mangoes, coffee, and papaya at a watershed restoration and homestead development project in Bahir Dar, the Amhara Region of Ethiopia. He says: "The difference with being involved in the project is huge. Now we are living cleanly and safely. We don't have to go to the market to buy fruits to feed our children, and we feel very healthy."



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# Foreword

**Transforming the world's food and land use systems is necessary to achieve the targets for climate and sustainable development set out in the 2015 Sustainable Development Goals and the Paris Agreement on climate change. The Food and Land Use Coalition (FOLU) was launched in 2017 to catalyse and speed up this transformation.**

The term "food and land use systems" covers every factor in the ways land is used and food is produced, stored, packed, processed, traded, distributed, marketed, consumed and disposed of. It embraces the social, political, economic and environmental systems that influence and are influenced by those activities. Food from aquatic systems, marine and freshwater, is also included in our definition because fish (wild and farmed) accounts for a significant share of the protein in human diets and this share will potentially increase.<sup>i</sup> The report also covers agriculture for non-food purposes, such as bioenergy, fibres for textiles and plantation forestry products, as these already compete with food for fertile land and the competition could intensify in the future.<sup>ii</sup>

To achieve its purpose, FOLU develops knowledge, tools and partnership platforms to help those involved in economic and political decision-making to identify and pursue pathways to sustainable food and land use systems. We demonstrate that applying systems thinking to these tasks can foster productive, prosperous rural economies, protect and value natural resources and ecosystems, and provide nutritious, affordable food to a growing global population.

FOLU's work divides between (i) making the strategic case for rapid change, (ii) supporting countries with their food and land use planning, policy and market redesign, (iii) empowering diverse change leaders across public, private and civil society sectors, (iv) developing evidence-based transformation pathways and (v) accelerating shifts throughout the private sector.

FOLU values independent, science-based thought leadership and policy recommendations and engages diverse stakeholders in their development. We believe business has a critical role to play in achieving the outcomes for climate, biodiversity, public health and prosperous livelihoods that the world needs. The World Business Council for Sustainable Development, a FOLU core partner, convenes business leaders to support them in this role. FOLU acknowledges the invaluable contribution of Unilever, Yara International and the Business and Sustainable Development Commission in nurturing our initial development.

For more information, please visit our website at [www.foodandlandusecoalition.org](http://www.foodandlandusecoalition.org)

<sup>i</sup> FOLU recognises the importance of the ocean as an essential source of protein and many other critical ecosystem services. We address the role of the ocean in the critical transition 4 on "Securing a healthy and productive ocean" and will look to strengthen our work on this critical aspect of the overall food and land use agenda over the coming years.

<sup>ii</sup> See Box 25 in critical transition 3 on Protecting and Restoring Nature in Chapter 3 of the full online report.

The FOLU community continues to grow and evolve.

It currently comprises the following elements:

**Core Partners:** organisations responsible for the Coalition's global-level initiatives and engagement.

These include:

- Alliance for a Green Revolution in Africa (AGRA)
- EAT
- Global Alliance for Improved Nutrition (GAIN)
- International Institute for Applied Systems Analysis (IIASA)
- Sustainable Development Solutions Network (SDSN)
- SYSTEMIQ
- World Business Council for Sustainable Development (WBCSD)
- World Resources Institute (WRI)

**FOLU Country Platforms:** stakeholder networks that support the development and implementation of food and land use transformation strategies at the national level, including through the FABLE Consortium which currently comprises independent research teams from 18 countries, including the European Union (see Box 39 in Chapter 3 of the full online report).<sup>iii</sup>

**Ambassadors:** professionals who serve in an individual capacity, drawing on their expertise to support FOLU's objectives.

**Supporters:** donors and philanthropic organisations providing financial support to our work.

These include:

- The Gordon and Betty Moore Foundation
- The MAVA Foundation
- Norway's International Climate and Forest Initiative (NICFI)
- The UK Department for International Development (DFID)

<sup>iii</sup> These independent research teams do not necessarily reflect the views of their respective governments.

The final report and its content are the sole responsibility of the Food and Land Use Coalition as represented by the undersigned:

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Alliance for a Green Revolution in Africa  
Consultative Group on International Agricultural Research (CGIAR) centres  
Food and Agriculture Organization of the United Nations (FAO)  
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University of California, Davis  
University of Leuven  
Wageningen University  
World Farmers Organisation  
World Vegetable Center

## Environment:

Bioversity International  
CGIAR Research Program on Water, Land and Ecosystems  
Columbia University  
Conservation International  
Environmental Market Solutions Lab (emLab) at the University of California, Santa Barbara  
Global Environment Facility (GEF)  
Alexander von Humboldt Biological Resources Research Institute

Hoffmann Centre For Sustainable Resource Economy at Chatham House  
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The International Resource Panel  
WorldFish  
World Wildlife Fund (WWF)

## Health:

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Partners in Public Health  
Tufts University  
The World Health Organization (WHO)  
UNICEF



Left: Ma Jinzhong joined the farm in 2013 and is now overseeing the greenhouses at the Pear Garden Farm in Beijing, China. He reflects on how farming approaches are going back to traditional ways: "We used cow manure before, and we use it now. I am going back to how I worked in the beginning." Right: Balaynesh Kasa with three of her children. She farms hops at a watershed restoration and homestead development in Bahir Dar, the Amhara Region of Ethiopia. This provides her with enough income to support her family and send her four children to school.

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# Executive summary

“You may delay, but time will not.”

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Benjamin Franklin

The world faces a remarkable opportunity to transform food and land use systems over the next ten years. By 2030, a determined reform agenda for food and land use systems could result in:

- Better environmental outcomes, delivering up to thirty per cent of emission reductions needed for the Paris Agreement climate change targets, halting biodiversity loss, restoring ocean fish stocks and slashing agriculture related pollution;
- Better human health through more nutritious diets for all, largely eliminating under-nutrition (except in extreme poverty-driven pockets) and halving the disease burden associated with consuming too many calories and unhealthy food;
- More inclusive development, accelerating income growth for the bottom 20 percent of the rural population, increasing yields of low-productivity smallholders, creating over 120 million extra decent rural jobs (largely off-farm) and contributing to a more secure future for indigenous peoples and other local communities across the world; and
- Significantly improved food security by helping to stabilise or even lower real food prices, producing enough food of the right quality and quantity, improving access for the poorest and most vulnerable.

Achieving these results would generate a societal return of around \$5.7 trillion annually, more than 15 times the related investment cost of \$300-350 billion per year (less than 0.5 percent of global GDP), and would create new business opportunities worth up to \$4.5 trillion a year by 2030.

At the heart of the transformation lies a fundamental change in how land and related water resources are used globally. By eating healthier diets, reducing food loss and waste, producing food with greater resource efficiency and avoiding perverse incentives for land expansion (i.e., bioenergy mandates/subsidies that drive land use change), we can free up to 1.2 billion hectares of land which is currently used for agriculture by 2050. By deploying effective land use planning and enforcement as well as large scale payments for ecosystem services, our remaining forests and other natural ecosystems could be protected and those 1.2 billion hectares restored to nature. This would yield massive benefits for, inter alia, climate change, biodiversity and freshwater production and management.



Right: A farmer tends to plants in a greenhouse at the Shared Harvest farm, a 66 acre community-shared organic farm in the Tongzhou and Shunyi Districts of Beijing, China.

Today, however, the case for urgent, deep change is not sufficiently compelling for many decision-makers. This report is the first integrated, global assessment of the social, economic and health benefits of transforming our food and land use systems, and the large, growing costs and risks of inaction. On the surface, food and land use systems have been doing well in recent decades, with production outpacing population growth, making food more affordable for households across the world. But dig deeper, and food and land use systems generate “hidden” environmental, health and poverty costs estimated at almost \$12 trillion a year, a number greater than the value of the same systems’ world output measured at market prices. These hidden costs are expected to grow significantly on current trends, leading, on the one hand, to irreversible damage to key ecosystems, fundamentally undermining food security in certain regions, and on the other hand, to growing public health costs, due mainly to chronic patterns of excess food consumption. Leaving food and land use systems on the current pathway would put the Sustainable Development Goals (SDGs) and Paris Agreement climate targets out of reach and undermine food security, creating needless human suffering, market disruption and political instability. Poorer countries, and within them poorer households and groups, especially women and children, would be hit first and hardest, but over time we would all suffer.

Transformation of food and land use systems thus needs to become an urgent priority globally and for everyone shaping today’s value chains – from smallholder farmers to heads of state to CEOs of food and agricultural companies to consumers. The Food and Land Use Coalition (FOLU) proposes structuring this transformation in ten critical transitions (see double page infographic on pages 12 and 13), covering what we eat and how we grow and distribute food in ways that also protect nature, expand consumer choice and supply options, and make the system fairer, creating opportunities for all. The precise reform agenda will inevitably vary from one country to the next, and from one community to the next. But all countries, despite profound differences in terms of culture, resources and level of economic development, could benefit from a more consistent set of policy signals, starting with far better targeting of public support measures (currently estimated at a total value of over \$700 billion per year globally) for public environmental, health and inclusion priorities.

Implementing these transitions will not be easy. Each one faces barriers, whether related to policy, regulation, finance, innovation or behaviour. The current system is both inefficient, with over 50 percent productivity losses measured on an end-to-end basis, and at the same time fragmented, with vested interests defending their own turf. However, practical examples of all ten critical transitions are already up and running across the world, driven by policy, business, financial, farming, community and social entrepreneurs.

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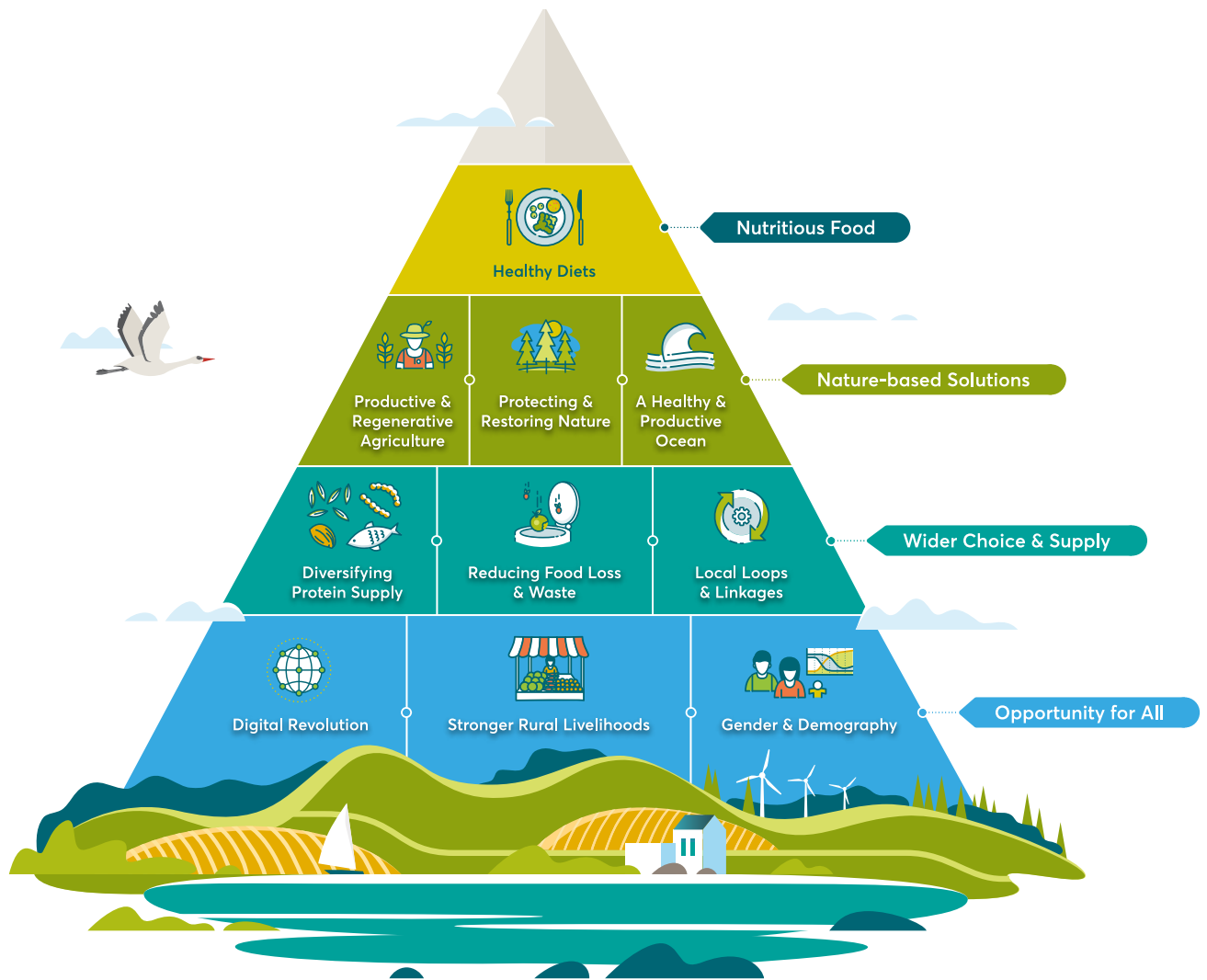
Chile has applied a sugar tax to drive down junk food consumption, with great benefits for health. China has massively increased forest cover over the last decades and is deploying its unique “ecological zoning” concept to protect remaining intact forests and ecosystems. In the Indian state of Andhra Pradesh, thousands of farmers are taking up regenerative agricultural practices, demonstrating both environmental and economic benefits. In India, Kenya and Rwanda, the potential of off-grid and mini-grid solar energy is being tapped, opening up massive new opportunities for sustainable rural development. In Colombia and throughout Latin America, granting indigenous peoples legal tenure over their traditional lands has proven the best way of protecting rainforests. Indonesia has implemented a set of policy reforms that have, in the last two years, seen massive reductions in the destruction of invaluable rainforests and peatlands. Ethiopia is integrating regenerative agricultural practices with forest restoration to increase agricultural production and protect soils and watersheds while also mitigating climate change. Norway and the United Kingdom are among a group of countries achieving significant reductions in food loss and waste through national public-private partnerships.

Progressive business is organising through initiatives like The Tropical Forest Alliance (TFA) to push collectively for viable solutions to climate change and biodiversity and ecosystem loss. Civil society is playing a fundamental role in holding governments, business and the private sector firmly to account using real-time information flows on their food and land use system activities. For example, initiatives like Global Forest Watch (GFW) are creating unprecedented transparency around forests. Technological and business model innovation is ushering in a fourth agricultural revolution, potentially enabling higher, more biodiverse and resilient crop production with far lower resource use and environmental footprint. New disruptive companies are breaking through with innovative models to improve the environmental performance of the livestock and dairy sector, to scale the supply chains for regenerative agriculture, to grow the market for alternative proteins, to invest in landscape restoration (getting paid for ecosystem services), to cut food waste and improve cold storage chains, and to expand fish supply (both ocean-based and aquaculture) in a much more sustainable way. Digital platforms are empowering actors across food and land use systems; consumers can make better choices through enhanced product traceability, smaller suppliers can obtain greater access to markets, financiers are more able to offer insurance products to cushion farmers and pastoralists from climate risk, and civil society is more able to hold larger actors to account. The challenge is now to scale up and speed up these innovations, working with public, private and civil society stakeholders.

Judging from experience, it is likely that, once the rules of the game are changed, and the private sector starts to innovate within the new paradigm, new opportunities and solutions will surface to make the benefits of the transformation even greater. Beyond the opportunities quantified in this report, there is ample additional potential for even more solutions to our greatest sustainable development challenges just waiting to be unlocked.

Together, humanity faces an opportunity to design food and land use systems that protect our environment, improve our health, increase social justice and strengthen food security. We have a year or two in which to turn them in the right direction, and a decade thereafter to transform them. There are already many courageous change agents working – often at significant professional and personal risk – to advance transformation. This consultation report is fundamentally for them: to support their efforts, to accelerate the process of creative discovery, debate and learning, and to help us all to shift our food and land use systems on to pathways that lead to hitting the SDGs and Paris Agreement targets on climate change. There is no time to lose.

# Growing Better: Ten Critical Transitions to Transform Food and Land Use



**Economic Prize**  
 \$5.7 trillion economic prize by 2030 and \$10.5 by 2050 based on avoided hidden costs

**Investment Requirements**  
 \$300-\$350 billion required each year for the transformation of food and land use systems to 2030

**Business Opportunity**  
 \$4.5 trillion annual opportunity for businesses associated with the ten critical transitions by 2030

## Cross Cutting Reforms to Transform Food and Land Use








				
<p><b>Government:</b> Establish targets; break down governmental silos; put a price on carbon; land use planning; repurpose agricultural support and public procurement; massively increase R&amp;D and target it on healthy, natural solutions.</p>	<p><b>Business &amp; Farmers:</b> Organise pre-competitively to support government reform agendas and set internal standards for specific sectors; establish true cost accounting for food and land use.</p>	<p><b>Investors &amp; Financial Institutions:</b> Build on the Task Force on Climate-related Financial Disclosures to cover nature; develop a set of financing principles for food and land use; develop innovative finance instruments, including blended finance, to manage risks and leverage opportunities.</p>	<p><b>Participants in multilateral processes and multi-stakeholder partnerships:</b> Raise ambition in the United Nations Framework Convention on Climate Change 2020 stock-take and ensure an ambitious outcome in the 2020 Convention on Biological Diversity in Kunming, China.</p>	<p><b>Civil Society:</b> Drive information campaigns for food and land use reform and direct campaigns against serial offenders (public and private).</p>

FINANCIALS KEY

 Economic prize by 2030

 Annual additional investment requirements to 2030

 Business opportunity by 2030

Ten Critical Transitions		Essential Actions	Financials (by 2030)
 <p><b>Healthy Diets</b></p>	<p>Global diets need to converge towards local variations of the "human and planetary health diet" – a predominantly plant-based diet which includes more protective foods (fruits, vegetables and whole grains), a diverse protein supply, and reduced consumption of sugar, salt and highly processed foods. As a result, consumers will enjoy a broader range of high-quality, nutritious and affordable foods.</p>	<p><b>Government:</b> Establish and promote planetary and human health dietary standards through repurposed agricultural subsidies, targeted public food procurement, taxes and regulations on unhealthy food</p> <p><b>Business:</b> Redesign product portfolios based on the human and planetary health diet</p>	<p> <b>\$1.28 trillion</b></p> <p> <b>\$30 billion</b></p> <p> <b>\$2 trillion</b></p>
 <p><b>Productive &amp; Regenerative Agriculture</b></p>	<p>Agricultural systems that are both productive and regenerative will combine traditional techniques, such as crop rotation, controlled livestock grazing systems and agroforestry, with advanced precision farming technologies which support more judicious use of inputs including land, water and synthetic and bio-based fertilisers and pesticides.</p>	<p><b>Government &amp; Business:</b> Scale up payments for ecosystem services (soil carbon/health and agrobiodiversity) plus improve extension services (training and access to technology, seeds, etc.)</p> <p><b>Business &amp; Investors:</b> Shift procurement from buying commodities to investing in sustainable supply chains; deploy innovative finance to reach currently underfinanced parts of supply chains</p>	<p> <b>\$1.17 trillion</b></p> <p> <b>\$35-40 billion</b></p> <p> <b>\$530 billion</b></p>
 <p><b>Protecting &amp; Restoring Nature</b></p>	<p>Nature must be protected and restored. This requires an end to the conversion of forests and other natural ecosystems and massive investment in restoration at scale; approximately 300 million hectares of tropical forests need to be put into restoration by 2030.</p>	<p><b>Government:</b> Put in place and enforce a moratorium on the conversion of natural ecosystems, and give legal rights and recognition to the territories of indigenous peoples</p> <p><b>Government:</b> Scale REDD+ to \$50 billion per year by 2030 if results delivered and establish a Global Alliance Against Environmental Crime</p> <p><b>Business:</b> Establish transparent and deforestation-free supply chains and demand the same of suppliers</p>	<p> <b>\$895 billion</b></p> <p> <b>\$45-65 billion</b></p> <p> <b>\$200 billion</b></p>
 <p><b>A Healthy &amp; Productive Ocean</b></p>	<p>Sustainable fishing and aquaculture can deliver increased supply of ocean proteins, reducing demand for land and supporting healthier, and more diverse diets. This is only possible if essential habitats – estuaries, wetlands, mangrove forests and coral reefs – are protected and restored and if nutrient and plastic pollution are curbed.</p>	<p><b>Government:</b> Protect breeding grounds, end both illegal fishing and overfishing, and provide title/ access rights to artisanal fishers</p> <p><b>Government &amp; Investors:</b> Develop new approaches and business models for insurance against catastrophic events affecting fisheries (storms, warming events, reef collapse) and for compensating poor fishermen for the cost of fish stock recovery</p>	<p> <b>\$350 billion</b></p> <p> <b>\$10 billion</b></p> <p> <b>\$345 billion</b></p>
 <p><b>Diversifying Protein Supply</b></p>	<p>Rapid development of diversified sources of protein would complement the global transition to healthy diets. Diversification of human protein supply falls into four main categories: aquatic, plant-based, insect-based and laboratory-cultured. These last three sources alone could account for up to 10 percent of the global protein market by 2030 and are expected to scale rapidly.</p>	<p><b>Government:</b> Use public procurement to secure long-term offtake for alternative protein sources</p> <p><b>Government:</b> Increase R&amp;D spending in alternative proteins (especially those with large benefits for lower-income consumers) and ensure that the resulting intellectual property remains in the public domain</p>	<p> <b>\$240 billion</b></p> <p> <b>\$15-25 billion</b></p> <p> <b>\$240 billion</b></p>
 <p><b>Reducing Food Loss &amp; Waste</b></p>	<p>Approximately one third of food produced is lost or wasted. To produce this food that is never eaten by people requires an agricultural area almost the size of the United States. Reducing food loss and waste by just 25 percent would therefore lead to significant benefits relating to environmental, health, inclusion and food security.</p>	<p><b>Government:</b> Regulate and incentivise companies to report on and reduce food loss and waste</p> <p><b>Investors:</b> Finance income-sensitive, climate-smart storage technologies</p>	<p> <b>\$455 billion</b></p> <p> <b>\$30 billion</b></p> <p> <b>\$255 billion</b></p>
 <p><b>Local Loops &amp; Linkages</b></p>	<p>With 80 percent of food projected to be consumed in cities by 2050, what urban dwellers choose to eat and how their needs are supplied will largely shape food and land use systems. This transition sets out the opportunity to strengthen and scale efficient and sustainable local food economies in towns and cities.</p>	<p><b>Investors:</b> Invest in emerging technologies and innovations which will close the food system loop</p> <p><b>Government:</b> City governments to foster local circular food economy through targeted public procurement and zoning</p>	<p> <b>\$240 billion</b></p> <p> <b>\$10 billion</b></p> <p> <b>\$215 billion</b></p>
 <p><b>Harnessing the Digital Revolution</b></p>	<p>Digitisation of food and land use systems is occurring through gene-editing techniques, precision farming, and logistics and digital marketing tools, enabling producers and consumers to make better, more informed choices, and to connect to the value chain rapidly and efficiently.</p>	<p><b>Government:</b> Open access to public sector data (e.g. on national land registries, fisheries, agriculture, soil health etc.) and regulate and incentivise the private sector to provide open source data where appropriate</p> <p><b>Civil Society:</b> Create, maintain and communicate results from real-time platforms for transparency, as is currently done through Global Forest Watch</p>	<p> <b>\$540 billion</b></p> <p> <b>\$15 billion</b></p> <p> <b>\$240 billion</b></p>
 <p><b>Stronger Rural Livelihoods</b></p>	<p>Underlying all ten critical transitions is a vision of rural areas transformed into places of hope and opportunity, where thriving communities can adapt to new challenges, protect and regenerate natural capital and invest in a better future. Ensuring a just transition.</p>	<p><b>All:</b> Establish public-private-philanthropic partnerships to train a new generation of young farmer entrepreneurs over the next decade</p> <p><b>All:</b> Scale up rural roads and digital investments to drive productivity, end rural isolation, and, in particular, initiate a global campaign for renewable electricity access for all</p> <p><b>Government:</b> Safety nets for individuals and stranded communities to ensure a just transition</p>	<p> <b>\$300 billion</b></p> <p> <b>\$95-110 billion</b></p> <p> <b>\$440 billion</b></p>
 <p><b>Gender &amp; Demography</b></p>	<p>Women can be enormously powerful in shaping food and land use systems, thanks to their central role in agriculture and in decisions concerning nutrition, health and family planning. Making sure women have equal access to resources, such as land, labour, water, credit and other services, should be central to policies concerning the ten critical transitions, including by accelerating the demographic transition to a replacement rate of fertility in all countries.</p>	<p><b>All:</b> Invest in maternal and child health and nutrition as well as education for women and girls</p> <p><b>All:</b> Ensure access to reproductive health services and products</p>	<p> <b>\$195 billion</b></p> <p> <b>\$15 billion</b></p> <p> <b>n/a</b></p>

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# Summary Report

## “It always seems impossible until it is done”

Nelson Mandela

The world faces a remarkable opportunity to transform food and land use systems over the next ten years. This report lays out, for the first time, the scientific evidence and economic case that by 2030, mankind can help bring climate change under control, safeguard biological diversity, ensure healthier diets for all, drastically improve food security and create more inclusive rural economies. And we can do that while reaping a societal return that is more than 15 times the related investment cost (estimated at less than 0.5 percent of global gross domestic product (GDP)), and creating new business opportunities worth up to \$4.5 trillion a year by 2030.<sup>1</sup> Delivering such a transformation will be challenging, but will ensure that food and land use systems play their part in delivering on the Sustainable Development Goals (SDGs) and the Paris Agreement targets on climate change.

Leaving these systems to continue on current trends, by contrast, means sleepwalking into a scenario wherein climate change, sea-level rise and extreme-weather events increasingly threaten human life, biodiversity and natural resources are depleted, people increasingly suffer life-threatening, diet-induced diseases, food security is compromised, and socioeconomic development is seriously impaired. Such a pathway will place the SDGs and Paris Agreement targets out of reach and within a few decades threaten our collective security.

The core messages and findings of this report are aligned with the United Nations Intergovernmental Panel on Climate Change (IPCC), including the Special Report on Global Warming of 1.5-degrees Celsius and the Special Report on Climate Change and Land, and with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services' (IPBES) Global Assessment Report on Biodiversity and Ecosystem Services. Through integrated and system-focused modelling, as described in Box 3, the Food and Land Use Coalition (FOLU) has applied an economic and social lens to these analyses, proving that the policies and measures required to fight climate change, biodiversity loss and ecosystem degradation make sense not only for the climate and environment, but also for human health and the global economy.

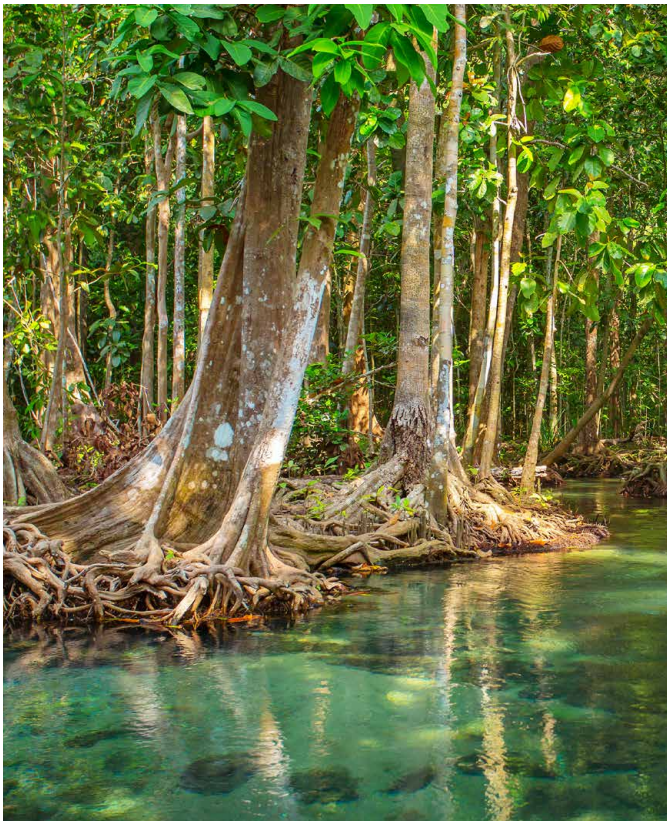
### BOX 1

#### Defining “Food and land use systems”

The term “food and land use systems” covers every factor in the ways land is used and food is produced, stored, packed, processed, traded, distributed, marketed, consumed and disposed of. It embraces the social, political, economic and environmental systems that influence and are influenced by those activities. Food from aquatic systems, marine and freshwater, is also included in the definition because fish (wild and farmed) accounts for a significant share of the protein in human diets and this share will potentially increase.<sup>iii</sup> The report also covers agriculture for non-food purposes, such as bioenergy, fibres for textiles and plantation forestry products, as these already compete with food for fertile land and the competition could intensify in the future.<sup>iv</sup>

<sup>iii</sup> FOLU recognises the importance of the ocean as an essential source of protein and many other critical ecosystem services. We address the role of the ocean in the critical transition 4 on “Securing a healthy and productive ocean” and will look to strengthen our work on this critical aspect of the overall food and land use agenda over the coming years.

<sup>iv</sup> See Box 25 on bioenergy, and critical transition 3 on Protecting & Restoring Nature in the full online report.



Public and private sector leaders need to make transformation of food and land use systems an urgent priority. Reaching a better future requires governments, businesses, farmers, financial institutions, academia and civil society organisations worldwide to make fundamental and urgent changes to food and land use systems. It requires that the “rules” determining how the system operates are changed to encourage practices that create public benefits and penalise behaviours that harm the public good. While this report advances a reform programme relevant to food and land use systems everywhere, it recognises that the specifics of change will inevitably look different from one country to the next and from one food and land use system to the next. The recommendations are, therefore, not intended as a universal blueprint. Rather, the aim is to help decision-makers in different countries and organisations choose their own pathways, working with their own stakeholders and taking their own circumstances into account.

The report is a “consultation report” in the fundamental sense of the term. It is based on technical and philosophical assumptions that can be legitimately challenged – which is why those assumptions have been explicitly spelled out. No approach to food and land use systems transformation will ever be complete. Therefore, the report is designed to inspire dialogue and debate across the world, and support a shared journey of learning, creativity and societal change. And it aims to build on the courageous work and experience of many change leaders by helping to scale up their efforts and accelerate progress towards the SDGs and Paris Agreement targets. It is to these change leaders – many of whom are taking significant professional and, at times, personal risks to construct more sustainable and inclusive food and land use systems – that the report is dedicated. We learn from and build on their experience.

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## The case for change

On the surface, the need for major change is not obvious. In recent decades, food and land use systems have done extraordinarily well in producing increasing quantities of food at low prices. Despite a rapidly growing population, more and more people worldwide have enjoyed affordable, safe and tasty food. While the prospect of famine and chronic food insecurity continues to stalk some areas of the world – including the Horn of Africa, Zimbabwe and Yemen – large-scale famine has become rare.<sup>2</sup>

Global food systems have consistently increased food production over the last three decades, aided by technology, greater inputs and unusually benign weather conditions in the most important food-producing areas.<sup>3</sup>

But that is not the whole story. Current food and land use systems are riddled with inefficiencies, including allowing land and water to be used in ways that are contrary to societal interests, slow diffusion of best practice beyond large commercial farms, under-investment in rural infrastructure and human capital, food loss and waste accounting for up to one-third of primary production, and negligible nutrient recovery from organic waste streams. They are heavily concentrated: four crops (wheat, rice, corn and potatoes) account for around 60 percent of calories consumed by humans,<sup>4</sup> and concentration ratios in key parts of the value chain are increasing sharply, not least because of mergers and acquisitions.<sup>v</sup> This increases risks — for example, of extreme weather events in several high-producing areas at the same time. It reduces resilience – as there are few buffers in the system and resilient, indigenous varieties of crops are crowded out. And it drives inequitable outcomes – as power and profits accrue to a limited number of actors and countries.

Food and land use systems also incur large and growing hidden costs:

- **Environment.** They are by far the single biggest driver of environmental damage.<sup>5</sup> They contribute approximately 30 percent of the greenhouse gas emissions driving climate change.<sup>6</sup> They are the leading cause of the continuing conversion of the world's tropical forests,<sup>vi</sup> grasslands, wetlands and other remaining natural habitats – and thus the main culprit of the ongoing "sixth extinction" of biodiversity.<sup>vii</sup> In addition, overuse of fertilisers and increasing use of herbicides and pesticides is polluting air, water and soils, creating ecological harm and material risks to human health in rural and urban areas.<sup>7</sup>
- **Public health.** Poor diets are compromising the health of billions. More than 820 million people, largely in sub-Saharan Africa and South Asia, still regularly go hungry.<sup>8</sup> One in five children under the age of five is stunted through undernutrition.<sup>9</sup> At the same time, more than two billion adults are overweight, of whom 680 million are obese.<sup>10</sup> If current trends continue, half the world's population will suffer from malnutrition by 2030, entailing escalating health care costs and human suffering.<sup>11</sup>
- **Inclusion.** The economic structure of food and land use systems means that hundreds of millions of people cannot make a decent living from their labour. They suffer from low levels of assets, particularly human capital, little connectivity to key markets, and a lack of tools to manage risks, making it hard for them to invest in their future. Power imbalances along global value chains further diminish opportunities for growth and diversification. Two-thirds of the 740 million people living in extreme poverty (on less than \$1.90 a day purchasing power parity (PPP) 2011) are agricultural workers and their dependents.<sup>12</sup> And while indigenous peoples and local communities customarily manage more than 40 percent of the world's remaining ecologically intact landscapes, governments formally recognise ownership rights to only ten percent of this area<sup>13</sup> – leading to rights violations and precarious livelihoods for many of the most vulnerable people.<sup>viii</sup>

<sup>v</sup> See for example IPES-Food. 2017. Too big to feed: Exploring the impacts of mega-mergers, concentration, concentration of power in the agri-food sector.<sup>14</sup>

<sup>vi</sup> Forests function as carbon sinks by removing carbon dioxide from the atmosphere during photosynthesis. Atmospheric carbon dioxide is fixed into the plant's chlorophyll and the carbon is integrated to complex organic molecules which are then used by the whole plant. When forests are cleared, for example through burning, they release the carbon within the plant into the atmosphere, becoming a source of carbon dioxide.

<sup>vii</sup> For more information on the "sixth extinction", see Ceballos, G., Ehrlich, P. and Dirzo, R. 2017. 'Population losses and the sixth mass extinction'.<sup>15</sup>

<sup>viii</sup> The world's 370 million indigenous peoples, inhabiting 3.8 billion hectares of land, are stewards of vitally important land.<sup>16</sup> 40 percent of the world's last remaining ecologically intact landscapes are under the tenure or management of indigenous peoples,<sup>17</sup> storing more than 200 gigatonnes of carbon and coinciding with areas that protect as much as 80 percent of the world's biodiversity.<sup>18</sup>



Analysis completed for this report estimates that these hidden costs amount to around \$12 trillion a year, equivalent to China's GDP and in excess of the \$10 trillion the global food and agriculture sectors contribute to world GDP, measured at market prices. These hidden costs are expected to grow to an estimated \$16 trillion by 2050 on current trends.<sup>19</sup> Moreover, some of the \$700 billion a year of support currently flowing to food and land use systems exacerbates these costs. And only around 15 percent of the support is dedicated to well-defined public benefit.<sup>20</sup>

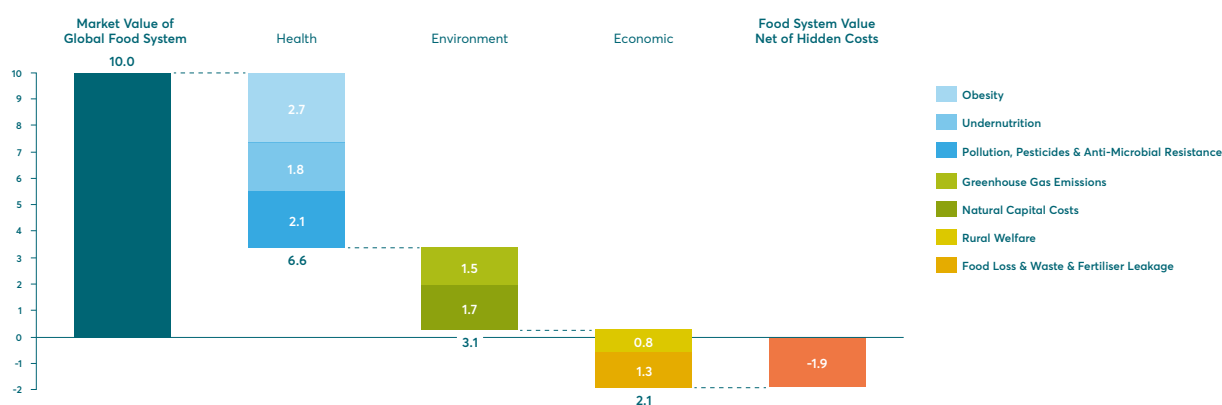
These hidden costs will continue to compound. Food and land use systems are leading sources of the greenhouse gas emissions driving climate change.<sup>21</sup> If these systems (along with energy systems) continue to follow current trends, the world will miss the Paris Agreement goals by a significant margin and could experience runaway climate change as a result. Catastrophes previously considered "tail-end"<sup>ix</sup> risks will then be increasingly probable. For instance, the likelihood of simultaneous production shocks affecting more than ten percent of production in the top four maize-exporting countries, accounting for 87 percent of global maize exports, rises from close to zero at present to seven percent under a 2-degrees Celsius warming scenario and to a staggering 86 percent under a 4-degrees Celsius warming scenario.<sup>22</sup> This would have a huge impact on global markets and the 740 million people living in extreme poverty. If that is allowed to happen, food shortages, migration and conflict on a scale rarely seen, and only in certain areas, over the past century will become regular events all over the world, with incalculable implications for food security and geopolitical instability.

Although numerous regions will struggle with these trends, nowhere are they likely to have greater impact than in sub-Saharan Africa, where they threaten to undermine recent economic progress and improvement in livelihoods, while causing extensive human suffering and ecological breakdown.<sup>x</sup> South Asia too is experiencing growing threats to its food security because climate change is destabilising water cycles in the region.<sup>23</sup> As the monsoon becomes less predictable, the risk of floods and droughts is rising. In both regions, these trends could lead to flows of climate refugees that will dwarf today's numbers, with profound humanitarian and political implications for the rest of the world.<sup>24</sup>

## EXHIBIT 1

# The hidden costs of global food and land use systems sum to \$12 trillion, compared to a market value of the global food system of \$10 trillion

Trillions USD, 2018 prices



Source: SYSTEMIQ, Food and Land Use Coalition, 2019 (see online technical annex for methodology)

<sup>ix</sup> Tail risk is defined here as the risk (or probability) of the occurrence of rare events.

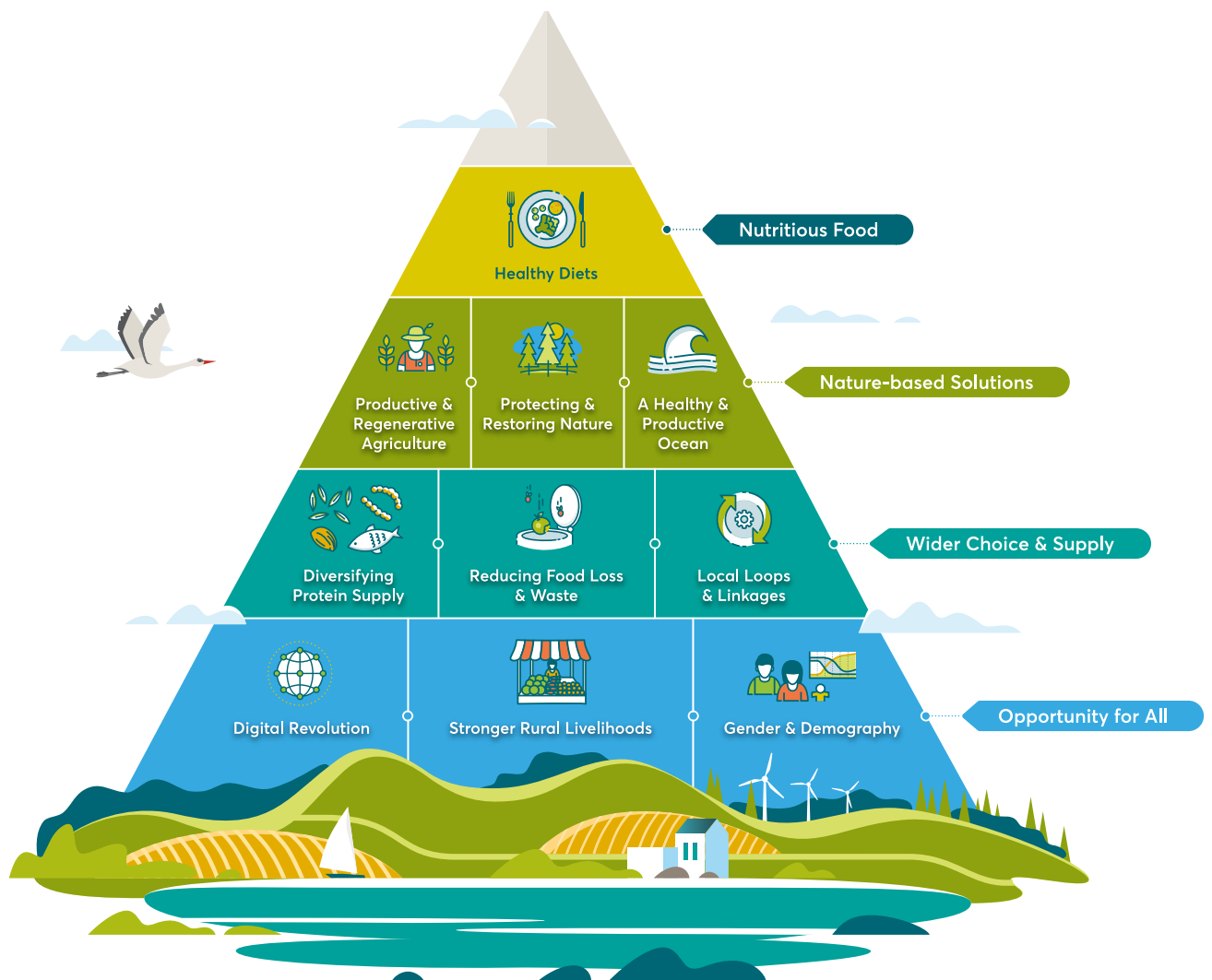
<sup>x</sup> For more information, see research paper commissioned for this report: "People, Health and Nature: A Sub-Saharan African Transformation Agenda" by Julia Turner, SYSTEMIQ & Assan Ng'ombe, AGRA. See also Chapter 3 of the IPCC Special Report on Global Warming of 1.5°C.<sup>25</sup>

# Ten critical transitions

Based on extensive consultation with practitioners and the research community, FOLU demonstrates that a reform agenda – centred around ten critical transitions (Exhibit 2) – could enable food and land use systems to provide food security and healthy diets for a global population of over nine billion by 2050, while also tackling core climate, biodiversity, health and poverty challenges.

## EXHIBIT 2

### Growing Better: Ten Critical Transitions to Transform Food and Land Use



The exhibit conceives of the agenda as a pyramid. At its apex is nutritious food. This is because the consumption patterns of more than nine billion people – what they choose to eat and how they make (or are influenced to make) those choices – are the critical factors shaping how food and land use systems evolve. Empowering consumers to make better-informed decisions and pursue a transition to diets that are healthier for them and for the planet ignites the whole reform agenda.

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At the second level of the pyramid, the power of nature-based solutions is mobilised to create more productive, regenerative techniques of food production, new approaches to protecting forests and other critical ecosystems, and new ways to manage the ocean in order to protect ocean life and increase ocean protein production. All nature-based solutions have common features. They require effective legal mechanisms to protect natural capital. They require producers – farmers, fishermen and indigenous communities – to be paid transparently and fairly for the ecosystem services they provide. And they show that it is possible simultaneously to strengthen food security, tackle climate change and protect biodiversity. No trade-off is necessary.

The third level is made up of transitions that expand consumer choice. Accelerating the diversification of protein supplies, reducing food loss and waste and creating more local supply chains, together with tighter resource looping, are all ways to diversify supply, reduce environmental pressures and expand consumer access to affordable, healthy food. All need different forms of public-private partnership and behaviour change, often at a local level, if they are to lend themselves to being scaled up fast.

Finally, the pyramid's foundation puts inclusion and justice at the heart of the transformation. The transitions at this level will ensure that digitisation is used to empower people rather than to concentrate data, that investment is made in the talent, infrastructure and social systems needed for a rural renaissance, and that women are supported in making choices that are better for their families and communities.

## Nutritious food

- 1. Promoting healthy diets.** This transition sees human food preferences worldwide converging towards the nutritious "human and planetary health diet" (see Box 2 below). This transition would help tackle malnutrition – too few calories, too little protein, and insufficient micronutrients, currently causing stunting, wasting and anaemia, on the one hand, and too many calories causing obesity and diet-related non-communicable diseases, including cardio-vascular disease and diabetes, on the other. Transition to healthier diets generates climate and biodiversity gains as foods prevalent in healthy diets are generally more resource efficient (for example, in the amount of land and water needed to produce them) than foods widely found in less healthy diets. In particular, limiting the growth of demand for meat, especially ruminant livestock, in tandem with more efficient production, yields massive land-sparing opportunities.

Accelerating the shift to healthier diets depends upon changing consumer behaviour and the food environment, i.e. making healthy food more available, appealing and affordable. Government and private sector action will thus be required. Governments should provide strong, clear dietary guidelines based on recognised approaches such as those from the World Health Organization and the EAT-Lancet Commission. They must align policy and regulatory frameworks, public procurement and fiscal policies to reward healthy food and penalise unhealthy food. For example, they could tax ultra-processed foods high in sugar, salt and saturated fats, and use subsidies to support the introduction of healthy foods. They can provide public health professionals with proper training in providing dietary guidance and impose tougher regulations and enforcement regarding labelling and marketing.

Business, for its part, needs to raise its game by consciously shifting product development, marketing spending, point-of-sale product information, supply chains and prime retail space towards affordable, healthy food options – for poorer and more affluent consumers alike.

Civil society could help drive this transition through high-impact public information campaigns – comparable to the effort to curb smoking – and by holding governments, business and finance to account.

## Key parameters of a human and planetary health diet

Achieving human and planetary health requires people's diets to:

- Converge to predominantly plant-based diets, though with still significant room for consumption of animal, oceanic and alternative proteins.
- Include more protective foods like fruits, vegetables, whole grains, legumes, and nuts.
- Limit unhealthy food consumption, such as salt, sugar and saturated fats.
- Moderate red meat consumption – meaning a reduction in settings currently consuming beyond their fair share but increases where consumption is below dietary recommendations.
- Transition to increased consumption of whole, rather than refined, grains.
- Include little, preferably no, ultra-processed foods high in saturated fats, salt, and sugar.

Food group intake ranges as recommended by national dietary guidelines or the EAT Lancet Commission's Planetary Health Diet allow flexibility to accommodate food types, agricultural systems, cultural traditions, and individual dietary preferences – including variations on flexitarian, omnivore, vegetarian, and vegan diets.

A universal healthy diet is attainable, and at the same time, options and pathways to affordable and desirable healthy diets are not uniform and can be applied locally.

## Nature-based solutions

- 2. Scaling productive and regenerative agriculture and making all agriculture more sustainable.** A large-scale shift to regenerative agriculture<sup>xi</sup> has the potential to maintain yields, while enhancing soil health, by reducing average per hectare use of fertilisers and pesticides and deploying them more intelligently, and increasing the diversity of healthy, planet-friendly foods produced and consumed. Farmers continuously experiment to get better results and forms of regenerative farming have been evolving for millennia, based on deep knowledge of local soil, water and weather conditions. Productive regenerative practices combine traditional techniques, such as crop rotation, controlled livestock grazing systems, low-till agriculture, agroforestry and cover crops, with advanced precision farming technologies and new bio-based fertilisers and pesticides. They are supported by related techniques such as sustainable land management and integrated water resource management.

For this transition to scale at speed, a number of things need to happen. Small farmers and local communities in many parts of the world need secure tenure rights to make their lands investable. They need improved extension services – including seedbanks providing locally adapted, agrobiodiverse selections – and access to finance and markets. Governments need to direct agricultural subsidies and other public finance (including carbon pricing) to support farming practices that deliver environmental and health benefits. Business needs to offer greater commitment through longer-term off-take agreements and more active support to farmers. Government and business together need to expand research and development (R&D) spending. And open-source information sharing should be established throughout food and land use systems.

<sup>xi</sup> Cranfield University have identified three main ways of defining regenerative agriculture: including 1) a set of practices that regenerate soil, 2) which may or may not avoid synthetic fertiliser and pesticides, and 3) a focus on going beyond the reduction of negative impacts to ensure that agriculture has a positive environmental effect. For more detail, please see: Burgess PJ, Harris J, Graves AR, Deeks LK (2019) Regenerative Agriculture: Identifying the Impact; Enabling the Potential. Report for SYSTEMIQ. 2019. Bedfordshire, UK: Cranfield University.

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**3. Protecting and restoring forests and other natural ecosystems.** This transition aims by 2030 to bring the gross loss of forest down to near zero and halt the conversion of other natural ecosystems, reduce tropical forest degradation to negligible levels and bring at least 300 million hectares of degraded tropical forests into a process of active forest restoration. Protecting and restoring global forests could reduce annual net greenhouse gas emissions by more than eight gigatonnes carbon dioxide equivalent (GtCO<sub>2</sub>e) by 2050, which is consistent with limiting global heating to 1.5-degrees Celsius. It would also come close to halting terrestrial biodiversity loss, and would, promote equitable development for forest-dwelling and forest frontier communities, whose land tenure and rights need to be secured and defended as a matter of priority.<sup>26</sup>

Success is compatible with growth in agricultural output: in the Brazilian Amazon, deforestation rates were cut by over 70 percent between 2005 and 2014, and regional agricultural production increased.<sup>27</sup> The success of this transition depends upon other transitions delivering raised productivity, a more diversified protein supply from land and ocean, and reduced food loss and waste.

Systems-level modelling shows that there is no macro-level trade-off between producing food and protecting nature. There is enough land for both, if land is managed well, albeit that international spill-over effects from subsidy regimes in a few major exporting countries can distort decision-making.

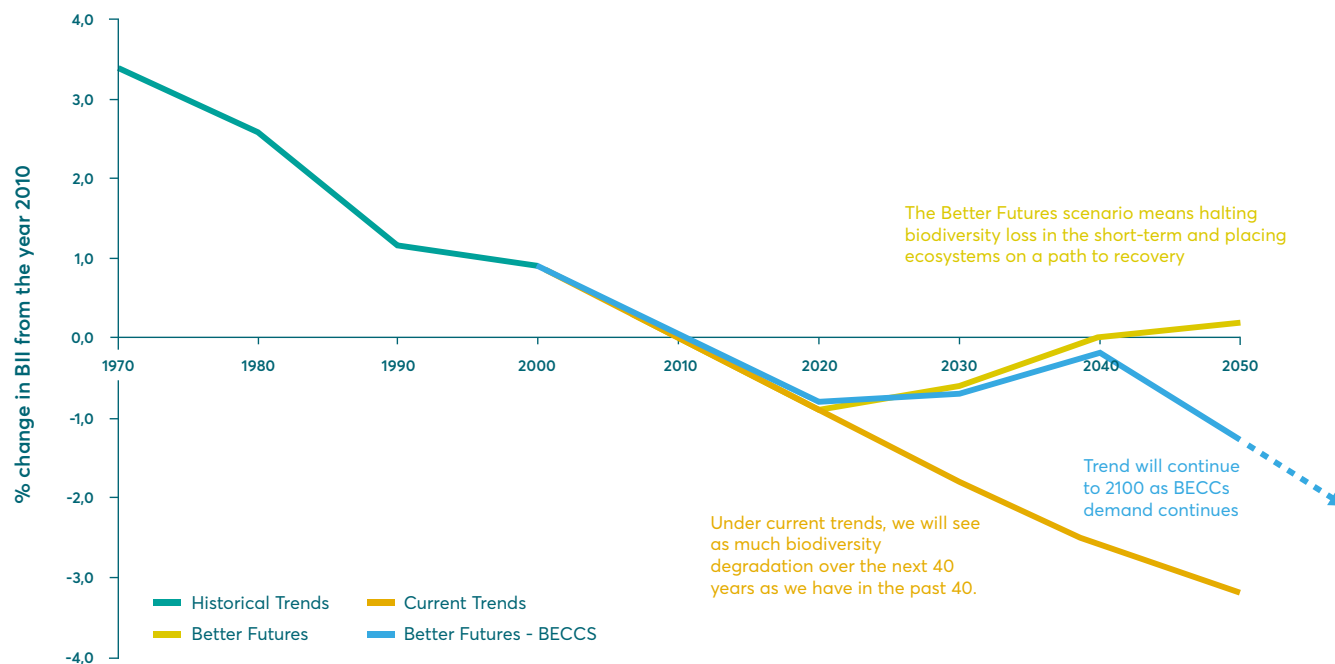
For the local farmer, however, choosing between protecting nature and expanding agriculture involves a very real trade-off. To make sure the farmers facing these trade-offs are exposed to the proper incentives, this report suggests the use of both “carrots and sticks”. The sticks are regulatory measures to make the encroachment of farming on forests less attractive. These include stricter land use planning, pricing of external factors such as greenhouse gas emissions, expanding protected areas and indigenous peoples’ territories, strengthening relevant public institutions and stronger law enforcement at all levels, including cracking down on rent-seeking behaviour from public officials.<sup>28</sup> An international crackdown on illegal deforestation through a Global Alliance Against Environmental Crime is essential.

The carrots are payments for ecosystem services – including a scale up of results based payments for reduced tropical deforestation (REDD+ or “Reducing Deforestation and Forest Degradation in Developing Countries”) to \$50 billion by 2030 if results are delivered – and investment in innovative forest frontier business models, which both protect forests and create alternative sources of income for local communities.<sup>29</sup>

This outcome also depends on governments halting support to the types of biofuels which compete for land with agriculture and natural ecosystems – as is generally the case with current biofuels mandates – and to hold at-scale bioenergy with carbon capture and storage (BECCS) as only a post-2040 option only. Maximising land use for natural reforestation in the meantime. Private sector involvement – most importantly through establishing a global standard of zero tolerance for deforestation and other ecosystem conversion in commodity supply chains – is essential.

## A BECCs scenario will reverse gains on biodiversity recovery and continue this downwards trend through to 2100

Biodiversity Intactness Index (BII): evaluates impacts on local biodiversity in terrestrial ecosystems



Source: IIASA GLOBIOM 2019; Le clere et al., "Towards Pathways Bending the Curve Terrestrial Biodiversity Trends within the 21st Century", 2018, for historical reconstruction

- 4. Securing a healthy and productive ocean.** The ocean could sustainably supply 80 to 90 million metric tonnes of seafood protein a year (versus around 50 to 60 million tonnes unsustainably sourced today),<sup>xii</sup> reducing demand for land to supply protein and improving human health at the same time.<sup>30</sup> The reform of wild-catch fisheries to uniformly sustainable practices will prevent their further decline, stabilise fish stocks and add a net 11 million tonnes of yearly protein supply – a relatively small but essential contribution.<sup>31</sup>

Most of the ocean's added protein potential will be supplied by mariculture,<sup>xiii</sup> especially from finfish. Key to expanding the sustainable wild-caught ocean food supply is the global adoption of limits on total allowable catch, the equitable allocation of that catch, tough national and international action to stop illegal fishing, and the rapid phasing-out of subsidies that expand fishing capacity. The growth of finfish mariculture requires the accelerated development of fish-free mariculture feed, the global adoption of safe operating practices, and the streamlining of regulatory processes. Coalition research also indicates the potential to expand the production of bivalves (such as clams, oysters and mussels) as an environmentally benign protein source both for direct human consumption and as feed for aquaculture, although further analysis and due diligence remain to be done before its sustainable potential can be quantified with any degree of certainty.<sup>32</sup>

### Wider choice and supply

- 5. Investing in more diversified protein supply.** This transition offers significant human health and environmental benefits. Diversification of human protein supply falls into four main categories: aquatic (as described in critical

<sup>xii</sup> Range accounting for uncertainty of bycatch volumes and refers to meat weight rather than whole fish weight.

<sup>xiii</sup> Mariculture is a specialised branch of aquaculture involving the cultivation of marine organisms for food and other products in the open ocean, an enclosed section of the ocean, or in tanks, ponds or raceways which are filled with seawater.

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transition 4 on securing a healthy and productive ocean), plant-based, insect-based and laboratory-cultured. The latter three sources alone could account for as much as ten percent of the global protein market by 2030 and then scale rapidly.<sup>33</sup> More R&D spending as well as tailored regulatory regimes are key to helping the private sector drive this change at speed and scale. Animal protein will continue to play an important role: certain vulnerable groups, such as women of childbearing age and young children in low-income countries will indeed need to increase their animal protein consumption to improve their health. More sustainable production of meat, dairy and eggs is therefore also essential.

- 6. Reducing food loss and waste.** Reductions of 25 percent in food loss and waste by 2050 would significantly reduce both demand for land and greenhouse gas emissions.<sup>xiv</sup> Effectively increasing the supply of perishable products such as fruit and vegetables would have public health benefits and contribute to incomes for smaller farmers, many of whom struggle to meet the precise product specifications of large retailers, leading to large volumes of food being rejected.

Reducing loss and waste is a challenge similar to improving energy efficiency. With effects that are often fragmented and invisible, for many actors it is not a top priority and is seen as a relatively small “tax” in a busy life where convenience wins out. Hence the seemingly unambitious aim of a 25 percent reduction. Driving real change will require much greater transparency in food supply chains, more investment in better (especially cold) storage and logistics, particularly in developing countries, and changes in consumer behaviour.

Many countries and companies are taking action in these areas though. Indeed, innovations are starting to break through, including the use of machine learning in the catering sector (leading to meal designs that are intrinsically low waste and that improve margins) and digital platforms which create local food-sharing cultures. So far, most countries and communities are only tapping into a small part of the potential prize. More could be done through shifts in regulation (enabling food retailers to dispose of post-dated but still safe food to charities, for example), through disclosure standards that would require larger companies (including retailers) to be transparent about food waste, and through efforts by civil society and companies to shift consumer norms in the same way that is happening with single-use plastics.

- 7. Building local loops and linkages.** Peri-urban areas could become major farming centres over the next decade, especially for fruit, vegetables and other perishable foods. Urban farming could provide useful supplementary production but is likely to remain at more limited scale. However, urban areas are huge producers of organic waste, less than two percent of which is recovered as nutrients that are looped back into the local agricultural economy.<sup>34</sup> There are already many different initiatives taking shape, from an explosion of farmers markets to new alliances that would push up nutrient recovery rates. Some cities are going further and supporting innovative investments in high-tech horticulture (e.g. hydroponics, vertical farming) and low-tech circular business models (e.g. turning rich coffee grinds back into a growing medium for mushrooms). However, the potential of local food economies to deliver health, environmental and employment benefits has been limited by a range of barriers from the way in which large retailers configure their supply chains through to the uncontrolled sprawl of towns into prime agricultural land. Around 0.4 million hectares of agricultural land is lost annually through urban sprawl, mainly in developing countries.<sup>35</sup> Strengthening local food economies, especially around rapidly growing towns, is a key part of an overall food security strategy for countries, and would benefit from better urban planning rules, smart public procurement, and new digital platforms to create direct linkages between producers and consumers, strengthening local value chains.

<sup>xiv</sup> SDG target 12.3 is to, by 2030, reduce per capita global food waste at the retail and consumer levels by 50 percent and to reduce food losses along production and supply chains, including post-harvest losses. The Better Futures scenario in the GLOBIOM model assumes a 25 percent reduction in both food loss and waste by 2030 as we did not want to be overly ambitious with our modelling. We do note, however, that further technological advances in this area, for example technology extending shelf life of perishable food and climate-smart cold storage, could enable even bigger gains with a reduction in food loss and waste by 50 percent.

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## Opportunity for all

**8. Harnessing the digital revolution.** Digitisation of food and land use systems is occurring through gene-editing techniques (including CRISPR<sup>xv</sup>), precision farming, and logistics and digital marketing tools. In principle, digitisation could be beneficial for small independent producers and consumers, enabling them to make better, more informed choices. Where infrastructure is weak, as in sub-Saharan Africa, digital innovation offers the opportunity to bypass now-obsolete technologies and connect to the value chain rapidly and efficiently.

There are real risks, though, that digitisation could result in greater corporate concentration and control, given the evolution of big data approaches. This transition, therefore, is about what governments, business and civil society must do to make digitisation a driver of a more equitable, sustainable food and land use systems: from the public sector's own approach to providing data access, to protecting consumers' data privacy and philanthropic support for open source communities.

**9. Delivering stronger rural livelihoods.** This transition recognises the massive changes taking place across the countryside, especially in the developing world. Inevitably, there will be further large-scale migration from rural to urban areas. Meanwhile, there is a major challenge in attracting young entrepreneurs to rural areas and keeping them there, whether for farming (increasingly knowledge-based and digital), for other nature-based activities (such as natural forest protection and restoration) or for non-agricultural businesses. Rural incomes across the world are on average half as much as urban incomes, and the gap is growing.<sup>36</sup> Serious efforts are therefore needed to make sure that the countryside is not left further behind.

Key actions identified in this transition include supporting the rights of women and indigenous communities to own, manage and control the land that provides livelihoods, community well-being and food security. Investment in rural infrastructure, whether in traditional assets such as roads or new assets such as broadband connectivity and renewable energy, will be essential. And training and support will be needed for the circa 100 million new rural entrepreneurs required over the next decade, in farming and other enterprises. Businesses must invest in value-added activities in a wider range of countries and regions and pay a living wage throughout their supply chains.

**10. Promoting gender equality and accelerating the demographic transition.** Women can be enormously powerful in shaping food and land use systems, thanks to their central role in agriculture and in decisions concerning nutrition, health and family planning. Strategies for implementing the critical transitions need to target gender equity explicitly, given the widespread inequality experienced by women in food and land use systems today. Making sure women have equal access to resources, such as land, labour, water, credit and other services, should be central to policies concerning the transitions.

Similarly, investing in education for girls and women, in maternal and child nutrition and in health and reproductive support services will accelerate the demographic transition in every country. Access to reproductive health services is the way to enable women to exercise their right to decide freely how many children to have and when to have them. Having smaller families, particularly in countries where large families have been the norm, will improve the lives of millions of women. As birth rates fall, families and countries can spend more per child on education and health, better preparing them to join the work force. Moreover, lower birth rates lead to reductions in greenhouse gas emissions, consumption of natural resources and competition for land.

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<sup>xv</sup> The CRISPR-Cas9 (Clustered Regularly Interspaced Short Palindromic Repeats and CRISPR-associated) revolution since 2013 dramatically increases opportunities to improve breeding through genetic manipulation. CRISPR enables researchers to alter genetic codes cheaply and quickly in precise locations, insert new genes, move existing genes around, and control expression of existing genes. CRISPR follows a related genomics revolution, which makes it cheap to map the entire genetic code of plants, test whether new plants have the desired DNA without fully growing them and purify crop strains more rapidly (World Resources Report, 2018).





Left: Farmer Usha Rani from the Agripally village in the Krishna district of Andhra Pradesh, India, utilising Zero-Budget Natural Farming (ZBNF) practices.

## A great deal for the planet

To understand the economic consequences of implementing the ten critical transitions, the research team evaluated two core scenarios, based on detailed modelling and analysis.

A Current Trends scenario shows the likely effects if food and land use systems follow current trends in dietary preferences and the use of natural resources. Choosing to follow this scenario will put the SDGs and Paris Agreement targets beyond reach, leading to incalculable human suffering.

A Better Futures scenario tests the implications of implementing a reform agenda consisting of the ten critical transitions (Box 3).

The results from any scenario modelling exercise are, of course, driven by assumptions and dependent on the model's technical specifications. They could also change dramatically because of shocks to the system, whether technological, climate-related or economic. Nonetheless, the directional results – the striking magnitude of divergence of outcomes between the Current Trends and Better Futures scenarios – offer a quantitative illustration of two alternative futures. In fact, if anything, evidence suggests that the formal results may understate the divergence. The risks in the Current Trends scenario are much greater than formally modelled, not least because climate-related risks to agricultural production are only partially addressed. And the upside from a deliberate, strategic shift to the Better Futures scenario could also be much greater, as new technologies benefit from their own experience curves and new, digitally enabled supply chains are configured.

## Modelling Current Trends and Better Futures

The main modelling for this report has been produced by the International Institute of Applied Systems Analysis' (IIASA) Global Biosphere Management Model (GLOBIOM), informed by in-depth analytical work on specific sectoral issues. The model provides a link between agricultural production choices and their impact on the planet. Complementary modelling was done by the University of Washington on diets and health; in addition, we run scenarios on income and employment using the World Bank Shockwave model. A more detailed exposition on the modelling can be found in the technical annex of the full online report (Annex B).

The aim of the modelling is to offer broad insights into developments under two different scenarios.

The baseline scenario, "Current Trends", was designed to deliver a picture of a future grounded in historical trends. This future would see considerable progress and innovation (for example with regards to agricultural productivity) within the framework of the current system. Current Trends mainly relies on the standardised set of assumptions that has informed the analysis of the Intergovernmental Panel on Climate Change's 5th Assessment Report (IPCC AR5), coupled with the matching set of climate assumptions.<sup>xvi</sup> Under this scenario the world gets nowhere close to meeting the SDGs or the Paris Agreement targets.

The reform scenario, "Better Futures", is based on ten assumptions of fundamental change, derived from the ten critical transitions. Strong (but not perfect) implementation of the ten critical transitions would be the key to achieving the outcomes described in this report.<sup>xvii</sup>

### The key assumptions are:

- 1. Aggregate average agricultural productivity** continues to increase following historic trends at a rate of 0.9 percent a year under Current Trends. The Better Futures scenario assumes an additional 12 percent increase in productivity by 2050 due to technological advancements, i.e., an annual rate of increase of 1.1 percent overall. This reflects renewed efforts in R&D and technological diffusion, and large investments in infrastructure, which would help raise yield and reduce the yield gap between more productive and less productive producers.
- 2. By 2050, food loss and waste could be reduced by 25 percent.**<sup>xviii</sup>
- 3. Negligible conversion of forests and other natural ecosystems from 2020 onwards is possible.**

This assumption is based on what exogenous climate modelling finds necessary to limit global warming to 1.5-degrees Celsius. It thus describes the necessary level of ambition. This report recognises that ending deforestation next year is unrealistic under any assumptions. However, the essential point to take away from the modelling is that the reform agenda to halt deforestation needs to be put in place without delay. The reform agenda described in this report aims to achieve the desired result as soon as possible, realistically between 2025 and 2030 (this has a knock-on effect for biodiversity, as well, where the model has recovery starting in 2020, yet realistically that would happen gradually between 2025 and 2030, as deforestation is gradually halted).

- 4. Systematic measures to increase energy efficiency globally** can achieve a reduction in energy demand by 40 percent relative to current demand – this would help the planet stay within a 1.5-degrees Celsius pathway without deployment of bioenergy with carbon capture and storage technologies (BECCS).<sup>xix</sup>

<sup>xvi</sup> Our Current Trends scenario is defined by the Shared Socio-Economic Pathway 2<sup>37</sup> and by the climate assumptions of the Representative Concentration Pathway 6.0.<sup>38</sup>

<sup>xvii</sup> A number of the key institutional features introduced in the critical transitions, such as structural changes that would lead to shorter supply chains, could not be modelled with the tools available. Their impacts are, therefore, described in more qualitative terms. These challenges were particularly strong when constructing socio-economic scenarios, given the limited number of variables that could be used to depict changes to livelihoods.

<sup>xviii</sup> Note that the Sustainable Development Goal target is to reduce per capita global food waste at the retail and consumer levels by 50 percent, and to achieve a reduction in food losses along production and supply chains, including post-harvest losses by 2030. Recent analysis, however, demonstrates that achieving this goal is only achievable with breakthrough technologies and behavioural change. To avoid unrealistic assumptions, a 25 percent reduction has been modelled for this report.

<sup>xix</sup> Grubler et al (2018) illustrates how such a low energy demand scenario is possible based on rapid social and institutional changes in how energy services are provided and consumed, in addition to technological innovation. Trends in this direction are already observable (e.g. digitalisation and device convergence reduce energy demand, with a smartphone providing a single integrated digital platform which potentially replaces over 15 different end-use devices).<sup>39</sup>

Though achievable, this is an ambitious assumption. For this reason, and because a number of other 1.5-degrees Celsius assumptions are also ambitious, an option is maintained to deforest, starting around 2040, some of the newly reforested land and use the biomass for BECCs, if such a solution becomes imperative to avoid runaway climate change and if further analysis demonstrates the relative merits of such an option relative to relevant alternatives.<sup>40</sup> Note that if the BECCS alternative is implemented, there will be significant negative consequences for biodiversity from 2040 onwards (see Box 25 on bioenergy in Chapter 3 of the full online report).

5. **Enough food will be produced in 2030 to deliver on the ambitions of SDG2** (to end hunger, achieve food security and improved nutrition and promote sustainable agriculture), making it possible to eliminate food insecurity by 2030.
6. **The world would converge towards “human and planetary health” diets by 2050** (see Box 2 on page 20), with significant progress in that direction by 2030. This would include a global convergence in calorie intake and average level and composition of protein consumption.
7. **The ocean would deliver 40 percent more sustainable proteins over the next 30 years.**

Note that the potential is far larger, as Chapter 3 demonstrates, but a number of uncertainties makes a conservative assumption more realistic.

8. **Significant investments in human capital, technology diffusion and the digital revolution** would support the emergence of a new generation of young rural entrepreneurs who can take advantage of the opportunities offered by the transformation of food and land use systems and create decent jobs in agriculture and in the processing of agricultural products.
9. **Increased investment in rural infrastructure** (e.g. roads, clean electrification) and connectivity would be the key to overall income growth, helping to drive off-farm value added and the creation of non-agricultural jobs.
10. **The combination of investments in rural assets and the design of new productive safety nets** increases the resilience of the rural population in the face of possible dislocations caused by the transformation of food and land use systems and increasingly likely weather shocks.

These assumptions were tested by conducting sensitivity analysis around variable specifications. The narrative accounts for key uncertainties – such as the potential negative impact of climate change and the potential positive impacts of technology – on agricultural yields. In sum, the assumptions provide a realistic basis for the Better Futures scenario, though, again, that scenario depends on the full implementation of the ten critical transitions laid out in this report.

The implication of recent reports from the IPCC is that limiting global warming to as close to 1.5-degrees Celsius as possible is essential to avoid the risk of runaway climate change and to minimise the consequences of unavoidable climate change. Following the precautionary principle, the modelling underpinning this report, therefore, takes the need for the world to get on to a 1.5-degrees Celsius pathway as an ongoing assumption. Success depends on fundamental changes not only in food and land use systems but also in other key systems, notably energy. None of these systems are advancing fast enough today. Implementing the report’s framework of reforms can get the world’s food and land use systems on the right track fast. However, success in transforming food and land use systems depends on other sectors stepping up the pace of change with the same degree of urgency (and vice versa).

### The main outcomes of the modelling include:

1. **Higher productivity, reduced food loss and waste and dietary shifts** yield the opportunity to shift up to 1.5 billion hectares of land away from agriculture compared to the Current Trends scenario, meaning that:

Greenhouse gas (GHG) emissions are reduced in a way that is consistent with the 1.5-degrees Celsius pathway recommended by science. At a conservative estimate of the social cost of carbon, the differential in emissions between the Better Futures and Current Trends scenarios can be estimated at around \$1.3 trillion annually, mainly achieved by protecting and restoring tropical forests.

The Biodiversity Intactness Index (BII) in the Better Futures scenario decreases by one percent between 2010 and 2020, which represents around one third of the losses experienced over the past 40 years. It, however, starts to recover after 2020, a sign of halting and reversal of biodiversity declines. In contrast, under the Current Trends scenario, biodiversity continues a steady decline towards the “sixth extinction” at a speed similar to that of the last 40 years, reaching 3.2 percent loss in BII between 2010 and 2050.

As demand and production methods change, the advantages of high intensity agriculture erode, reducing overuse of fertilisers and herbicides/pesticides.

By 2030, sufficient food is produced to feed everybody on the planet nutritious diets, while protecting affordability. A number of actions, such as ongoing agricultural productivity gains, reductions in food loss and waste and shifts in diet towards less-resource intensive foods, contribute to making this food affordable and accessible to the full global population. This could yield dramatic gains in the battle against poverty.

Shifting to healthier diets has the potential to more than halve by 2050 the number of people dying prematurely due to diet-related non-communicable diseases caused by high body mass index, from ten million to around five million.

2. **The economic gains to society from reducing the current “hidden costs” of food and land use systems** would sum up to \$5.7 trillion annually by 2030 and \$10.5 trillion annually by 2050. These numbers are almost certainly under-estimates, since they do not properly price in the benefits of reducing tail risks.
3. **Rural incomes grow twice as fast over those under the Current Trends scenario, and over 120 million more decent jobs are created in the countryside.**
4. **Financing the food and land use transformation agenda requires significant reallocation of capital** to new assets across food and land use systems, combined with an estimated annual \$300 – 350 billion increase in total capital investment – less than 0.3 percent of global GDP during the period. The world needs to invest more wisely, reducing systemic inefficiencies and redeploying capital in line with a more honest account of risk-adjusted returns.

The scale and extent of these results are impressive. They may even seem over-optimistic. However, the modelling of the Better Futures scenario has incorporated a large degree of caution and flexibility. In particular, the assumptions are based on the scaling-up of existing technologies, while in many areas there are signs that entirely disruptive change is within reach.

Thus, while some aspects of the recommended transformation are likely to turn out less positively than modelled, others might be more positive, for example;

- Mariculture production of seafood is primarily constrained by the availability of feed in the form of fish meal and fish oil. If it were possible to remove this constraint by sourcing these proteins from molluscs, the productive potential of oceanic aquaculture would become almost unlimited. If such a technological breakthrough were achieved, consumption of poultry and pork could be replaced by consumption of farmed carnivorous fish such as salmon, and about 200 million hectares of cropland would be saved in the process.

**BOX 3 - Continued**

- The model allows for significant reforestation over 800 million hectares, but the theoretical potential under the hypothesis of agricultural intensification is more than twice as large. Even if only half of the additional potential were leveraged, almost four additional gigatonnes of carbon dioxide equivalent (GtCO<sub>2</sub>e) would be removed from the atmosphere annually by 2050, for a value to society of \$400 billion.
- Scientific consensus indicates that a range of five to 13 GtCO<sub>2</sub>e a year of additional sequestration from forests could be achieved, depending on tree species' growth differences and what happens to the timber afterwards. However, these differences cannot currently be captured by the model in its calculations.
- Assuming that the appropriate measures were put in place by governments to support such activity, re-wetting deforested peatlands could result in a two thirds reduction of ongoing emissions from deforested land from 2025 onwards, resulting in a net negative emissions from the pre-farmgate food and land use sector by 2050 (up to one GtCO<sub>2</sub>e per year). That seems, for now, a likely scenario, given the impressive progress the Government of Indonesia is currently making in this area.
- While modelling for this report assumes a 25 percent reduction in food loss and waste, the potential is clearly larger if sufficient capital, regulatory action and innovation is targeted at the problem, yielding the potential for additional economic gains and reductions in greenhouse gas emissions as well as in biodiversity and ecosystem loss.

In other words, there is significant potential upside in the Better Futures scenario beyond the encouraging outcomes described above, if the ten critical transitions are fully implemented. As so often, the essential variable is political will.

**EXHIBIT 4**

**In 2050, the hidden costs of Global Food and Land Use Systems rise to \$16.1 trillion under the Current Trends scenario and reduce to \$5.5 trillion in the Better Futures scenario**



Source: SYSTEMIQ, Food and Land Use Coalition, 2019 (see online technical annex for methodology)

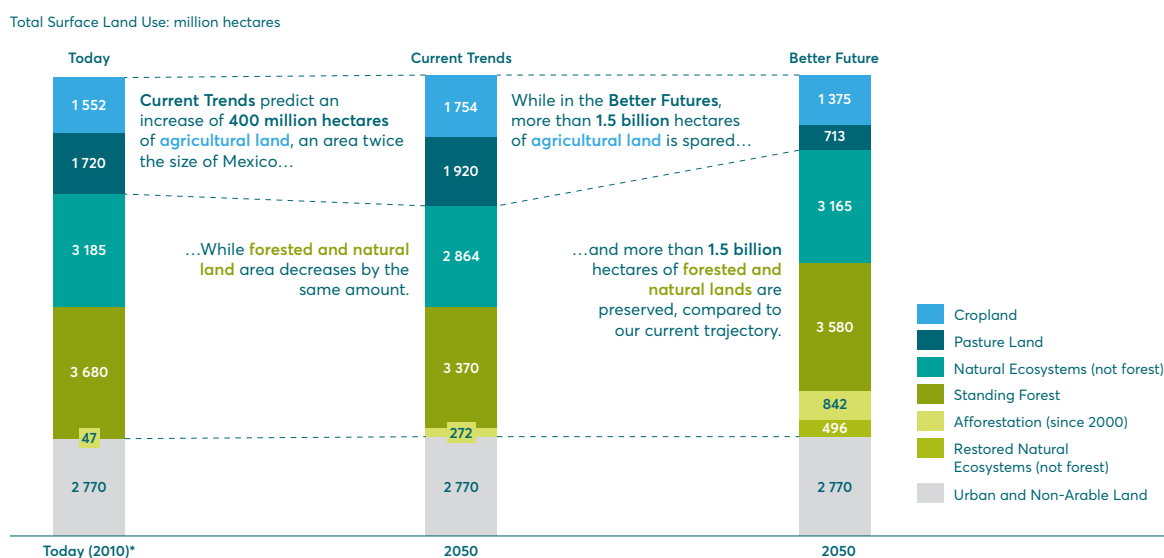
As Box 3 demonstrates, the Better Futures scenario yields significant gains for the environment, human health, inclusive development and food security, relative to Current Trends. In sum, the economic gains to society from implementing the ten critical transitions and thereby reducing the hidden costs of current food and land use systems could reach an estimated \$5.7 trillion a year by 2030 (equivalent to Japan's GDP today) and \$10.5 trillion a year by 2050.<sup>41</sup> Rural incomes will grow twice as fast as expected as more than 120 million additional jobs paying decent wages are created in the countryside, helping to close some of the current gap between rural and urban incomes and stem pressures to move to urban areas (Exhibit 4).<sup>42</sup>

Taking a more granular perspective, the ten critical transitions could drive a turnaround of food and land use systems. They could deliver:

- **Better environment.** Benefits to be achieved include becoming net carbon-neutral, contributing up to one-third of the mitigation needed for the 1.5-degrees Celsius climate pathway recommended by scientists and the Paris Agreement, halting biodiversity loss, restoring ocean fish stocks and bringing about an 80 percent reduction in air pollution caused by food and land use systems.
- **Better health.** Through a global convergence on the human and planetary health diet and producing enough nutritious food – including a diversified mix of proteins to fulfil everyone's needs – eliminate under-nutrition (in aggregate, recognising that there will still be extreme poverty-driven pockets) and halve the disease burden associated with consuming too many calories and unhealthy food.
- **Inclusive development.** The transitions could boost income growth for the bottom 20 percent of the rural population, increase yields of low-productivity smallholders, create over 120 million extra decent rural jobs and contribute to a secure future for indigenous peoples and other local communities across the world.

## EXHIBIT 5

**In the Better Futures scenario, 1.2 billion hectares of land which is currently used for agriculture will be freed up for restoration of natural ecosystems by 2050. Conversely, in the Current Trends scenario, a further 400 million hectares of natural ecosystem will be converted for agriculture**



\* Baseline data forecast from 2000  
Source: IIASA GLOBIOM 2019

Note: According to IIASA estimates, parts of the permanent pastures, as defined in the IPCC 2019 Special Report on Climate Change and Land report, are pastures without significant contribution to total livestock production and thus, are included in the land use classification 'Natural Ecosystems Land'. The 'Pasture' land use classification includes only grassland utilised for agricultural production.

- **Food security.** The transitions could increase food security significantly by helping to stabilise or even lower real food prices, supplying enough food of the right quality and quantity and improving access for the poorest and most vulnerable.

The explanation for the – somewhat counterintuitive – downward rather than upward pressure on food prices is a combination of the dietary shift towards less resource-intensive foods, combined with ongoing increases in agricultural productivity and reductions in food loss and waste.

By far the most important reason why these results are achievable, is the freeing up – relative to Current Trends in 2050 – of more than 1.5 billion hectares of land that would otherwise be used for farming and livestock grazing. This land can be restored to nature, creating potential to protect all remaining forests and other natural ecosystems and to enable more sustainable, secure food production by helping to stabilise local and global climate conditions. Instead of repeating the developed-country cycle of massive natural capital destruction followed by partial regeneration, developing countries could deploy their land in ways that would be better for farmers, for local indigenous communities, for nature and for the climate. With the right policies, transition support and investments in place, these objectives are not in conflict, but positively reinforce one another. But the change will not happen without real support, financing and leadership.

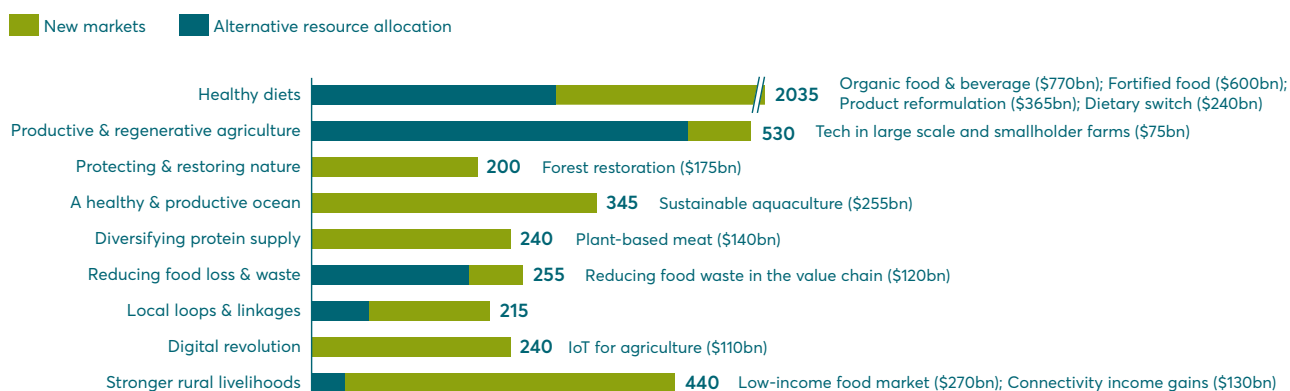
Achieving these outcomes also depends on international trade continuing to deliver a significant though decreasing proportion of total food supply, while meeting stricter sustainability criteria to support rather than undermine long-term food security, climate change mitigation and biodiversity. Trade is likely to change in nature, however, as more local, circular food economies expand in and around the towns and cities where populations will increasingly be concentrated. In some regions, such as sub-Saharan Africa, increased intra-regional trade will also enhance local food security and resilience.

Not least, the transitions will open up business opportunities to the tune of \$4.5 trillion a year by 2030 (Exhibit 6).<sup>43</sup> Some opportunities are based on tackling inefficiencies in the current system, for example by reducing food loss and waste or deploying precision agriculture techniques to existing cropping patterns. But the more transformational business innovations are likely to come from investment in healthy foods that contribute to individual health and wellbeing, in regenerative agriculture systems and their biological inputs, in alternative proteins and in nature-based solutions. The innovation potential is almost unlimited – and we should expect to see a new generation of disruptive, purpose-driven companies change the game.

## EXHIBIT 6

# There is an annual business opportunity of \$4.5 trillion associated with the ten critical transitions in 2030

USD billions (2018 prices), 2030 estimates, examples of opportunities >\$100bn



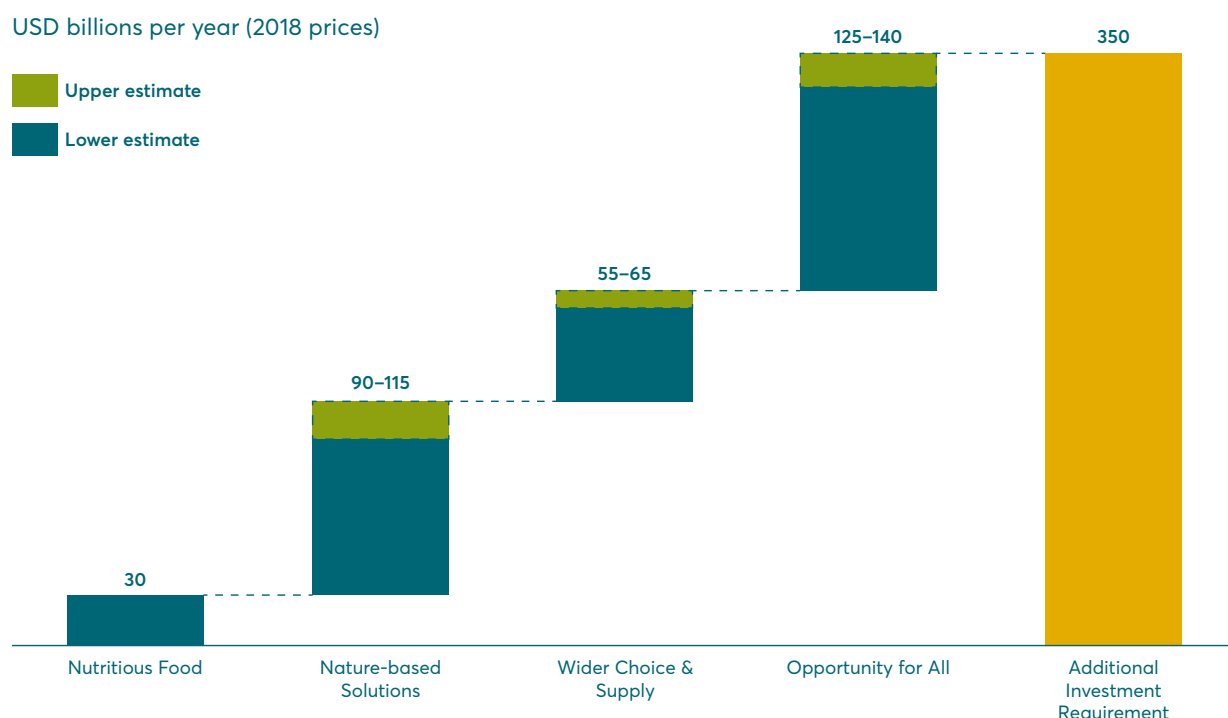
Source: SYSTEMIQ, Blended Finance Taskforce, 2019 (see online technical annex for methodology)

## What investment is needed and how will it be financed?

The investment required is modest in comparison to the gains. New investment of between \$300 billion and \$350 billion a year would capture a \$5.7 trillion annual economic gain for society by 2030, creating a societal return ratio of more than 15:1.<sup>44</sup> Much public and private capital would need to be reallocated, posing a significant challenge, and financial innovation, including forms of blending, would be needed to de-risk and scale assets. But on the basis of these figures, scaling the ten critical transitions for a better food and land use future would be a great deal for society and for the natural world on which it depends.

### EXHIBIT 7

## The additional annual investment requirements associated with the ten critical transitions are between \$300 and 350 billion (2018 – 2030)



Source: SYSTEMIQ, Blended Finance Taskforce, 2019 (see online technical annex for methodology)

Getting capital to the right places fast is critical and not straightforward, however. Much more needs to be directed towards developing countries, especially in sub-Saharan Africa. But potential investors are inhibited by both real and perceived risks. Many policy reforms, aimed at improving the investment environment, are embedded in the ten critical transitions and will help to address these risks. But additional public finance mechanisms will be needed to help “de-risk” unfamiliar asset classes (such as soil capital, ecosystem concessions, urban and peri-urban agriculture models and alternative proteins). Higher capital allocation and, essentially, greater use of blended finance instruments by bilateral donors and multilateral development banks will be critical to crowd in private investment into these new asset classes and help them to mainstream and scale.



# Implementing the ten critical transitions

Each transition faces barriers: policy and regulatory, financial, technological and behavioural (Exhibit 8). The current system is fragmented, with vested interests defending their turf. Practical examples of all ten critical transitions are already up and running across the world, however, driven by policy, business, farmers, communities and social entrepreneurs. Entrepreneurs are creating waves of change, many of them starting bottom-up in local communities and triggering generational shifts in values and behaviour. What they have started has the same potential to surge as the renewable energy movement, with new social norms and disruptive technologies – from agro-genomics to alternative proteins via satellite monitoring technology to digital traceability systems – ushering in a food system revolution. But there is no time to lose. Unless food and land use systems are turned around in the next ten years, the compounding risks of their current trajectory will be unmanageable.

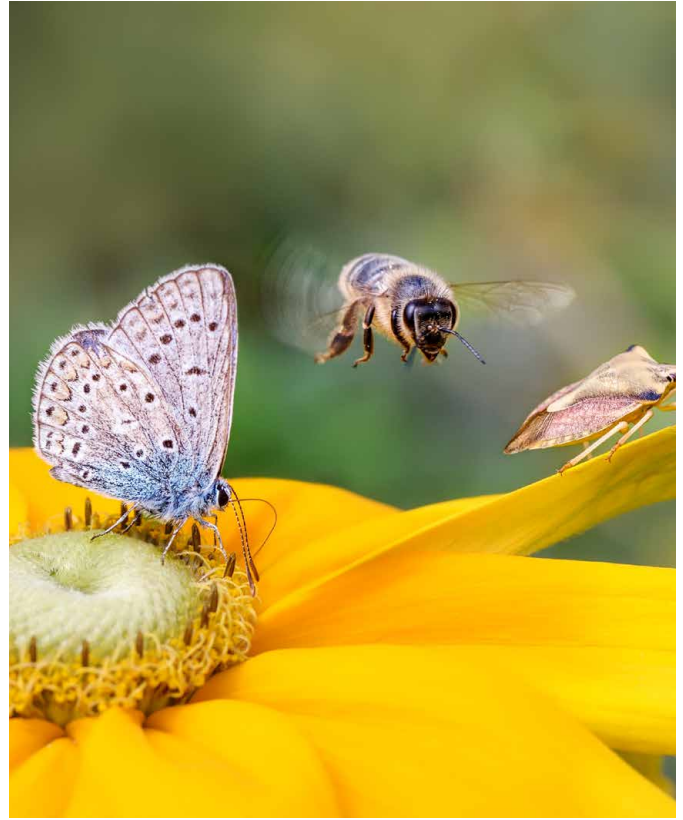
## EXHIBIT 8

### Implementation challenges of the ten critical transitions

Scale of challenge ● Low ● Medium ● High					
	Policy & Regulation	Finance	Tech & Innovation	Behavioural Change	
 Healthy Diets	●	●	●	●	●
 Productive & Regenerative Agriculture	●	●	●	●	●
 Protecting & Restoring Nature	●	●	●	●	●
 A Healthy & Productive Ocean	●	●	●	●	●
 Diversifying Protein Supply	●	●	●	●	●
 Food Loss & Waste	●	●	●	●	●
 Local Loops & Linkages	●	●	●	●	●
 Digital Revolution	●	●	●	●	●
 Stronger Rural Livelihoods	●	●	●	●	●
 Gender & Demography	●	●	●	●	●

Source: Food and Land Use Coalition, 2019

What would it look like if leaders in public, private and civil society sectors were to make food and land use systems an urgent priority, grasping the scale of the opportunity as well as the risks of inaction? What would it mean if they were to push this transformation to the top of their short-term priority list rather than allowing the tyranny of the urgent to crowd out the essential?



Left: A family presents the brinjal (aubergine) which they produced at their house in the Sankli village in the Sagai forest in Gujarat, India.

First, **governments** – ideally working with key stakeholders – would develop national food and land use pathways rooted in science, and consistent with the SDGs and Paris Agreement targets, and a comprehensive reform agenda creating numerous win-win opportunities. These pathways would then be translated into consistent policy signals to the market and society at large:

- On **healthy diets**, governments would issue strong, clear health guidelines; use public procurement to scale the market for healthy food; and deploy fiscal instruments to reward producers of healthy food (making it more affordable for everyone, but especially lower-income households) and penalise producers of unhealthy food.
- On **nature-based solutions**, governments would shift public support for agriculture and fisheries, currently running at over \$700 billion a year with only around 15 percent targeted at public goods, towards paying farmers and fishers to produce the right food in climate- and nature-friendly ways.<sup>xx</sup> Pricing carbon and water use properly and fairly would be a game-changer. Governments would also institute regimes to protect and pay for nature, especially tropical rainforests, and grant secure tenure and the means to defend it to the indigenous communities whose wisdom is critical to their stewardship. Policies that add to competition for land – such as subsidy regimes driving agricultural expansion, or biofuels mandates directly or indirectly driving deforestation or other ecosystem conversion – would be phased out.
- On **wider choice and supply**, governments would increase, at least double, public R&D, with strong open source principles, over the next decade, to accelerate the scale-up of regenerative agriculture, promote value creation based on natural solutions, and help mitigate climate-related impacts on agricultural production. They would act to cut food loss and waste, requiring greater transparency from larger companies, and level the playing field to stimulate a flowering of local, smaller suppliers.

<sup>xx</sup> The amount of subsidies aimed at “public goods” is captured by the Organisation for Economic Co-operation and Development (OECD) definition of General Services Support Estimates, that is “public financing of services that create enabling conditions for the agricultural sector.”

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- On **opportunities for all**, governments would take a lead in putting key public data into the public domain, helping civil society to monitor large players and hold them to account. In parallel, they would increase public investment in rural infrastructure (roads, broadband, solar power) and in rural education and training by \$100 billion to \$150 billion a year, with funding support for low-income countries from the international community. This report recommends a massive global push to drive solar energy electrification throughout low- and medium-income rural economies. The gains for the environment, agriculture, food value chains and off-farm employment would be substantial.

Second, **business leaders** would get behind the transformation programme, voice strong public support for government reforms and work with government and civil society to accelerate the transitions. Chief Executive Officers (CEOs) and company boards would recognise the risks from a business-as-usual strategy and commit their companies to science-based targets in line with the SDGs and the Paris Agreement. They would put in place easily monitorable plans for reshaping their supply chains, product development and marketing strategies in line with “healthier diets”, “nature-based solutions”, “wider choice and supply” and “opportunity for all”. And they would develop and scale pre-competitive coalitions across the ten critical transitions, working with government, academia and civil society.

#### BOX 4

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### The role of farmers in food and land use systems

Farmers are the original food and land use system entrepreneurs. They are CEOs of the most critical set of businesses in these systems. Today, however, farmers everywhere face ever more pressure and risks: from growing weather uncertainty as a result of climate change, increasingly stringent customer demands, shifting and complex public policies and support regimes, and new banking terms and conditions. This, indeed, is mainly why this report puts such emphasis on changing the rules of the game, and on shaping the game so that farmers are paid fairly to produce the right food in the right way. This includes allocating risk (market, weather, production) in ways that do not leave farmers carrying most of the risk while getting the least of the returns; protecting their tenure and giving them confidence to make longer-term investments; and improving opportunities for women and younger farmers while respecting their experience in land stewardship and food production. Farmers are natural entrepreneurs – and will play a critical role in any successful transformation of food and land use systems.

For many companies in food and land use industries, whether growers, traders, processors, retailers or caterers, these changes will be huge. Their current business models are typically based on traditional scale economies, with product formulations designed for cost, convenience and shelf life. Traceability between producer and end-consumer is limited or even non-existent. There are huge opportunities – up to \$4.5 trillion a year by 2030 – for those companies that can translate today’s hidden costs into tomorrow’s new markets and purpose-driven strategies.<sup>45</sup> But seizing them is likely to require new business models that emphasise value over volume-based economics, which in turn might require a generational shift in mindsets and leadership.



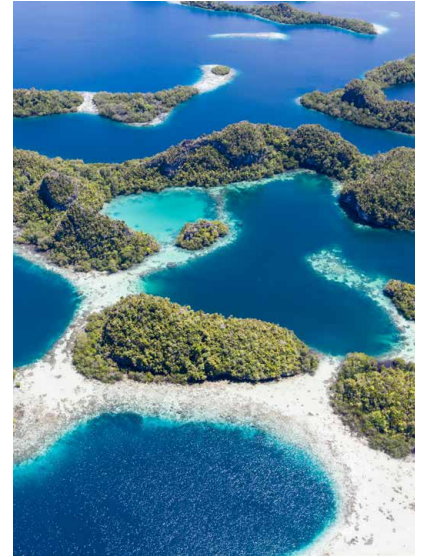
Right: Volunteers with freshly plucked organic cherries at the Tianfu Garden Farm (God's Grace Garden) in Beijing, China.

Third, **private investors** would demonstrate how, with public counterparts, they could, by 2023, drive up to \$100 billion a year into the relevant asset classes and instruments needed to transform food and land use systems globally. Together with regulators, they would pilot the extension of the guidelines issued by the Task Force on Climate-related Financial Disclosures (TCFD) into food and land use systems, covering physical, transition, health and social risks. And they would establish a set of core financing principles, along the lines of the Equator Principles or Principles for Responsible Investment, that would guide their capital allocation into better food and land use systems and away from high-risk companies.

Fourth, **the United Nations (UN) Secretary-General, leaders in UN agencies, presidents and shareholders of multilateral development banks and the International Monetary Fund (IMF)** would align their institutions' investment, advisory and normative activities on food and land use systems to support and inspire governments' reform agendas, adapting organisational strategies and mobilising resources to reflect the scale and urgency of the challenge. Their governing bodies would provide unequivocal and well-aligned direction across the different entities in the multilateral system to maximise efficiency and effectiveness, in keeping with the ongoing reform processes led by the UN Secretary-General. The banks, together with bilateral donors, would set ambitious targets to increase their investments, including the use of first-loss instruments and guarantees, to support the \$300 billion to \$350 billion investment requirements. And the IMF would include more explicit consideration of climate and food and land use systems risk in its Article 4 surveillance activities.<sup>xxi</sup>

Fifth, **civil society** would shape social change movements, support the government and private sector and hold all parties to account. The philanthropic community could have an outsized impact if it tripled its funding for food and land use systems and directed it to the ten critical transitions, taking the risk to get behind new coalitions and social entrepreneurs.

<sup>xxi</sup> When a country joins the IMF, it agrees to subject its economic and financial policies to the scrutiny of the international community as part of the IMF's Article IV surveillance activities. This regular monitoring is intended to identify weaknesses that are causing or could lead to financial or economic instability.



Left: A farm in the Amhara region of northern Ethiopia incorporates tree-planting where cattle graze as part of a wider effort to restore the watershed there.

Finally, the next one to two years, starting with the UN Climate Action Summit in September 2019, present unique opportunities for decision-makers to set new directions for food, ocean and land use systems that can deliver the SDGs and Paris Agreement targets:

- Food and land use transformation, including the role of deforestation-free, sustainable supply chains and the need for agricultural subsidy reform, would be embedded in the agendas of the G20 and the G7.
- At the 15th Conference of Parties of the Convention on Biological Diversity, to take place in Kunming in October 2020, Heads of State and Government would ideally align around a “New Deal for Nature and People”. Two sets of outcomes would be crucial to drive progress. One is an ambitious agenda modelled on the Paris Agreement, including agreement on post-2020 global goals and an implementation framework that ensures the greatest possible ambition and ratcheting up of that ambition over time. The second would be informal coalition(s) of the willing to accelerate the implementation of key operational elements of protecting ecosystems and biodiversity, and thus of the food and land use transformation, i.e., supply chains that are transparent and avoid deforestation and conversion of natural ecosystems, a Global Alliance Against Environmental Crime, practices, principles and programmes for regenerative agriculture and sustainable fisheries management, scaled-up conservation financing and the desirability of a shift to a planetary and human health diet.
- With support from the private sector and civil society, governments would treat the 26th Conference of Parties of the UN Convention on Climate Change in the autumn of 2020 as a mission-critical moment in which they increase the ambition of their Nationally Determined Contributions under the Paris Agreement, including a strong set of commitments around food and land use systems.

Momentum could gather through the UN Ocean Conference in Portugal and the Global Nutrition Summit in Japan – both in 2020 – and the UN Summit on Sustainable and Inclusive Food Systems in 2021. All provide powerful opportunities to consult widely with public and private stakeholders, and to shape global and regional agreements on the most pressing issues. For example, the food systems summit could develop measures to mitigate the risk of food supply disruptions by promoting greater supply chain transparency.



Left: Women working in the fields of Kahansingh Bhai in the Sankdi village in the Narmada district of Gujrat, India, where the local community have been given rights to the lands.

Right: Villagers at the Sankli village in the Sagai forest in the Narmada district of Gujarat, India.



## Making the choice

There is a stark difference between a world that has chosen to transform food and land use systems and one where current trends have been allowed to continue. Choosing transformation will lead – if all sectors do their part to stop climate change – to a productive, thriving planet in balance, able to feed a growing, increasingly affluent population with nutritious, affordable diets. Allowing current trends to continue leads – no matter what happens in other parts of the economy – to a planet trapped in a downward spiral of global warming, shrinking ecosystems, degrading lands and falling agricultural productivity, large parts of its population plagued by diet-induced poor health and scarred by poverty.

Choosing transformation will not ensure success. But addressing food and land use systems offers a broader set of benefits in line with the SDGs and Paris Agreement than changing any other single economic system. Today there is an opportunity to build systems that are regenerative by design, deliver fairer and more equitable outcomes and are transparent, trusted and innovative. Seizing that opportunity requires collective action to implement the ten critical transitions outlined in this report, starting now, from governments, businesses, financial institutions, farmers and civil society worldwide. The process is already ongoing, and brave reformers are driving the agenda all over the world, but to reach speed and scale we need to support them and level the playing field for sustainable practices. Together, we have until the end of 2020 to shape the agenda, then a decade to implement it fully. There is no time to lose.

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# Annex A:

FOLU partners, supporters and Ambassadors

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### FOLU partners:

African Green Revolution Alliance (AGRA): Growing Africa's Agriculture  
EAT  
Global Alliance for Improved Nutrition (GAIN)  
International institute for Applied Systems Analysis (IIASA)<sup>xxii</sup>  
Sustainable Development Solutions Network (SDSN): A Global Initiative for the United Nations  
SYSTEMIQ  
World Business Council for Sustainable Development (WBCSD)  
World Resources Institute (WRI), including the New Climate Economy: Global Commission on the Economy and Climate

### FOLU is supported by:

Gordon and Betty Moore Foundation  
MAVA Foundation  
Norway's International Climate and Forests Initiative (NICFI)  
UK Department for International Development (DFID)

FOLU acknowledges the invaluable contribution of Unilever, Yara International and the Business and Sustainable Development Commission in nurturing our initial development.

### FOLU Ambassadors:

**Sri Adiningsih**, Chairperson, Indonesian Presidential Advisory Council; Professor of Economics, University of Gadjah Mada  
**Assefa Admassie**, Director, Ethiopian Economic Policy Research Institute; Professor of Economics, Addis Ababa University  
**Rina Agustina**, Chair, Human Nutrition Research Center of the Indonesian Medical Education and Research Institute; University of Indonesia  
**Bethlehem Tilahun Alemu**, Founder and Executive Director, Sole Rebels, Republic of Leather, Garden of Coffee  
**Sharan Burrow**, General Secretary of the International Trade Union Confederation  
**Helen Clark**, Former Prime Minister of New Zealand; Former Administrator, United Nations Development Programme  
**Nicolás Cock**, Co-founder, EcoFlora and President Bio-protection Global  
**Sebsebe Demissew**, Executive Director, Gullele Botanic Garden; Professor of Plant Systematics and Biodiversity, Addis Ababa University  
**Wiebe Draijer**, Chairman of the Board, Rabobank  
**Shenggen Fan**, Director General, International Food Policy Research Institute  
**Jessica Fanzo**, Professor of Food Policy & Ethics, Johns Hopkins University; Co-chair, Global Nutrition Report  
**Meaza Biru Gebrewold**, Founder, General Manager, Producer & Owner of Sheger 102.1 FM, Ethiopia  
**Rosario Córdoba Garcés**, President, Private Council for Competitiveness, Colombia  
**Alejandro Gaviria**, President, Universidad de Los Andes, Colombia  
**Marion Guillou**, President of the Board of Directors, Agreenium  
**Lawrence Haddad**, Executive Director, Global Alliance for Improved Nutrition  
**Kurniatun Hairiah**, Professor, University of Brawijaya, Indonesia; Partner, World Agroforestry Centre  
**André Hoffmann**, Board Director, MAVA Foundation  
**Naoko Ishii**, Chief Executive Officer and Chairperson, Global Environment Facility  
**Ajay Vir Jakhar**, Chairman, Bharat Krishak Samaj  
**Agnes Kalibata**, President, Alliance for a Green Revolution in Africa  
**Sam Kass**, Founding Partner, Trove Worldwide  
**Segenet Kelemu**, Director General and Chief Executive Officer, International Centre of Insect Physiology and Ecology

<sup>xxii</sup> Note that SDSN and IIASA convene the FABLE Consortium (Food, Agriculture, Biodiversity, Land Use and Energy)



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**Marco Lambertini**, Director General, WWF International  
**David W. MacLennan**, Chairman and CEO, Cargill Limited  
**Strive Masiyiwa**, Board Chair, Alliance for a Green Revolution in Africa; Panel Member, Africa Progress Panel  
**Sara Menker**, Founder and Chief Executive Officer, Gro Intelligence  
**Divine Ntiokam**, Founder and Managing-Director, Climate Smart Agriculture Youth Network  
**Ndidi Nwuneli**, Founder and Director, Leadership Effectiveness, Accountability and Professionalism (LEAP) Africa  
**José Antonio Ocampo**, Co-Director, Bank of the Republic of Colombia  
**Ngozi Okonjo-Iweala**, Former Minister of Finance, Nigeria  
**Cristiana Paşca Palmer**, Executive Secretary, Secretariat of the Convention on Biological Diversity  
**Ángela Penagos**, Director, Rimisp Colombia  
**Paul Polman**, Co-founder & Chair, IMAGINE; Chair of the International Chamber of Commerce (ICC)  
**Vineet Rai**, Chief Executive Officer & Managing Director, Aavishkaar; Co-founder & Chairman, Intellect Group  
**Juan Lucas Restrepo**, Director General of Bioversity International; Co-Director, Bank of the Republic of Colombia  
**Felia Salim**, Vice Chief Executive Officer, PT Bank Negara Indonesia  
**Cristián Samper**, President, the Wildlife Conservation Society  
**Jaidev Shroff**, Global Chief Executive Officer, UPL  
**Feike Sijbesma**, Chief Executive Officer, Royal DSM  
**Erik Solheim**, Ex-Minister of Development and Environment, Government of Norway  
**Budiman Sudjatmiko**, Coordinator of Advisory Board, PAPDESI (Perkumpulan Aparatur Pemerintah Desa Seluruh Indonesia/Association of the Village Governments in Indonesia)  
**Ishmael Sunga**, Executive Director, Southern African Confederation of Agricultural Unions  
**Getachew Gebru Tegegn**, President, Ethiopian Society of Animal Production; Deputy Director, MARIL Ethiopia  
**Izabella Teixeira**, Co-chair, International Resource Panel  
**Svein Tore Holsether**, President and Chief Executive Officer, Yara International  
**Laura Tuck**, Vice President for Sustainable Development, World Bank

**Ann Tutwiler**, Senior Fellow, Meridian Institute; Senior Advisor, SYSTEMIQ  
**Gerda Verburg**, Coordinator, Scaling Up Nutrition Movement  
**Sunny Verghese**, Co-Founder and Group Chief Executive Officer, Olam International  
**Dominic Waughray**, Managing Director, Head of the Centre for Global Public Goods, World Economic Forum  
**Kathy Willis**, Professor of Biodiversity, Oxford University

The FOLU Ambassadors network is co-chaired by Shenggen Fan, Agnes Kalibata and Paul Polman.

#### **FOLU Global Report Reference Committee:**

**Per Pharo**, Co-Chair of FOLU Global Report Reference Committee & Lead Author  
**Lawrence Haddad**, Co-Chair of FOLU Global Report Reference Committee & Executive Director, Global Alliance for Improved Nutrition  
**Mari Elka Pangestu**, Professor of Economics, University of Indonesia  
**Johan Rockström**, Director, Potsdam Institute for Climate Impact (PIK)  
**Bernice Lee**, Research Director for Global Economy & Finance and Executive Director of the Hoffmann Centre for Sustainable Resource Economy at Chatham House  
**Jianguo "Jack" Liu**, Rachel Carson Chair in Sustainability, University Distinguished Professor at MSU and Director of the Centre for Systems Integration and Sustainability  
**Ruth Oniang'o**, Editor and founder of the African Journal of Food, Agriculture, Nutrition and Development (AJFAND), Professor of Food Science and Nutrition  
**Louise O. Fresco**, President of Wageningen University & Research  
**Juliano Assunção**, Associate Professor in the Department of Economics at the Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio) and Executive Director at the Climate Policy Initiative Brazil  
**Frances Seymour**, World Resources Institute Distinguished Senior Fellow  
**Zhang Linxiu**, UN Environment's International Ecosystem Management Partnership (UNEP-IEMP)  
**Charles Godfray**, Hope Professor of Zoology at Jesus College, Oxford, and Director of the Oxford Martin Programme on the Future of Food





Annette Rypalski, Biodiversity director at Odonata in Mount Rothwell research and conservation centre in Victoria, Australia.

## FOLU Australia

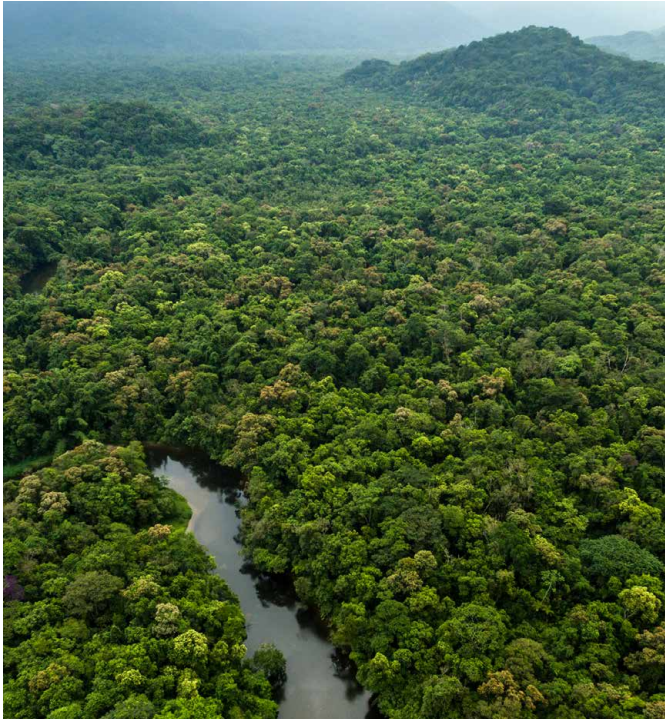
ClimateWorks Australia, CSIRO and Deakin University are participating in FOLU through the Land Use Futures project, which resources and convenes a highly participatory, evidence-based process centred on developing integrated land use pathways and action roadmaps for sectors, including national, state and local government. In early 2019, ClimateWorks hosted a Natural Capital Summit, hosting 150 leaders from diverse sectors. The Summit identified key areas for action including fit-for-purpose systems for measuring and valuing natural assets, mainstreaming innovative sustainable land management practices, accelerated demonstration of blended finance and investment models, and introduction of government incentives and support.



Liu Guiyan, from Heilongjiang province, China, left her hometown to work on a farm in Beijing in 2014. Last year she joined Shared Harvest, an organic farm promoting the Community Shared Agriculture model.

## FOLU China

In China, FOLU has established a national FOLU platform to support domestic and international approaches that strengthen ecological protection, alongside improved health and rural prosperity outcomes. The national platform seeks to strengthen the evidence base for action, and to support efforts in China to ensure responsible commodity sourcing. It also provides a bridge to the larger FOLU network, enabling China to share its rich development and environmental experience with other countries. Core partners in the platform include WRI China, China Agricultural University and Tsinghua University. A crucial component of the FOLU work in China is to support the development of the data and modelling infrastructure needed to produce long-term pathways towards sustainable food and land use systems, led by the FABLE Consortium.



Anteggn Wunetu (pictured here) and his wife Mekle farm on a watershed restoration and homestead development project in Bahir Dar, the Amhara Region of Ethiopia. They have just bought 24 chickens.

## FOLU Colombia

FOLU in Colombia is a vibrant national platform, comprising over 100 actors from national and local government, the private sector and civil society. FOLU Colombia has initiated a number of action coalitions, including on the sustainable use of pesticides and fertilisers, the promotion of jurisdictional approaches to better food and land use in two regions (Quindío and Urabá), the measurement of food loss and waste, supporting healthy school diets and action on the ocean. The Coalition is also working with partners to pursue behavioural change and more effective communications, as well as in a series of value chains – including milk, meat and a cocoa and forest initiative – to bring about more sustainable outcomes. Across these areas, FOLU brokers strategic alliances between universities, governments, civil society organisations and the private sector. Colombian research institutions also participate in the work of the FABLE Consortium, where they advance analytical and modelling capacities to assess long-term sustainable development pathways in land use.

## FOLU Ethiopia

FOLU in Ethiopia comprises a vibrant network of partners and experts working together to provide support to policymakers and other influential stakeholders at the national and local level. These include the Agricultural Transformation Agency, the Ministry of Agriculture, the Environment, Forest and Climate Change Commission, and the National Planning and Development Commission. The Coalition is also supported by a diverse and proactive group of “Goodwill Ambassadors” – prominent figures who advance and champion the vision and objectives of the Coalition. To catalyse action, the Coalition partners have prepared an Action Agenda with broad stakeholder engagement including diverse development actors, government, private sector, and experts. The Action Agenda outlines a vision and proposes innovative actions on food and land use for incorporation into the country’s forthcoming five- and ten-year plans. FOLU Ethiopia partners are also working with the FABLE Consortium to develop long-term science-based targets and pathways that set out what sustainable food and land use systems could look like in Ethiopia.



Workers in the R&D fields of the Jain Irrigation in the Jalgoan facility in Jalgoan, India.

## FOLU India

In India, the work of FOLU is being spearheaded by a core group of four organisations: Council on Energy, Environment and Water (CEEW), the Indian Institute of Management, Ahmedabad (IIMA), The Energy and Resources Institute (TERI), and WRI India. A key component of the FOLU work is the development of decision-support tools by the FABLE Consortium, led by IIMA, which can inform policy decisions in rigorous ways, beginning with a test case on the impacts of biofuels on India's food and land use systems.



Portrait of an ilipe nut farmer at the forest in Sintang regency, West Kalimantan, Indonesia.

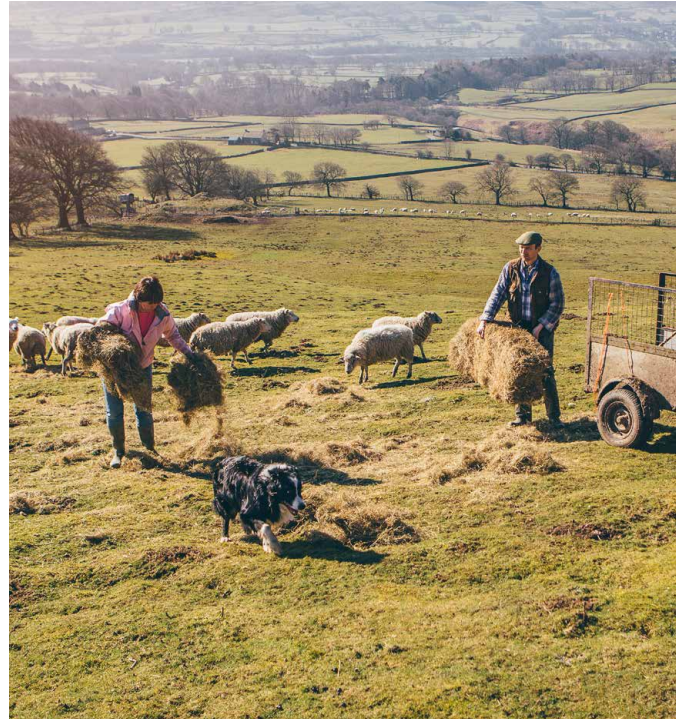
## FOLU Indonesia

FOLU in Indonesia is housed in the National Planning Ministry BAPPENAS' signature Low Carbon Development Initiative, where it contributes to the formulation of Indonesia's next mid-term national development plan (the RPJMN for 2020-2024). FOLU Indonesia's Action Agenda, Ambassadors, partners, studies, research and convening have played a critical role in support of the LCDI as well as other relevant national policy (e.g. EAT's work on sustainable and healthy diets with the Ministry of Health). Indonesian research institutions are involved in the FABLE Consortium's scenario and development pathway planning exercises. FOLU has also worked at the regional level, including in the provinces of East Kalimantan and Papua and West Papua, in areas including food security, sustainable aquaculture, eco-tourism and mobilising finance for forest protection and restoration.



## FOLU in the Nordics

FOLU has an active and growing network across the region with a strong set of civil society organisations and innovative private sector players, led by the Stockholm Resilience Centre of Stockholm University and the EAT Foundation. The role of the Coalition includes coordinating the Nordic Modeling Network (a group of over 15 modelers representing Sweden, Finland, Norway and Denmark, engaged in the FABLE Consortium) and progressing stakeholder dialogues with critical actors across the food system.



## FOLU UK

FOLU has entered into a partnership with The Royal Society of Arts' "Food, Farming and Countryside Commission". The Commission is an independent inquiry, chaired by Sir Ian Cheshire, involving 15 Commissioners from farming and food businesses, public health and citizens' groups, think tanks and universities, all committed to tackling the challenges faced by the sector. The Commission recently published flagship reports, "Our Future in the Land" and "Field Guide for the Future" which draw on their national consultations.

FOLU is also contributing to the National Food Strategy, led by Leon restaurant founder Henry Dimbleby, and is involved in the FABLE Consortium through research organisations in the UK.

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# Growing Better:

## Ten Critical Transitions to Transform Food and Land Use

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**The Global Consultation Report**  
of the Food and Land Use Coalition

September 2019

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 **The  
Food and Land Use  
Coalition**

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