

The big food redesign

REGENERATING NATURE WITH
THE CIRCULAR ECONOMY



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In support of the study

"We are all in the race to a net-zero and nature-positive future: the Race to Zero and the Race to Resilience. I am delighted to see and support the work the Ellen MacArthur Foundation together with FMCG companies, many of whom are Race to Zero members, is doing in reimagining the food system for the benefit of the farmer, consumer and the planet. I remain confident that together we can and will achieve a net-zero and nature-positive future with farmers in the centre."

Nigel Topping, High Level Champion for Climate Action at COP26

"We welcome the call to redesign food portfolio's from 'farm to fork'. Accelerating the transition to regenerative food systems is critical to deliver on climate goals and restore biodiversity. Business can and must lead the transition through supporting farmers, leading product and supply chain innovation, and offering consumers more diverse, regeneratively sourced products. Unilever, through its Knorr brand's 'Eat for Good' campaign, is committed to lead the way at scale."

Hanneke Faber, President, Foods and Refreshment, Unilever

As someone who has been inspired by the Ellen MacArthur Foundation's vision of a circular economy, I could not have been more delighted to hear that they are now focusing their attention on industry-led solutions for transforming our broken food systems. We welcome this report and look forward to collaborating with the Foundation over the coming months and years to make nature-positive food the norm.

Patrick Holden, Farmer and Chief Executive, Sustainable Food Trust

"It has become a global consensus that developing a circular economy could be a way to respond to global challenges such as climate change and biodiversity loss. From the perspective of the circular economy development model, the Ellen MacArthur Foundation's study, The big food redesign: regenerating nature with the circular economy, has outlined, it further explains the huge contribution that a circular economy can make to global sustainable development."

Zhao Kai, Vice President, China Association of Circular Economy

"A circular and regenerative food system can protect and restore our environment and enhance biodiversity. We welcome this landmark study highlighting how the circular economy can help achieve a nature-positive future. By providing relevant, science-based evidence, these studies can play an important role in setting out how FMCG companies can contribute to delivering a food system that helps nature and people thrive."

Mark Schneider, Chief Executive Officer, Nestlé

"We all know our food systems are in crisis. As we look to feed a planet of eight billion people, we can no longer afford to waste, pollute, and deplete. We must invest in food systems, built regeneratively, that allow nature to flourish. This is an important step in our transition to a circular economy. This study offers critical solutions on how fast-moving consumer goods companies and food retailers can play a critical role in this move towards a food system that works for both people and the environment."

Inger Andersen, Executive Director, United Nations Environment Programme

"This study is a treasure trove. It pinpoints how fast-moving consumer goods companies and retailers can drive real transformation in our food systems for the benefit of people and the planet, making money on the vanguard of change while they're at it. As nations around the world, triggered by this year's UN Food Systems Summit, chart their pathways to sustainable food systems by 2030, this study offers critical insights as to how food companies can accelerate the urgent shifts that are required towards regenerative food production and healthy food consumption."

Dr Gunhild Stordalen, Founder & Executive Chair, EAT

“We welcome this new paper exploring how the pursuit of a circular economy can help deliver transformative change for a safer, more equitable, and biodiverse future. Our future prosperity and survival depend on a living planet and our ability to create a nature-positive economy – one that operates within planetary boundaries and that helps us reverse nature loss and overcome the climate crisis. The study aligns with WWF’s approach to food system transformation, clearly showing that systemic action across production, consumption, and loss and waste is required to achieve a truly sustainable future. We are part of nature, not separate from it. Investing in what is our most precious asset will make it our greatest ally.”

Marco Lambertini, Director General, WWF International

“The ambition of this study to support an increased use of products produced using agroecological principles is one that is endorsed by the Soil Association. There is increasing recognition of the vital role that our farming, land use, and food systems play in tackling the interconnected climate, nature, and health crises and we look forward to working with the Ellen MacArthur Foundation and partners to achieve real transformational change.”

Liz Bowles, Associate Director, Soil Association

“We were honored to contribute to this work, which reaffirms our conviction that food can be a solution to many of the societal challenges we face. The big food redesign: Regenerating nature with the circular economy shows how circular economy principles can help us design and deliver products that fight climate change, protect biodiversity and reconnect consumers with their food. The opportunity is one we must seize – for our business and for our planet.”

Henri Bruxelles, Executive Vice President and Chief Operating Officer, Danone

“We support this study for its innovative and comprehensive proposal for fighting food waste and climate change, which highlights the need for collaboration along the production chain. This study informs our new initiatives that will contribute to regenerative agriculture, engage small rural producers, and work towards completing the cycle of the circular food economy.”

Lucio Vicente, Sustainability Director, Carrefour Brasil Group

“Applying circular economy principles can help transform our food systems to tackle critical challenges including climate change and biodiversity loss. Accelerating this shift can boost resilience and unlock sustainable economic opportunities, like the 5% projected annual growth in the USD 46 billion upcycled foods market. By strengthening the knowledge base, this important study will contribute to the informed action we urgently need. UNECE will continue to support countries to leverage existing political commitment for circular economy in all sectors.”

Olga Algayerova, Executive Secretary, United Nations Economic Commission for Europe (UNECE)

“Applying the findings of this collaborative work, and reflecting on our current dependency on only a few crops is essential to address our agricultural footprint and create positive outcomes for the climate and nature. We must not forget that biodiversity enabled agriculture, and allowed humanity to thrive around the world: our future continues to depend on it. Let biodiversity be the source of innovation and sustainable growth.”

Florence Jeantet, Managing Director, One Planet Business for Biodiversity (OP2B)

“The UK government is committed to ensuring that our entire food system is sustainable for generations to come – a commitment which we will pursue further through our upcoming Food Strategy White Paper. This study shows that much can be gained by effective collaboration across the entire supply chain – from our farmers and food producers, all the way through to our hospitality sector and supermarkets – to help build a better food system.”

Victoria Prentis, Food and Drink Minister, Department for Environment, Food and Rural Affairs (DEFRA)

“To transform global food systems, we must completely rethink how we grow our food and how we make our food products by applying the principles of a circular economy, as well as how we inspire consumers to choose sustainably sourced products. As part of our Positive Agriculture Ambition, PepsiCo has committed to spreading the adoption of regenerative farming practices and strengthening farming communities. But we cannot stop there. We agree that further action must be taken and thank the Ellen MacArthur Foundation for its guidance as we continue this critical journey.”

Ramon Laguarta, Chief Executive Officer, PepsiCo

“LEAF welcomes this study. It provides excellent insights and guidance to help break the mould of the current food system and build practical, innovative, and smart approaches for our economy, using circular principles to transform farming and food systems. This work supports LEAF’s commitment to the health, diversity, and enrichment of our farms, people, and planet, and our work to develop and promote the adoption of more regenerative, integrated, and nature-based agriculture. We look forward to working together to deliver nature-positive farming that supports our biodiversity and precious ecosystems.”

Caroline Drummond MBE, Chief Executive, Linking Environment And Farming (LEAF)

“Food systems are a major driver of environmental issues, particularly climate change, biodiversity loss, and soil degradation, as well as contributing to diet-related ill-health. Food systems need to be re-engineered to minimise their negative impacts. Building supply chains that are more regenerative is a key route towards this aim, and this study is a concrete contribution to how this can be accelerated by the industry.”

Tim Benton, Research Director, Emerging Risks, and Director, Environment and Society Programme, Chatham House

“This study presents an inspiring opportunity for FMCGs and retailers to start designing the future of our food in a way that is circular and regenerative. This points to the need for new forms of collaboration to demonstrate how regeneratively grown food products should become the norm in markets and also to bring clarity to ecosystem indicators and outcomes that should guide the transition to regenerative agriculture.”

Felipe Villela, Founder and CCO, reNature

“There’s no doubt that food companies have changed the world – unfortunately, often for the worse. But today, fast-growing food companies can no longer ignore the health of people or the planet. This study shows that businesses have an incredible opportunity to not only change the way we eat, but restore ecosystems, help solve the climate crisis, and improve biodiversity. It should be required reading for all food CEOs and CSOs.”

Danielle Nierenberg, President & Founder, Food Tank

“This study highlights the great opportunity food buyers have to redesign menus and food products in ways that help achieve a nature-positive food system.”

Michiel Bakker, VP, Global Workplace Programs, Google

“We wholeheartedly agree with the recommendations in this study. The fight against climate change can only be won if everyone in the food system plays a part. When sourcing our food we are mindful of the resources we use and our aim is to protect vital ecosystems and give nature a chance to thrive. We will continue to do all we can to offer our customers food that is not just good for them but good for the planet too.”

Marija Rompani, Director of Sustainability & Ethics, John Lewis Partnership

This study proves we don’t need breakthrough food technologies to solve the food system crisis. Instead, we need to break away from foods that stress and degrade the environments. The Ellen MacArthur Foundation has been leading the way in showing how the circular economy can achieve this, and in the process create a new cultural economy connected to how good food is actually grown and raised.

Dan Barber, chef and author of *The Third Plate*

“As we build momentum towards a nature-positive, low-carbon global economy in 2050, businesses, policymakers, and all sectors of society can rely on the circular economy principles to go beyond incremental improvements. The insights in this study can be used instead to transform the food sector, reduce pressure on biodiversity loss and make us more resilient to the impacts of climate change. The illustrative cases included highlight that this ambition is not only required, it is possible and growing.”

Gonzalo Muñoz, Co-founder, Sistema B, and Founder, TriCiclos

“This study gives practical actions by which food producers can redesign their product portfolios for regenerative outcomes that not only mitigate climate change, but also economically benefit actors across the full food production ecosystem. The circular design for food approach will be leading our Circular Food System’s portfolio and inform our regenerative agriculture projects with farmers. We recommend it to all players in the food system.”

Dr Ir Martine van Veelen, Director, European Institute of Innovation & Technology (EIT) Food, CLC West (Belgium, Luxembourg, France, Switzerland)

“FMCG and retail companies play a pivotal role in shifting to a climate- and nature-positive food system, and the shift to healthier, sustainable products is a significant business opportunity. This study provides a timely call to action and roadmap to help companies go from incremental sourcing improvements to portfolio redesign.”

Jeremy Oppenheim, Founder and Senior Partner, SYSTEMIQ

“How we grow, produce, and eat food makes a difference for the climate and the future of our planet. We all know this, but too often we don’t know how to take action. This study creates an entry point for anyone working in food retail or fast-moving consumer goods companies to be part of the solution.”

Melina Shannon-DiPietro, Executive Director, MAD

“Rethinking how we design food is essential to accelerate the move to a regenerative food system that is centered on biodiversity. This report marks an important step in the Ellen MacArthur Foundation’s work to balance efforts to solve today’s ecological and economic challenges through the circular economy. Notably, it bridges critical tactical gaps for food FMCGs and retailers in search of new ways to meet their sustainability goals, showing how the circular economy framework can be practically – and fruitfully – realised within the food sector.”

Dr Nabil Nasr, CEO, the REMADE Institute, and Associate Provost for Academic Affairs & Director, Golisano Institute for Sustainability, Rochester Institute of Technology

“This study is one of the first to explore the options for a smarter use of ingredients through sourcing improvements. This can be a major contribution of food companies to increase biodiversity and provide the reliability needed for farmers to grow these rare species. The same goes for upcycled food – there are so many by-products that still end up as feed, despite being nutritious and fit for human consumption!”

Stephanie Wunder, Senior Fellow, Coordinator Land Use Policy, Coordinator Food Systems, Ecologic Institute

“The Ellen MacArthur Foundation has written a must-read primer for anyone considering the food industry’s role in tackling climate change. As a business focused on creating sustainable proteins and fibres that nourish the world through the power of circular economy, we prove that it’s possible now – that we can design future-proof food products that taste better than ever and are nature-positive.”

Gregory Belt, CEO, EverGrain

“The population of the world has grown from below 2 billion a century ago to nearly 8 billion today. That we can sustain a four-fold increase in humanity is incredible – but it is happening at a huge environmental cost. Human ingenuity can create fresh, local, sustainable foods for all, but only through brave and insightful leadership from government and business. This study lights a path to a regenerative, nature-positive food system built on circular principles: I recommend it to all leaders in the food industry.”

Richard Pennycook, Chairman, British Retail Consortium

“Our Group is supporting companies in the food sector to redesign the current production approach and enhance new business models within the entire food chain. In fact, responding immediately with a circular approach, both to current demands and to the needs and aspirations of future generations, will bring not only environmental benefits, but also strategic opportunities for growth and competitiveness for all the players involved.”

Maurizio Montagnese, Chairman, Intesa Sanpaolo Innovation Center

About this study

The circular economy is increasingly recognised as a solutions framework to address global challenges like climate change and biodiversity loss. Moving towards a food system that builds natural capital and that is pro-nature, i.e. one that allows nature to thrive, is an essential part of the transition to a circular economy. While the current food system has sustained a growing population and brought economic development, much of it is essentially 'linear' and extractive, particularly in more developed markets. It is wasteful, polluting, and depletive, and is the primary driver of biodiversity loss and accounts for a third of global greenhouse gas emissions.

The Ellen MacArthur Foundation started its exploration of a circular economy for food in 2013, as part of the report *Towards the circular economy vol. 2*, in which it explored how food waste and the by-products of food processing could be used to help transform food systems.

In 2019, the report *Cities and circular economy for food* focused on cities as major hubs of food consumption, and identified opportunities for businesses, governments, and other organisations in urban settings to create a healthy food system by applying circular economy principles.

Building on that work, this study now looks at the role fast-moving consumer goods companies (FMCGs) and food retailers can play to move us towards a food system with significant positive impacts for business, people, and the environment. It explores the ways in which food products can be designed in closer collaboration with farmers, for nature. It also investigates the crucial enabling role of policies and incentives.

This study builds on the Foundation's papers *The nature imperative: how the circular economy tackles biodiversity loss* (2021) and *Completing the picture* (2019), which illustrate the fundamental role of the circular economy – particularly when applied to food – as a solutions framework to achieve biodiversity and climate goals, respectively.

This study aims to add to the existing landscape of food system efforts and studies by:

- Identifying the significant opportunity for FMCGs and retailers to catalyse a rapid transition towards a nature-positive food system
- Exploring how circular design for food can be fully leveraged as the approach to realise such an outcome

- Analysing the economics of circular design opportunities for a select number of food types in the EU and the UK, using a replicable approach
- Laying out what businesses and policymakers can do to accelerate progress on this agenda

This study was produced in collaboration with Material Economics, which provided analytical support and expertise, and Alpha Food Labs, which worked on the product concepts of the future featured in the study. Many others have contributed to this work and all contributing organisations are listed at the end of this document. We are deeply grateful to all collaborators and contributors for the time and expertise they have dedicated to this project.

To quote the study, please use the following reference: Ellen MacArthur Foundation, *The big food redesign: Regenerating nature with the circular economy* (2021)

What if food
could help
tackle climate
change?

What if food could build biodiversity?

What would that look like?
Here are four concept foods
from a nature-positive future...

**The More
The Merrier.**



Down To Earth.
Heirloom Potatoes.

**Taste
Biodiversity.**



Down To Earth.
Heirloom Potatoes.

Chato

**Diversify
Your Potato.**

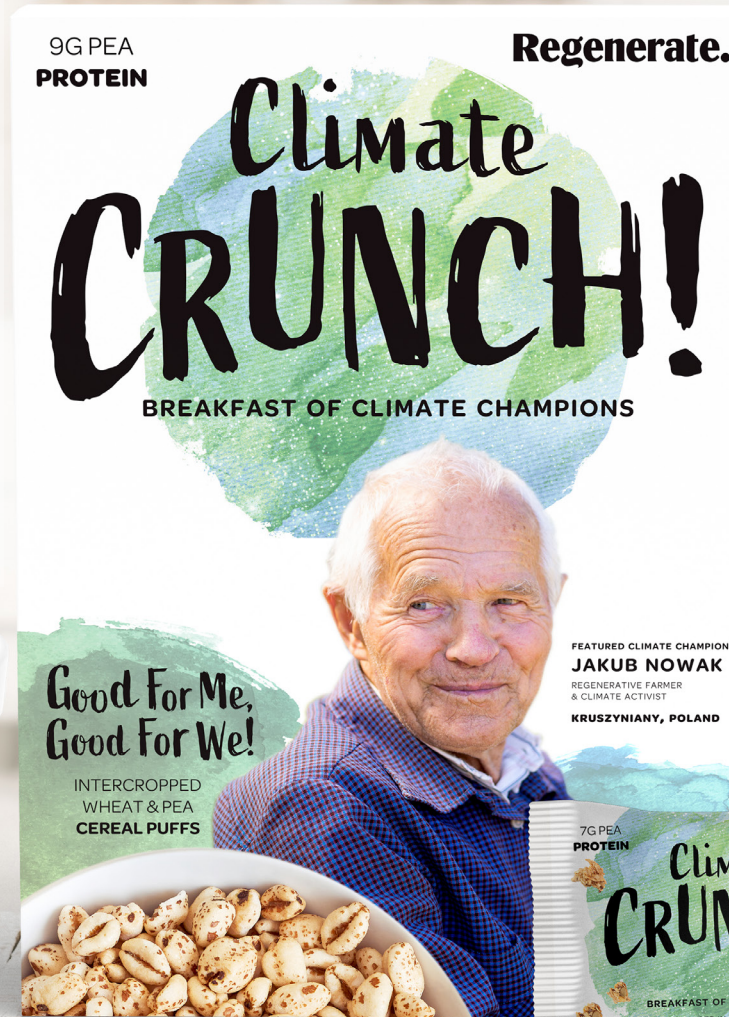


Down To Earth.
Heirloom Potatoes.

These are now your average potatoes!
*Down To Earth is a line of super delicious,
resilient potato varieties grown in a way that reduces
their carbon footprint and biodiversity impact.*

Down To Earth.

Regenerate
your →
mornings!



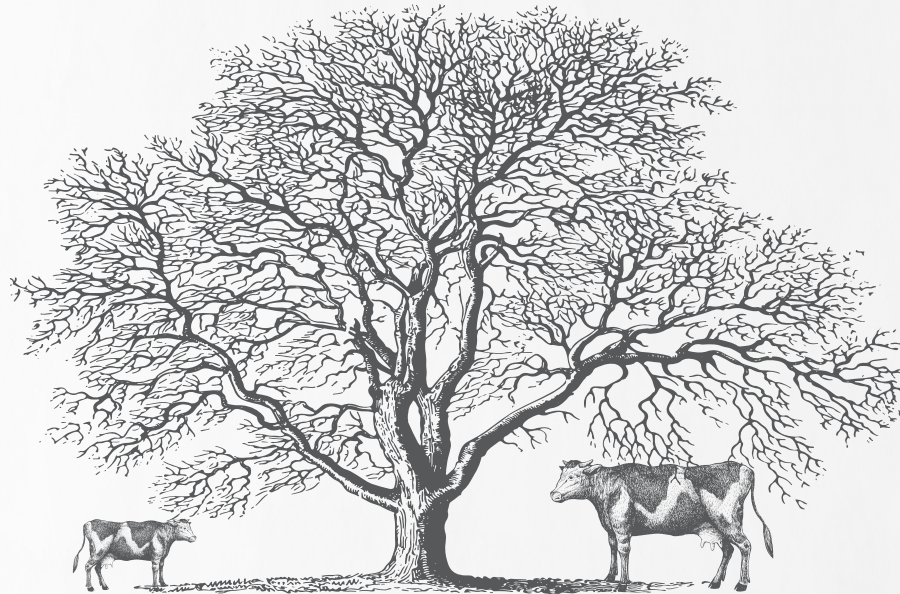
**Start your day with our classic cold cereal,
hot cereal, or on-the-go bar!**

Regenerate's Climate Crunch is a delicious, nutrient-dense, protein-packed blend of regeneratively grown wheat and peas that will keep you full for hours. And with every bite you are helping to reverse climate change.



Regenerate.

FOOD THAT'S GROWN TOGETHER, TASTES BETTER



Silvo makes deliciously indulgent dairy and plant-based cheeses that are good for the planet without compromise. Our award-winning cheeses are made with walnuts and cow's milk grown together symbiotically on silvopasture farms. All part of our mission to transform the food system through one of the most delicious foods on the planet.



SILVO
Take a piece of silvopasture with you.

COOKIES YOU LOVE

MADE FROM THINGS YOU'D NEVER EXPECT!



Sweet Up cookies are made from plant-based, nutrient-dense upcycled ingredients. Baked with upcycled flours made from plant-based milk alternative by-products and coffee cherry. Sweetened with upcycled sweeteners, made from cacao fruit pulp, fruit juice pulp, or crop leftovers. They're insanely delicious, good for the planet, and help support farming communities.

FULL CIRCLE FARMS

UPCYCLED, SWEET.

Rather than
bending nature to
produce food, food
can be designed for
nature to thrive.

Executive summary

Fast-moving consumer goods companies (FMCGs) and food retailers have an enormous opportunity to mainstream nature-positive food that is good for farmers and business. This study provides a new, design-led approach to realise the opportunity, and demonstrates it is possible.

As the primary driver of biodiversity loss and accounting for a third of global greenhouse gas emissions, it is now well-established that food needs to be a crucial part of the solution to climate change and biodiversity loss.¹ Leading FMCGs and retailers have substantial influence on the food system: in the EU and UK, for example, 40% of agricultural land use is influenced by the top 10 FMCGs and retailers.² Many of these players are currently part of the problem, but given their size and influence they can be, and need to be, part of the solution. They have a unique opportunity to contribute at scale and speed to creating a nature-positive food system that supports the livelihoods of current and future farmers. It is critical that actions by large FMCGs and retailers – on which this report focuses – are complemented by additional efforts to create a food system that is distributed, diverse, and inclusive.

By acting now, FMCGs and retailers can maximise benefits not only to the environment but also to their businesses, to consumers, and to farmers.

Transforming the food system will take time and investment but there are significant benefits to be reaped by taking bold action now. Businesses can tap into growth opportunities by creating offerings that meet growing consumer demand for products that are nutritious and good for nature. The scale of these opportunities are illustrated by sales of organic food and drink reaching USD 129 billion in 2019³ and Unilever's Sustainable Living Brands growing 69% faster than the rest of its business.⁴ Supporting regenerative food production can improve supply-chain resilience, helping safeguard ingredient supply from pests, diseases, and increasingly frequent extreme weather events. By taking actions to build a nature-positive food system, FMCGs and retailers can better support farmer livelihoods, by not only strengthening their resilience to shocks but also helping them to increase total food output, diversify their income streams, improve their profitability (after a transition phase), and provide health benefits. These actions can also enable businesses to move ahead of changing government regulations aimed at, for example, including environmental impacts in product labels and standards.

Top 10 FMCGs and retailers influence

40%

of agricultural land
in the EU and UK

To realise this opportunity, businesses will need to move beyond incremental sourcing improvements by redesigning their product portfolios.

Many leading FMCGs and retailers are already setting climate and biodiversity targets through efforts such as the Race to Zero,⁵ the Science-Based Targets initiative (SBTi),⁶ and the Science-Based Targets (SBTs) for Nature,⁷ expected in 2022. All businesses are encouraged to follow in these leaders' footsteps. Yet meeting these commitments will not be possible by solely relying on better sourcing of the current ingredient mix. Today, just four crops provide 60% of the world's calories,⁸ and many locally relevant ingredients that could substitute for higher impact ones are hardly used. A nature-positive food system requires a more diverse mix of plants and livestock, and a better understanding of local contexts to function effectively.

Major FMCGs and retailers can catalyse this shift in the mix of crops and livestock at scale and pace by creating the demand for diverse ingredients, which most often means fundamentally redesigning their food product portfolios. Food design shapes what is eaten, which ingredients are grown, and how they are produced.

Some businesses are already recognising the role of food design in positive food system transformation.

For example, 'developing product portfolios to boost cultivated biodiversity' is one of the pillars of the business-led One Planet Business for Biodiversity initiative.⁹ But, across the food industry, food design remains an underexplored yet significant opportunity to create products that are not only nutritious and tasty, and tap into new business growth opportunities, but also help achieve climate and biodiversity goals.

Circular design for food makes possible a future in which food is good for nature, farmers, and business.

Circular design for food – the combining of food design with the principles of the circular economy – offers an actionable framework to redesign product portfolios for nature-positive outcomes (see Figure 1). It encompasses rethinking product concepts, ingredient selection and sourcing, and packaging. This study shows that combining four ingredient selection and sourcing opportunities unlocks substantial environmental, economic, and yield benefits.

CIRCULAR DESIGN FOR FOOD

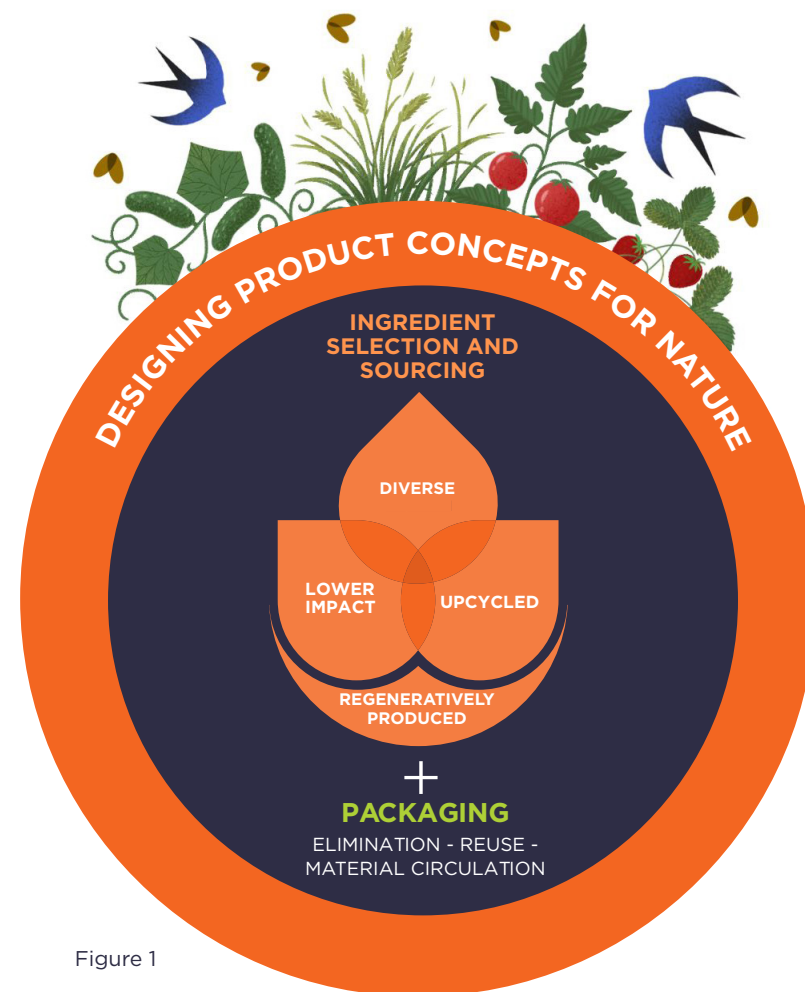


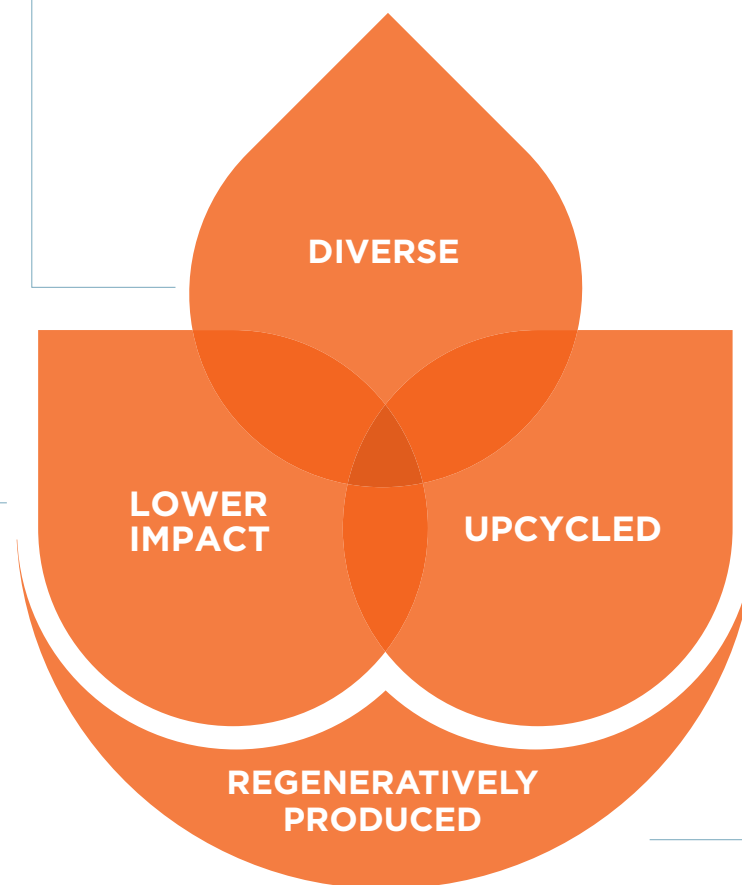
Figure 1

DIVERSE INGREDIENTS

To increase genetic diversity of crops and livestock, and therefore build food supply resilience, businesses can incorporate a broader range of ingredients in their product portfolios. For example, the culinary property of sweetness can be derived not just from sugar cane, sugar beet, or corn, but also from perennial crops such as date palm, carob, and coconut, and high-intensity natural sweeteners such as monk fruit and stevia. The same reasoning applies to varieties. Planting a range of crop varieties such as population wheat can make wheat production globally more resilient to shocks.

LOWER IMPACT INGREDIENTS

'Quick wins' are available by shifting from conventionally produced animal products to lower impact alternatives, as well as from higher impact crops to lower impact crops. Many businesses are already exploring the potential to switch from conventionally produced animal proteins to plant proteins. This study shows that the opportunity extends well beyond diversifying protein sources. For example, within the modelled geographies, replacing conventional wheat flour with pea flour in a box of breakfast cereal can reduce farm-level greenhouse gas emissions by 40% and farm-level biodiversity loss by 5%.

**UPCYCLED INGREDIENTS**

With a third of food being lost or wasted, upcycling innovations provide opportunities not only to avoid sending food and by-products to landfill, but also to turn them into high-value ingredients. The USD 46 billion upcycled food market is projected to grow at 5% annually, enabled by new technologies.¹⁰ FMCGs and retailers can scale these solutions to tap into the growing market opportunity. Using upcycled ingredients alleviates pressure on land and maximises return on invested land, energy, and other inputs used to grow food.

REGENERATIVELY PRODUCED INGREDIENTS

In recent years, leading businesses have recognised the environmental benefits of regenerative production. It can lead to greater yields and compelling increases in farmer profitability. There is no one-size-fits-all approach and practices used will need to be reviewed over time. However, for all the ingredients modelled, a set of context-dependent practices have been identified that, on average and after a transition period, increase total food output and provide additional profitability for farmers, while generating significant climate and biodiversity benefits.

In this study, regenerative production refers to growing food in ways that generate positive outcomes for nature, which include but are not limited to: healthy and stable soils, improved local biodiversity, improved air and water quality. Farmers may draw from many different schools of thought such as regenerative agriculture, agroecology, agroforestry, and conservation agriculture to apply the best set of practices to drive regenerative outcomes on their land.

Comprehensively applying circular design for food results in environmental, economic, and yield benefits significantly greater than those achieved by better sourcing alone.

Analysis of example ingredients – wheat, dairy, and potatoes in the EU and the UK, and sweeteners – shows that taking advantage of all four circular design for food opportunities together has the potential to generate substantial environmental, food output, and farmer profitability benefits versus business-as-usual¹¹ (see Figure 2). The benefits of these actions, which are first steps on the journey to a nature-positive food system, are significantly more compelling than better sourcing of current ingredients alone.

While the exact benefits are ingredient- and geography-specific, the consistency of findings

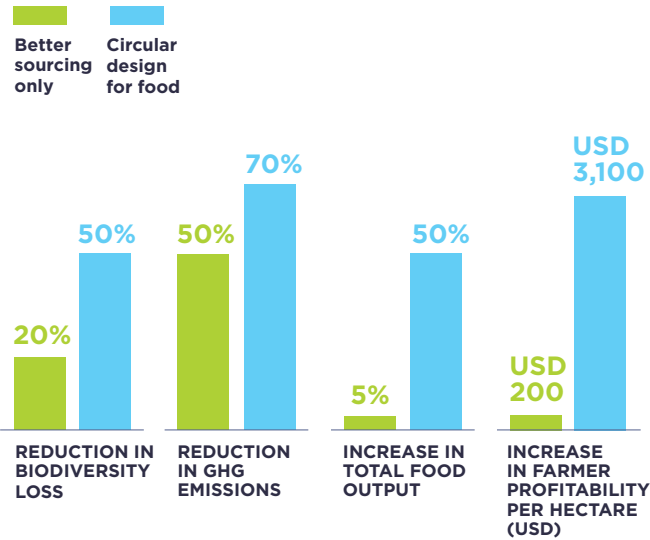
across modelled ingredients suggests circular design for food will lead to superior increases in farmer profitability, total food output, and environmental benefits in many other cases as well.

A key component here is moving from looking at individual ingredients in isolation to understanding the wider ecosystems they belong to. This means designing in partnership with farmers to ensure that the reality of evolving farm systems is taken into account. Doing so will enable food design strategies to realise the potential of the diverse crops and livestock that are integral components of regenerative farming systems. This potential, only a fraction of which is modelled in this study, is to make the food system truly nature-positive – rather than only reducing its negative impact – while maximising total food output and profitability for farmers.

Businesses can take five actions to make nature-positive food mainstream:

- 1. Create ambitious and well-resourced action plans to make nature-positive product portfolios a reality
- 2. Create a new collaborative dynamic with farmers
- 3. Develop iconic products to showcase the potential of circular design for food
- 4. Contribute to and use common on-farm metrics and definitions
- 5. Advocate for policies that support a nature-positive food system

Figure 2
CIRCULAR DESIGN FOR FOOD OFFERS SIGNIFICANTLY GREATER BENEFITS THAN BETTER SOURCING ALONE*



*On average for three modelled ingredients (per harvest for wheat and potatoes, and per year for dairy) in the UK and EU.

A future where nature-positive food is available at scale is possible. Circular design for food offers FMCGs and retailers a pathway to realise food's potential to be good for nature, farmers, and business.

1. Why *now* is the time for industry to drive food system transformation



The food system globally is responsible for

1/3

of greenhouse gas (GHG) emissions

1/2

of human-induced pressures on biodiversity

The food system has a vital role to play in tackling climate change and biodiversity loss

As climate change and biodiversity loss reach the top of agendas in business and government, it is clear that the food system has a vital role to play in tackling both challenges. As highlighted in *The nature imperative: how the circular economy tackles biodiversity loss*,¹² the food system globally is responsible for a third of greenhouse gas (GHG) emissions¹³ and half of human-induced pressures on biodiversity.¹⁴

Recognising this, the policy landscape is moving to support food system transformation. The EU's Farm to Fork Strategy, for example, supports the carbon-neutrality ambitions of the bloc's Green Deal and integrates the goals of its Biodiversity Strategy.¹⁵ Similarly, the UK government has recently published a National Food Strategy – an independent review of the country's entire food system – and is developing new funding schemes for farmers based on the principle of “public money for public goods”, linking rewards directly to the practices adopted.^{16,17}

The Food and Agriculture Organization (FAO) of the United Nations is supporting a number of governments around the world in the development and implementation of policies to promote agroecology.¹⁸ In Mexico, for example, the government has initiated a consultation process in five regions for the development of a national Agroecological Transition Programme.¹⁹ Cities such as Milan and São Paulo are also developing policies that promote regenerative

outcomes, which include offering support to agroecological farming within city boundaries and interventions that better connect local producers with those living in urban areas.^{20,21}

Industry leaders have also set commitments to tackle climate change and biodiversity loss, and are implementing programmes to provide support at the farm level. Unilever, for example, has set an ambition to reach net-zero emissions from all its products by 2039 and has published a set of regenerative agriculture principles, noting it will prioritise key crops and will work with farmers to bring environmental benefits, such as enhanced soil health and improved livelihoods.²² Likewise, PepsiCo's Positive Agriculture strategy aims to work with farmers to build soil health, increase biodiversity, and improve farmer livelihoods across 7 million acres of farmland.²³ Some of this work is already underway through PepsiCo's global network of demonstration farms. Meanwhile, Walmart aims to protect, manage, or restore at least 50 million acres of land and 1 million square miles of ocean by 2030, through initiatives such as driving the adoption of farming practices for regenerative outcomes.²⁴

However, while 75% of food and agriculture businesses have made public commitments,²⁵ **only a handful have set out tangible plans** to shift their entire value chains to a nature-positive food system. As well as an implementation gap, there is also a lack of ambition. Most commitments focus on finding single solutions to individual challenges, such as shifting from conventionally produced animal

proteins to plant proteins. Indeed, of the 350 food and agriculture businesses currently being assessed by the World Benchmarking Alliance, only 12 are cited as having a holistic understanding of the roles they can play in shifting the food system.²⁶

Commitments and actions need to move beyond incremental improvements and towards accelerating a fundamental transformation of the food system.

FMCGs and retailers have the power to transform agricultural landscapes to tackle climate change and biodiversity loss

Globally, the sourcing power of FMCGs and retailers in the food sector is considerable. In the EU and UK, for example, 40% of agricultural land use is influenced by the top 10 FMCGs and retailers.²⁷

The size and market position of these businesses are often used to highlight the part they play in the current damaging food system. However, it is these very factors that also give them a unique opportunity to contribute at scale and speed to creating a nature-positive food system that supports the livelihoods of current and future farmers.

It is critical that the actions taken by large FMCGs and retailers – on which this report focuses – are complemented by additional efforts to create a food system that is distributed, diverse, and inclusive.

By acting now, FMCGs and retailers can accelerate positive impacts and maximise benefits not only for the environment but also for their businesses, consumers, and farmers

Transforming the food system to one that is nature-positive will take time and require investment, but by acting now FMCGs and retailers can accelerate positive impacts and reap significant benefits, including:

Tap into market growth areas

The popularity of new food products – such as those that are protein-rich, plant-based, or contain superfood ingredients – has been enhanced by the current global health challenges and the climate crisis. For example, the plant-based food and beverage market in the EU and the UK grew 49% between 2018 and 2020,²⁸ fuelled by businesses like Oatly – an oat beverage company that was established in 2016 and in 2021 had its IPO valued at USD 10 billion.²⁹ Businesses that cater to evolving consumer preferences can increase brand reputation, customer loyalty, and presence in new product categories.

Progress on climate and biodiversity goals

Moving to a nature-positive food system can contribute to FMCGs and retailers achieving their goals relating to halting and reversing biodiversity loss and reaching net-zero GHG emissions. Credible plans and actions for creating such a system could increase brand equity with consumers, who are clearly looking

Top 10 FMCGs and retailers influence about

40%

of agricultural land in the EU and UK

for businesses to be part of the solution. For example, Unilever's Sustainable Living Brands are growing 69% faster than the rest of its business.³⁰

Improve supply-chain resilience

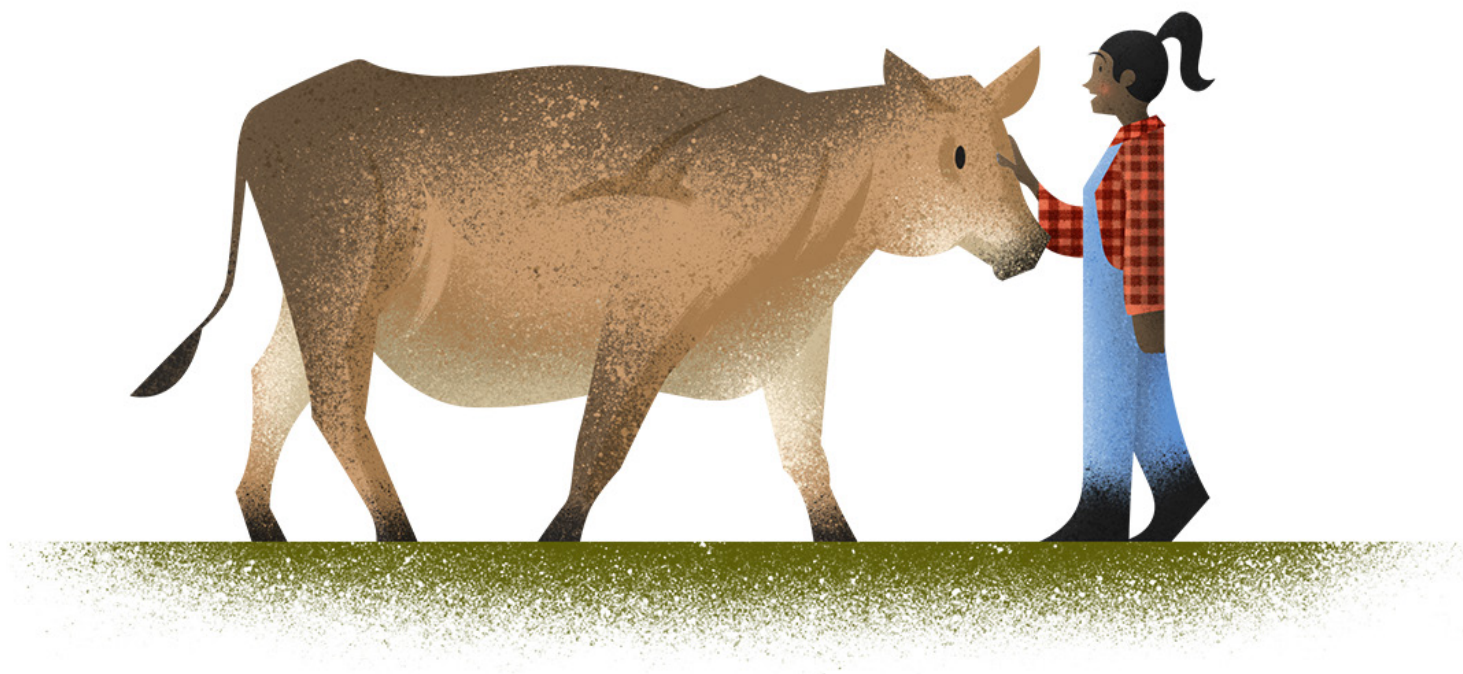
Supply chains and business profitability are increasingly threatened by physical shocks such as floods, droughts, and diseases. By designing products for nature to thrive, businesses will source a wide variety of ingredients from farms that employ practices with regenerative outcomes, which strengthens their resilience to these shocks. This can help establish more reliable long-term supplies of ingredients.

Support farmer livelihoods

By taking actions to build a nature-positive food system, FMCGs and retailers can better support farmer livelihoods, helping them to increase total food output, improve their profitability (after a transition phase), diversify their income streams, improve resilience to environmental shocks, and gain health benefits. *For details, see Section 4.*

Move ahead of changing regulations

Governments are increasingly considering initiatives and possible legislation aimed at, for example, including environmental impacts in product labels and standards.³¹ To meet these requirements, FMCGs and retailers will need to rethink their ingredient selection and sourcing. By taking bold actions to get ahead of future changes to regulations now, businesses can benefit from becoming more attractive to investors and consumers.



2. To build a nature-positive food system, FMCGs and retailers need to redesign their food portfolios



Improving the sourcing of current ingredients is not enough to build a nature-positive food system. Diversity needs to be designed into it

A nature-positive food system requires an understanding of local contexts and a different, more diverse mix of plants and livestock to function effectively.

The regeneration of ecosystems requires growing diverse plants and livestock that work together symbiotically in farming systems and in harmony with surrounding nature. The appropriate combination of ingredients and production practices is tailored to the unique local context. What is produced today in a region might not be what is needed to regenerate nature there tomorrow.

More cultivated biodiversity is also needed to promote the resilience of the food system against pests, diseases, and climate variability, thereby enhancing food security. This entails going far beyond the handful of foods eaten at scale globally today, and requires the selection of a broader range of ingredients.

To ensure regenerative production is financially attractive for farmers, all that is produced on their land needs to be attributed value. In order to maximise the profitability for farmers and minimise the time it takes to break even when transitioning to regenerative production systems, cash crops need to be leveraged.

This means using cover-, inter-, and rotation-crops as ingredients in products, and creating diverse revenue streams for farmers.

Building a nature-positive food system will be impossible unless FMCGs and retailers go beyond incremental improvements in the sourcing of current ingredients, and start selecting ingredients fit for regenerative production. FMCGs and retailers can catalyse the shift towards a more diverse mix of crops and livestock, at scale and pace, by creating the demand for different ingredients through the redesign of food portfolios.

Food design shapes what is eaten, and which ingredients are grown

Most of the food that is eaten, from breakfast cereals to pasta, has been *designed*. Intentional decisions have been made that determine the food's flavour, texture, nutritional content, and appearance. *Food design* includes shaping a product's concept, ingredient selection, sourcing, and packaging.

While the term food design is relatively nascent, businesses use food design to optimise for consumer outcomes, such as flavour and nutrition (see boxout 'Food design and dietary shifts'), with teams from across the organisation contributing.



PRODUCT CONCEPT

Team: Marketing

Impact on outcomes:

The product concept captures ideas for the product, communicated through the product brief. This includes product category, target customer group(s), and brand positioning; the decisions that shape the product concept also determine the parameters within which other teams can work, identifying pricing, taste, and nutritional requirements.

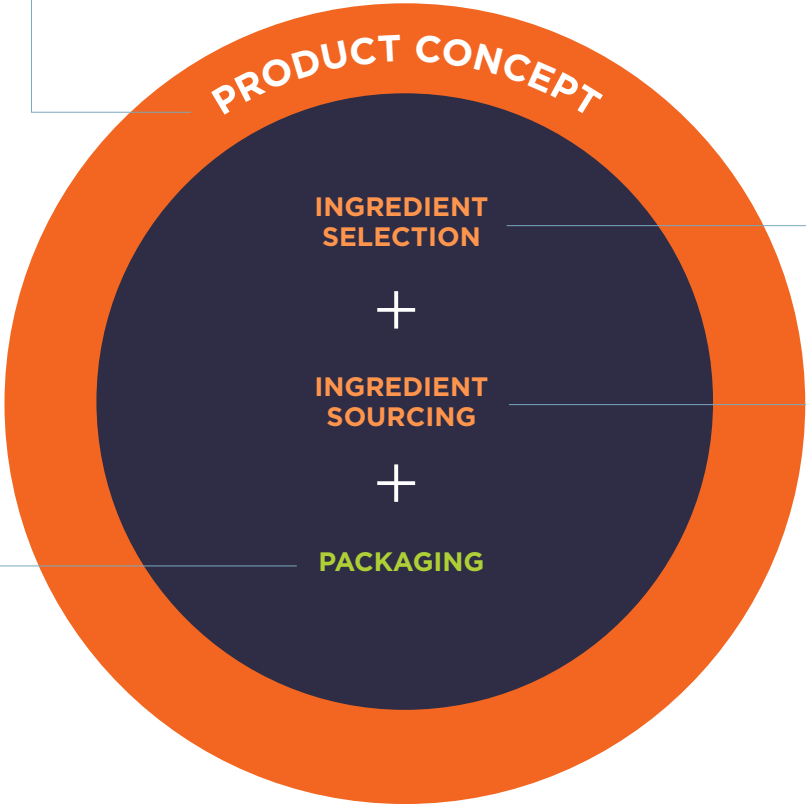
PACKAGING

Team: R&D

Impact on outcomes:

The packaging of a product is key to defining the length of its shelf life, and the material and design choices have strong environmental impacts throughout the journey of the product, from production to post-consumption.

FOOD DESIGN



INGREDIENT SELECTION

Team: R&D

Impact on outcomes:

The decisions made by this team affect the texture, taste, nutrition, and environmental impact of the end-product. Each ingredient has various properties and a different inherent potential impact on climate change and biodiversity.

INGREDIENT SOURCING

Team: Procurement

Impact on outcomes:

Procurement decisions define how direct the relationship with suppliers is, how far the ingredient has to travel, and what the requirements are on the way it was produced or grown which, in turn, have an important influence on environmental, economic, and societal outcomes for the farmers and suppliers.

Efforts are being made by businesses to follow dietary recommendations and cater to evolving consumer preferences by reducing the use of sugar, salt, and fat, as well as artificial additives and preservatives, in their products. For example, Heinz made recipe changes that allowed it to launch a version of [Heinz Tomato Ketchup](#) that contains 50% less sugar and 50% less salt.³² In 2012, [Nestlé Confectionery UK](#) announced the removal of artificial colours, flavours, and preservatives from its entire confectionery range – replacing them with ingredients such as concentrates of carrot, hibiscus, radish safflower, and lemon.³³

Decisions made at the product design stage radiate throughout the food system, from farmers to consumers, impacting economic, societal, and environmental outcomes. To ensure these impacts are positive, at every stage of the design process there needs to be a continuous oscillation between zooming in to the consumer's needs and zooming out to consider the environmental and societal impacts.

FOOD DESIGN AND DIETARY SHIFTS

In recent years, reports from organisations like EAT Foundation³⁴ and Chatham House³⁵ have emphasised the need to shift to diets that stay within planetary boundaries and provide people with high-quality nutrition. Food design is an important tool for businesses to shape product offerings that meet these nutritional requirements. This study focuses on the first steps businesses can take to designing food products that allow nature to thrive, but to optimise outcomes for the entire system, food products also need to be designed for people to thrive. Circular design for food can contribute to this: for example, regeneratively produced ingredients may also be more nutrient-dense (see boxout 'Regenerative production and nutrient density of food' on page 51).



3. Circular design for food is a framework that can be used to design for nature



To design for positive consumer, economic, farmer, and environmental outcomes, food design can be combined with the principles of the circular economy. This is circular design for food.

Circular design is a framework that embeds the principles of the circular economy – eliminating waste and pollution, circulating products and materials, and regenerating nature – and systems thinking in the creation of products and services. It can be applied across industries.

When applied to food, approaches based on the principles of the circular economy work to tackle climate change,³⁶ prevent biodiversity loss,³⁷ bring societal and economic benefits,³⁸ and support long-term food supply resilience.³⁹

The health of nature cannot be uncoupled from the health of economies.⁴⁰

For food, this means that positive outcomes are maximised by designing with the whole system in mind and applying circular economy principles across all dimensions of food design, from product concept, through ingredient selection and sourcing, to packaging.

WHAT IS THE CIRCULAR ECONOMY?

The circular economy provides a framework to go beyond simply undoing the damage of the current food system, and move towards actively regenerating local ecosystems and landscapes, and building a nature-positive food system. It is a solutions framework that empowers organisations to address global challenges by fundamentally redesigning systems around three principles:

- Eliminate waste and pollution
- Circulate products and materials
- Regenerate nature



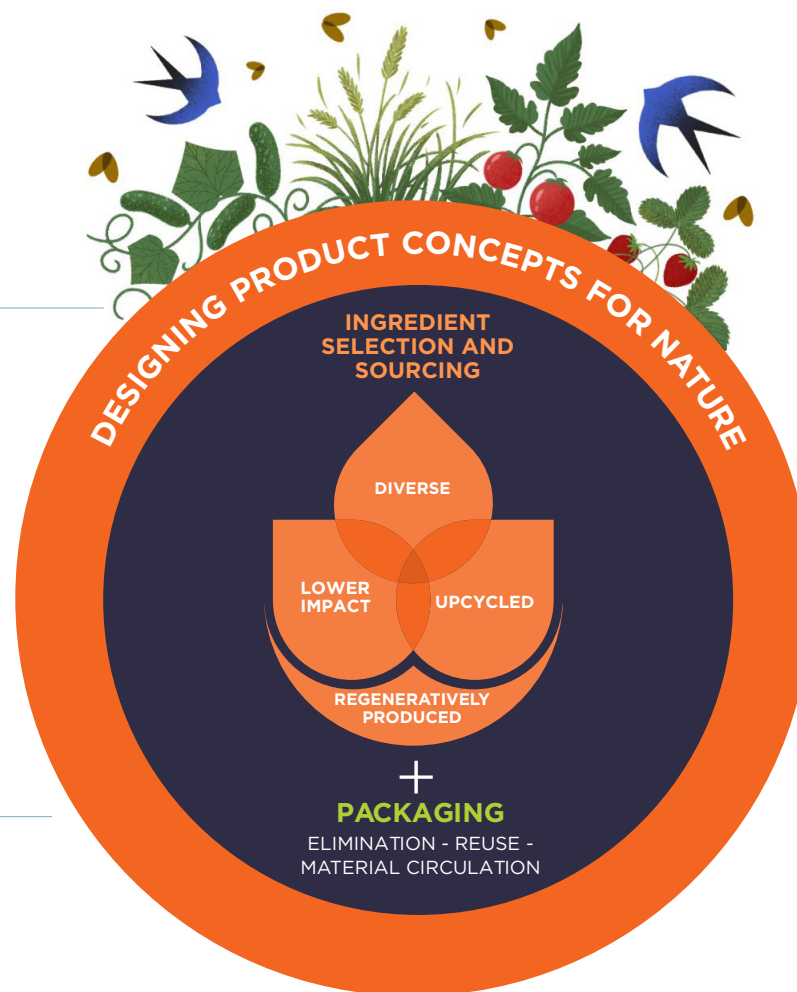
DESIGNING PRODUCT CONCEPTS FOR NATURE

At the heart of circular design for food sits the intent to deliver positive outcomes for nature. Designing product concepts that enable nature to thrive and embedding nature-positive targets in the product brief can provide clear incentives for product development teams to design for regenerative outcomes.

PACKAGING

When designing a product, packaging should be considered in parallel with the product itself, as both have strong implications on each other and on environmental outcomes. Three strategies can be used to help businesses achieve their circular economy goals for packaging: **elimination, reuse, and material circulation**. For more information, see [*Upstream innovation: a guide to packaging solutions*](#).⁴¹

CIRCULAR DESIGN FOR FOOD



INGREDIENT SELECTION AND SOURCING

R&D and procurement teams can tap into the power of circular design for food by taking a collaborative approach when jointly making ingredient selection and sourcing decisions. That means focusing on achieving the best outcomes by taking into account *which* ingredients are included in formulations, *how* they are produced, and importantly, *what role they play* in regenerating the landscapes they are produced in.

Four ingredient selection and sourcing opportunities can be combined to tap into the power of circular design for food.

Rather than bending
nature to produce food...



food can be designed for nature to thrive

What could nature-positive food products look like?

Let's fast forward to 2030,
when foods that actively tackle
climate change and build
biodiversity are widely available
across Europe and the UK...

FUTURE PRODUCT 2030

CLIMATE CRUNCH

Regenerate your morning

Start your day right with Regenerate’s Climate Crunch – a delicious, nutrient-dense, protein-packed blend of wheat and peas that will keep you full for hours. Whether it’s our cold cereal, hot cereal cup, or cereal bars, with every bite you are part of a movement of consumers who are helping to reverse climate change and support local farming communities. Our farmers are our climate champions, and that’s why they’re featured on our products.



HEAR ONE FARMER’S JOURNEY

“Before I became a regenerative farmer, my main source of income was wheat because that’s what my family had been growing here in Poland for generations. To keep my farm going, I was relying on synthetic fertilisers and pesticides, and I could see the damage it was doing to the land and the plants and animals around us. So, in 2021, I decided to intercrop peas with my wheat because it fixes nitrogen in the soil. This enabled me to reduce my reliance on synthetic inputs and allowed me to diversify my income, as I was no longer reliant only on the price of wheat being good. Since then, the health of my soil has improved immeasurably!

The support that I received from Regenerate helped me invest in some new machinery, which would have taken some years to pay off without any financial assistance. Now, I can grow almost 50% more food from each field thanks to intercropping peas and wheat than if I grew each of them separately. I hadn’t considered growing peas before as there wasn’t much demand for them, but working with Regenerate ensured that I had someone to sell them to.”

HOW CLIMATE CRUNCH WAS BROUGHT TO LIFE...

Farm

To initiate the transition, Regenerate provided some financial support to farmers with a grant matching programme, it also set up a training programme with local agronomists to help farmers learn about intercropping and worked with them to form a cooperative for machinery leasing.

Buying model

Regenerate has collaborated with farmers to agree supportive contract terms. Most opted for longer term 10-year contracts, supplying all the wheat and pea volumes produced on the farm to allow the farm system to reach maturity and produce consistent yields.

Product design

The product recipes were designed to use wheat and peas in proportion to their production volumes from supplying farms to help ensure there is ongoing demand for both crops, providing farmers with enduring incentives.

* Compared to a box of cereal containing 100% of wheat grown conventionally. Data is for wheat and peas and does not account for other ingredients or GHGs beyond primary production.

FUTURE PRODUCT 2030

SILVO

Food that's produced together, tastes better

Silvo is on a mission to transform our food system through one of the most delicious foods on the planet: cheese. We make deliciously indulgent dairy and plant-based cheeses that are good for the planet without compromise. Our award-winning cheeses are made with walnuts and cow's milk produced together symbiotically on silvopasture farms.



HEAR ONE FARMER'S JOURNEY

"In 2018, we began transitioning from conventional grazing on our dairy farm to Managed Intensive Grazing within a silvopasture system. Our farm, in Bretagne, France, has always supported a herd of around 80 cows but we've been worried about the climate change impacts of raising livestock and the pressure to meet net-zero emissions. Now, our fields are also lined with walnut trees that are mature and bearing nuts. The trees help our production to be net carbon neutral, provide us with more diverse and stable sources of income, and give the cows shelter. Currently our herd spends the harshest part of winter inside, and their feed is partially supplemented with grains that we buy in. We'd love to be able to feed them only with feed we've produced ourselves on the farm, such as tree hay, but we're not quite there yet."

The up-front investment in tree saplings, machinery, and other equipment was quite expensive, and learning to grow and manage tree crops was totally new for us, so it was a bit of a learning curve at first. We will still need subsidies for a while as we transition to silvopasture and to help to sustain a stable revenue, but the positive impact on the environment is worth it. The 20-year contract we have signed with Silvo allows us to support the land and our livelihood, and to leave a legacy for our children, when they one day take over the farm."

HOW SILVO WAS BROUGHT TO LIFE...

Farm

Silvo partnered with a local farming cooperative to provide training to support farmers in the transition to silvopasture systems. Dairy farmers who shifted to silvopasture systems received extra government funding, which helped them purchase the walnut trees.

Public policies

A new ecosystem service payment scheme was introduced by the regional government to compensate farmers for their carbon sequestration. Cheeses are stamped with a Protected Designation of Origin (PDO) linked to their specific region and the silvopasture practices.

Buying model

Silvo committed to buy every output from supplying silvopasture farms with 20-year flexible contracts.

Product design

A multi-pack of cheeses made from ingredients produced together in a silvopasture system, and packaged and sold together.

FUTURE PRODUCT 2030

DOWN TO EARTH

Resilient Roots

These are now your average potatoes! Down To Earth is a line of super delicious, resilient potato varieties grown in a way that reduces their carbon footprint and biodiversity impact. But while these potatoes have heroic benefits to the environment, they are affordable and cook and taste just like the potatoes you’ve always known.



HEAR ONE FARMER’S JOURNEY

“I am a farmer in Norfolk, UK, growing potatoes once every six or seven years along with mustard, cereals, and carrots. I used to grow a potato variety that was very popular with English customers. But people didn’t realise at the time that it’s quite susceptible to diseases, so I had to use a lot of pesticides to prevent losses. I have switched to new disease-resistant varieties and practices that have regenerative outcomes. I began trialling manure application and growing mustard in rotation, which I plough back into the soil. This would have been impossible with the old variety I used to grow because of their vulnerability to pests. All of these changes have reduced my use of synthetic inputs drastically and because the yields are higher with these potato varieties, my income has already improved after two rotations.

I have also trialled a few heritage potato varieties. It has taken a few years to find the right ones that work for me but now I have a diverse selection that suits my soil and is nutritious for consumers.”

HOW DOWN TO EARTH WAS BROUGHT TO LIFE...

Farm

Farmers who were part of the Down To Earth programme started by experimenting with new varieties and new practices on part of their land. They were given access to a regional training hub, which was funded and managed by a coalition between the government, Down To Earth, and several retail chains.

Public policies

Farmers in the UK received dedicated funding to support their transition to regenerative food production through the Sustainable Farming Incentive, which supplemented financial support provided by Down To Earth.

Buying model

Retailers who took part in the Down To Earth programme agreed to a whole-crop purchasing model, in which they bought all outputs of the farm. They also paid a premium for the new varieties of potatoes to compensate for the loss of volume of other crops due to the added mustard rotation.

Product design

Retailers adapted their specification criteria to allow for all of the edible potatoes to be sold in their stores.

FUTURE PRODUCT 2030

SWEET UP

By Full Circle Farms. Upcycled. Sweet.

The cookies you love, made from the things you'd never expect. Sweet Up is a line of cookies made from plant-based, nutrient-dense upcycled ingredients. Each type of cookie in our range is baked with different blends of upcycled flours made from plant-based milk by-products and coffee cherry. They are sweetened with different low-glycaemic upcycled sweeteners, made from cacao fruit pulp, fruit juice pulp, or crop leftovers. The coffee flour's deep fruity flavour truly makes our cookies stand out. They are insanely delicious, good for the planet, and help to support farming communities. Have your cookie and eat it, too!



COFFEE CHERRY



FRUIT JUICE BY-PRODUCT



CACAO FRUIT PULP



CROP RESIDUES

HEAR ONE FARMER'S JOURNEY

"I am a coffee farmer in Brazil. I used to sell only coffee beans and was vulnerable to commodity prices. I had no use for the rest of the coffee cherry and would often leave it to rot in the field."

"When Full Circle Farms said they would buy my entire coffee crop – the beans and the rest of the cherry – I was very surprised that someone wanted to use what I considered waste at the time. However, they offered training and support to help the cooperative that I am a member of establish a new supply chain. The coffee cherry has a lower density than beans, which makes the bags light enough for the women to carry, creating more jobs in the community."

"This extra income has also allowed me to reinvest in my farm and implement agroforestry practices in my coffee plantation, which, in turn, have improved the quality of my coffee beans and cherries."

HOW SWEET UP WAS BROUGHT TO LIFE...

Sourcing

Full Circle Farms used by-products from their own plant-based milk production, including soy and oat milk, and regeneratively produced ingredients to create flour for the cookies. They worked with farmers in Brazil to build and ensure the supply chain of coffee and cacao by-products, and collaborated with a third-party company to transform these by-products into ingredients.

Public policies

Government-funded universities and research centres investigated the potential of different upcycled sweeteners. Meanwhile, all the ingredients used in the cookies became part of a list of novel foods approved for consumer use by the European Commission.

Buying model

Full Circle Farms works with other FMCGs to establish a collaborative buying model in which each buys a different part of the ingredient. In the case of coffee, Full Circle Farms purchase the coffee cherry while the other FMCGs purchase the beans.

Product design

The line was designed to expand as new by-products are transformed into ingredients in different geographies, and new upcycled ingredients are added to the list of novel foods approved for consumer use. For example, making flour from solid by-products of different plant-based milks, depending on the context.

4. Businesses, farmers, and nature all benefit from circular design for food



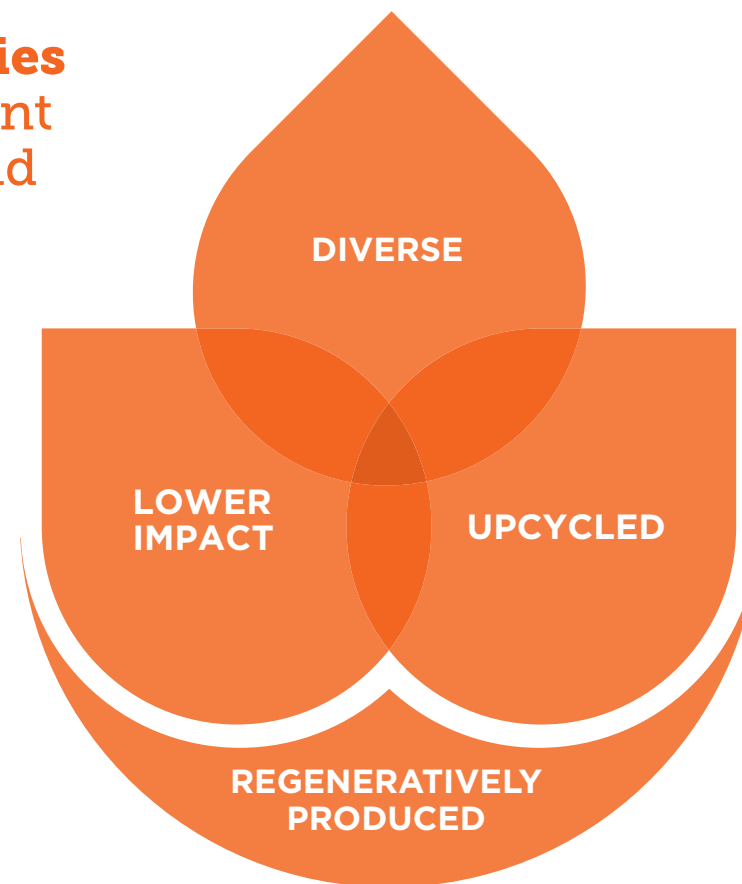
Products like Climate Crunch, Silvo, Down To Earth, and Sweet Up could all be commonplace on retail shelves by 2030 if businesses apply circular design for food at scale to ingredient selection and sourcing.

To get there, businesses can set product portfolio strategies underpinned by a mindset of designing for nature, and use ingredients that are: **diverse, lower impact, upcycled, regeneratively produced.**

Rather than viewing ingredients in isolation, designing for nature to thrive requires an understanding of the ecosystems that ingredients are produced in and the value chains surrounding them. When embarking on the journey towards this ideal state, it is important to understand the environmental and economic benefits that each of the four design opportunities can offer individually and in combination.

The full benefits of a nature-positive food system can only be achieved by combining all of these opportunities at the same time across product portfolios.

Four circular design opportunities for ingredient selection and sourcing



ANALYSING THE BENEFITS OF DESIGN OPPORTUNITIES

For this study, an analytical framework was developed to quantify the environmental, food output, and farmer profitability benefits of applying circular design for food.*

Metrics assessed in this framework⁴² are:*

Assessed metrics

- **Climate change**

Farm-level GHG emissions, including all emissions generated during the production phase, emissions generated from the production of agricultural inputs plus net carbon sequestration through land use, were measured using the GWP₁₀₀ metric.⁴³

- **Biodiversity**

On-farm, above-ground biodiversity footprint – measured in ‘biodiversity weighted hectares’. This is a product of: land-use area, proportion of biodiversity lost due to agricultural intensity, and relative global importance of the biodiversity of that geographic location. This is calculated using the Biodiversity Impact Metric (BIM) developed by the Cambridge Institute for Sustainability Leadership (CISL).⁴⁴

- **Total food output**

Total volume of food produced per hectare, in tonnes.

- **Farmer profitability**

The implications of applying selected practices that support regenerative outcomes for farmer profitability were modelled, presented in USD per hectare.⁴⁵

All metrics are assessed when applying the design opportunities versus business-as-usual, which denotes conventional production methods.

Ingredients modelled

To do this, the benefits of design opportunities were modelled for four ingredients – wheat, dairy, potatoes, and sweeteners. These ingredients were selected based on three key criteria:

- **Represent substantial agricultural footprint in EU/UK.** Wheat, dairy, and potatoes collectively make up about 30% of Utilised Agricultural Area (UAA) in the EU and 22% of UAA in the UK.⁴⁶

- **Significant ingredients in most FMCG and retailer product portfolios.** All of the ingredients are typically among the top 10 ingredients sourced by volume, by major FMCGs and retailers.⁴⁷

- **Represent a broad set of ingredient types, farming systems, and associated environmental challenges.**

Design opportunities for wheat, dairy, and potatoes were analysed in the UK and EU, while sweeteners were analysed at a global scale to explore upcycling opportunities.

This analysis aims to quantify the benefits of circular design for food – a combination of four related but distinct opportunities – by assessing a small set of ingredients. By analysing the environmental impacts, food output, and farm profitability, insights are gained as to how the opportunities can be best applied across a range of food types, geographies, and contexts. The consistency of many of the findings suggests this is indeed the case. For more detail about the methodology and analytical framework, including assumptions made, please refer to the [‘Technical Appendix’](#).

*The set of practices and combination of crops and livestock to support regenerative outcomes, as well as lower impact alternative ingredients, selected for each ingredient are illustrative and are not intended to be a one-size-fits-all solution. The agricultural practices and crop/livestock combinations most appropriate for regenerating nature will vary significantly depending on context-specific factors such as climate and soil types and should be tailored to the needs of the specific location. A subset of economically attractive practices that support regenerative outcomes have been selected and analysed, however they represent just the first few steps on the journey towards a fully regenerative production system, and more ambitious sets of practices would be expected to achieve even greater environmental outcomes. Still, the modelled examples illustrate the potential environmental benefits that can be achieved profitably by applying a set of well-studied practices for the ingredients analysed. The quantified outcomes are expected to vary according to a farmer’s given context, or might be achieved through application of a different set of practices.

Diverse ingredients

What are diverse ingredients?
Diverse ingredients are those that come from a broad range of plant and animal species, as well as varieties within those species. For example, today, just a small selection of potato varieties are consumed, yet over 4,500 diverse varieties exist globally (Figure 3). The same is true for the production of other ingredients, such as sweeteners. Rather than using just three crops – sugar beet, sugar cane, and corn – to produce the majority of sweeteners, a greater diversity of crops can be used to fulfil the same properties (Figure 4).

Figure 3
Cultivated biodiversity within species:



Just a small selection of potatoes are consumed, yet...

**OVER
4,500
DIVERSE VARIETIES
EXIST GLOBALLY**



Figure 4
Cultivated biodiversity between species of sweetener crops:

The property of sweetness is currently provided mostly by three crops – sugar beet, sugar cane, and corn...



SUGAR BEET



SUGAR CANE



CORN



AGAVE



CACAO



LACUNA



MAPLE



MONK FRUIT



FRUIT SUGAR ALCOHOLS



COCONUT



YACON



JERUSALEM ARTICHOKE



STEVIA



DATE PALM



CAROB

**DIVERSE CROP SPECIES
COULD BE USED FOR
SWEETNESS**

Why shift to diverse ingredients?

As the diversity of foods produced decreases, so does the resilience of the food system to threats such as pests, diseases, and extreme weather shocks exacerbated by climate change. By using inter-, cover-, and rotational-crops, diverse food types can be incorporated as essential components of regenerative farming systems.

Today, just four crops – wheat, rice, corn, and potatoes – provide almost 60% of the calories consumed globally.⁴⁸ Only a few varieties of each of these staple crops are cultivated at scale and, overall, varieties and breeds of domesticated plants and animals are increasingly being lost as the food system becomes more homogenised.⁴⁹

Designing products to use more diverse ingredients can enable a shift towards regenerative production systems that integrate a variety of food types which benefit one another when grown together. Using more diverse ingredients not only increases cultivated biodiversity within and between species, but also promotes biodiversity more broadly. This approach can also enhance the resilience of the food system against threats such as pests, disease, and environmental shocks, and, as a result, enhance food security. Overreliance on a single variety can lead to entire crops failing, which was the case during the Great Famine in nineteenth-century Ireland when a potato variety was devastated by disease,⁵⁰ and more recently as Panama disease threatens the dominant banana variety, the Cavendish, much like it did with the dominant Gros Michel variety in

the 1950s.⁵¹ Research shows that climate change could cause global potato yields to decline by up to a third by 2060, unless diverse climate-resilient varieties are widely adopted.⁵² Diversifying livestock breeds may also bring benefits as certain breeds thrive in different climates and topographies,⁵³ for example Pineywoods cattle, a breed more tolerant to hot climates,⁵⁴ and North Devon Cattle that require little supplementary feed and may be more resistant to parasites and disease.⁵⁵

Designing food products to use more diverse ingredients can also provide people with access to a wider range of food flavours and expand the nutritional profile of diets. Many conventional crop varieties are selected for efficiency and yield, often at the expense of flavour or nutritional density,⁵⁶ which are properties that food designers and consumers seek out. However, more diverse farm ecosystems can produce more nutritionally dense food.⁵⁷

Initiatives to stimulate diversity are already underway such as Knorr and WWF's 'Future 50 Foods',⁵⁸ the Lexicon's 'Reawakened 25',⁵⁹ and Slow Food's 'Ark of Taste'⁶⁰ – all of which highlight diverse underutilised crops, such as teff, yacon, and moringa, that can be used to create flavourful and nutritious food products.

Culinary traditions are often built around diverse local varieties of ingredients, and many traditional farming practices based on indigenous knowledge support biodiversity.⁶¹ Designing food products for diversity and building demand for these ingredients, can support livelihoods and preserve

food traditions and cultural food heritage.⁶² The ongoing 'Millet Revolution' in India is an example of how rediscovering and using forgotten varieties of staple crops, such as small millets, can preserve agrobiodiversity, ensure food sovereignty, and empower women through training and new business opportunities.⁶³

Today, just four crops –
wheat, rice, corn, and
potatoes – provide almost

60%

of the calories
consumed globally



Lower impact ingredients

What are lower impact ingredients?

Lower impact in this context means ingredients that are conventionally produced but that have significantly reduced environmental impacts. (See ‘Regeneratively produced ingredients’ section for other details.)

Why shift to lower impact ingredients?

Businesses can explore alternative conventionally produced ingredient types and varieties that are available at scale today, and provide desired properties but have fewer negative climate and biodiversity impacts. These ‘quick wins’ can be realised by shifting from higher impact crops to lower impact crops, as well as from conventionally produced animal products to lower impact alternatives.

From conventionally produced animal products to plant-based ingredients

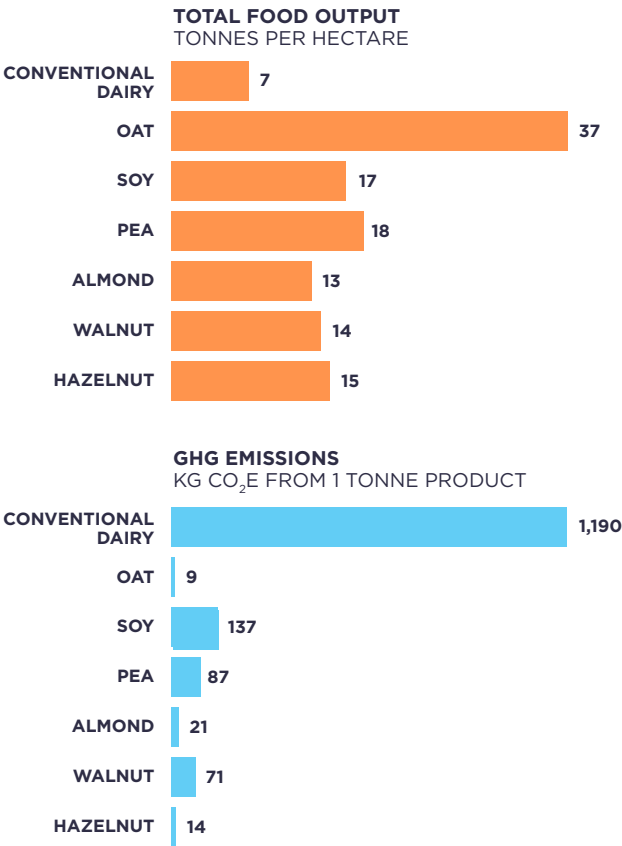
The conversation on the role of livestock continues, encompassing environmental impacts, nutritional benefits, and by-product management. While

livestock, when managed for regenerative outcomes, can play an important role in a nature-positive food system (see boxout ‘The role of livestock in a nature-positive food system’ on page 43), plant-based ingredients can provide lower environmental impacts than conventionally produced animal products.

Today, businesses are exploring opportunities to shift from conventionally produced animal products to lower impact alternatives. Over a hundred businesses are producing milk alternatives from more than 30 different plant-based ingredients, including diverse grains, pulses, and nuts.⁶⁴ As shown in Figure 5, many of these milk alternatives have lower GHG emissions, land footprints, and biodiversity impacts than conventionally produced dairy milk alternatives.⁶⁵

However, this is not to say that all animal milk should be replaced by plant-based alternatives. Plant-based milk alternatives have a range of nutritional profiles, and can be appropriate substitutes for animal products, particularly for adults in developed countries who eat a diverse and healthy diet. However, plant-based milk alternatives may not always be as nutritionally dense as animal milk, especially without fortification, and animal milk may be more appropriate for young children and the elderly.⁶⁶

Figure 5
TOTAL FOOD OUTPUT AND GHG EMISSIONS OF CONVENTIONALLY PRODUCED COW’S MILK AND DIFFERENT PLANT-BASED MILK ALTERNATIVES*⁶⁷



* Impacts are on average, for the EU and UK.

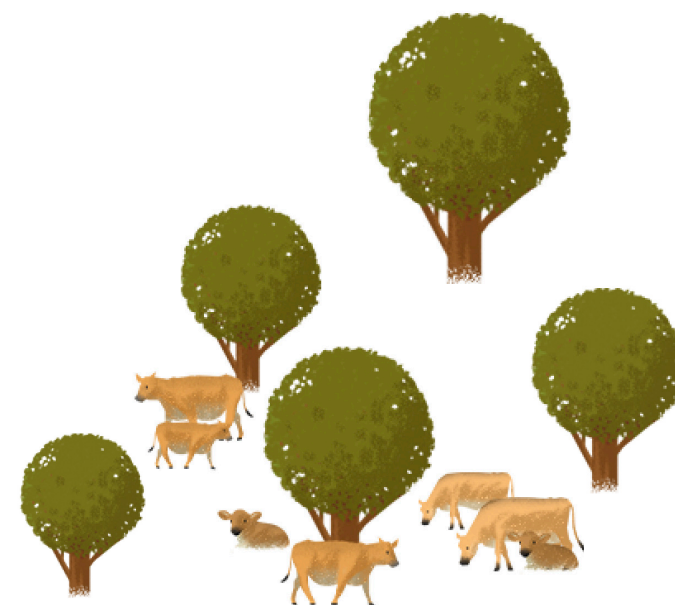
THE ROLE OF LIVESTOCK IN A NATURE-POSITIVE FOOD SYSTEM

Historically, animals have played a key role as nutrient cyclers within healthy agroecosystems. By integrating animals into regenerative mixed farming systems, their manure – along with soil amendments made from other organic by-products – can be directly applied to enrich soils for crop production and reduce the need for synthetic fertilisers (see the ‘Regeneratively produced ingredients’ section on page 48).

Around 60% of grassland used for agriculture is marginal land unsuitable for growing crops due to topographic, soil, and climatic conditions.⁶⁸ Therefore, the only way to produce food for people from this land may be through grazing livestock, which also provides valuable ecosystem services such as carbon sequestration within soils and habitat provision for biodiversity. This should be balanced with restoration of ecosystems such as forests to maximise benefits to biodiversity.

In contexts where animals cannot be kept on pasture year-round and/or require supplementary feed, agricultural and food by-products offer a viable alternative to conventional feeds, which represent a significant share of the land use and corresponding biodiversity impacts related to livestock production.⁶⁹

Integrating livestock into regenerative mixed farming systems is a way to produce a range of food products with diverse nutritional profiles to satisfy different dietary requirements, as well as non-food products. Using animal products from livestock raised in regenerative systems is a complementary strategy that can be applied in parallel to using plant-based ingredients.



From higher impact crops to lower impact crops

The lower-impact ingredient opportunity extends well beyond diversifying protein sources. Shifting from a higher impact crop to a lower impact crop offers significant opportunities. For example, designing a wheat-based product such as pasta to use peas instead of wheat could reduce GHG emissions by 40% and biodiversity impacts by 5%, while increasing yields by 5% in the modelled geographies.⁷⁰ Leguminous crops, such as beans and peas, can reduce the need for synthetic inputs by fixing nitrogen into the soil at much higher rates than many other cereal crops, at the same time as building soil health.

There are also opportunities to make changes within a single crop species by designing with a lower impact variety. For crops such as potatoes that are particularly vulnerable to pests and diseases, shifting to more resilient varieties can provide significant benefits. For example, by replacing the common Maris Piper variety of potato with higher yielding potato varieties that are resistant to pests and diseases, such as potato cyst nematodes, synthetic fertiliser use could be reduced and land-use efficiency improved, leading to a 20% reduction in GHG emissions and 35% reduction in biodiversity loss, while increasing total food output by 60% in the modelled geographies.⁷¹

Within grains, perennial varieties offer benefits. For example, perennial wheat (also known as Kernza or intermediate wheatgrass) is a variety, developed by The Land Institute in the US, that builds soil health as it doesn't need to be tilled and re-sown after each harvest, unlike conventional annual wheat. Perennial wheat mimics native prairie grasses, with deep roots that absorb more nutrients and water from soils. It can sequester around 1 tonne of CO₂e per hectare per year,⁷² which is about 10 times more than conventional wheat varieties.⁷³ As yields improve over time, Kernza and other perennial grains and legumes could become viable substitutes for cereals in food products, with positive impacts on agroecosystem health and resilience.

Figure 6
INCREASES IN BENEFITS OF USING PEAS RATHER THAN WHEAT IN A PRODUCT*

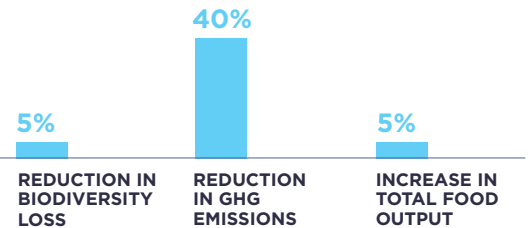
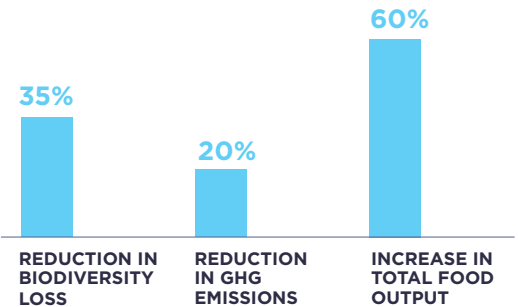


Figure 7
INCREASES IN BENEFITS OF USING DISEASE-RESILIENT POTATO VARIETIES IN A PRODUCT RATHER THAN CONVENTIONAL VARIETIES*



* Impacts are on average, per harvest, for the EU and UK

ASSESSING LOWER IMPACT INGREDIENTS OVER TIME

While some ingredients inherently bring environmental benefits regardless of production methods, their benefits can be further enhanced when they are regeneratively produced. When it comes to transitioning to a nature-positive system, one business' journey might look quite different to another's due to its current ingredient mix. For example, a business could begin right away by swapping high-impact ingredients for lower impact ones – that are currently available at sufficient volumes, and then work with suppliers to shift to regenerative production.

There are some ingredients that are inherently lower impact because they might be less water intensive or they fix nitrogen in the soil, for example, but choosing the 'best' lower impact ingredient may depend on the local context. Plant-based milk alternatives, for example, do not guarantee lower impacts than dairy milk, particularly when comparing a conventionally produced plant-based milk, which may degrade the local ecosystem, with a regeneratively produced dairy milk, which may support regenerative outcomes.

The use of lower impact ingredients (which might initially be conventionally produced) can be an integral intermediary step on a business' journey to continuously improve its product portfolio in regard to nature-positive outcomes, with the aim being that these ingredients will be regeneratively produced in the future.

HIGH-POTENTIAL INGREDIENTS TO EXPLORE

There are a number of promising emerging ingredients which, although not widely used today, hold great potential to be an integral part of designing food products for nature-positive outcomes in the future.

Algae

Algae can be divided into microalgae and seaweed. Both of them are a promising protein source. According to a report from the European Commission, algae could account for 18% of protein sources by 2054.⁷⁴

[SuSeWi](#)⁷⁵ has developed technology to grow marine microalgae and transform it into ingredients that provide a natural, abundant, and regenerative source of protein, Omega 3, and many other ingredients.

Spirulina is an algae and one of the richest protein sources available. Protein-rich food sources such as spirulina play an important role in providing alternatives to animal proteins.

[Spireaux](#)⁷⁶ has developed a compact bioreactor with which fresh spirulina can be grown much more efficiently and sustainably.

Insects

Even though they are a common ingredient in traditional cooking in many parts of the world, insects have yet to become mainstream in Western food cultures, largely due to negative perceptions.⁷⁷ Insects are a highly nutritious and healthy food source with high fat, protein, vitamin, fibre, and mineral content.⁷⁸ They provide significant environmental benefits compared to other animal sources of protein. Insects are reported to emit fewer greenhouse gases and less ammonia than cattle or pigs, and they require significantly less land and water than cattle rearing.

In May 2021 for the first time, the [European Commission](#)⁷⁹ approved an insect as 'novel food' in the EU: the dried yellow mealworms, of the *Tenebrio molitor* species. It can be used as a whole dried insect in the form of snacks or as a food ingredient, in a number of food products.

[Ÿnsect](#)⁸⁰ transforms insects into premium, high-value ingredients. They raised USD 224 million in 2020 to build out the world's largest insect farm.

Through their Protifarm branch, they have created [AdalbaPro](#),⁸¹ the world's first food ingredient line made from insects with products such as concentrates and powders.



Upcycled ingredients

What are upcycled ingredients?

Upcycled ingredients are ingredients made from food by-products *“that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment.”*⁸²

Upcycling is enabled by innovations in processing technology and supply chain management that transform what was once considered ‘waste’ into nutritious ingredients to make new food products with.

Upcycled ingredients can be used as substitutes for conventional food crops. Figure 8 illustrates options for replacing conventional sugar or sweeteners with ingredients made from upcycled by-products that fulfil the same property of sweetness.

Why shift to upcycled ingredients?

Currently, 28% of agricultural land is used to produce food that is never eaten, including huge volumes of inedible by-products.⁸³ At the farm level alone 1.2 billion tonnes of food is wasted each year, with a value of USD 370 billion.⁸⁴ Upcycling (in addition to preventing food waste and loss) is a way to get the most value from the land, water, and agricultural inputs and effort that went into growing the food in the first place, and ensures that nutrients are kept in use at their highest value.

Upcycled ingredients could help to meet the global population’s growing nutritional needs without increasing pressure to convert ecosystems to agricultural land, which is one of the primary drivers of biodiversity loss. For example, in addition to producing oat milk, by upcycling the solid by-product of oat milk production into flour (e.g. as demonstrated by Renewal Mill⁸⁵), and by upcycling post-harvest agricultural residues from growing oats into sweeteners (e.g. as Comet Bio⁸⁶ does), more food for people could be produced from this same area of cropland. These by-products are typically used as animal feed or bedding, or agricultural inputs, but could be kept at their highest value to produce food for human consumption (see box out ‘Upcycling opportunities in local contexts’).

Many upcycled ingredients have a lower environmental impact than the conventionally produced ingredient they substitute. For example, EverGrain makes flour from Brewers Spent Grain, resulting in a 60% reduction in GHG emissions compared with conventional flour.⁸⁷

Upcycling can also generate economic opportunities for farmers and food businesses alike. Selling on-farm by-products can help diversify income for farmers. Coffee and cacao farmers could increase their annual income by 20%⁸⁸ and 30%,⁸⁹ respectively, by selling the whole fruit, which can be upcycled into sweeteners and other products, rather than just selling the coffee or cacao beans (good examples of this in practice are Coffee Cherry Company and Koa).

Additionally, upcycling can allow new revenue streams, jobs, and innovator ecosystems to emerge, as demonstrated by the more than 150 members of the Upcycled Food Association.⁹⁰ Through upcycling innovations, food businesses can tap into the growing global upcycled food market, valued at USD 46.5 billion in 2019.⁹¹

UPCYCLING OPPORTUNITIES IN LOCAL CONTEXTS

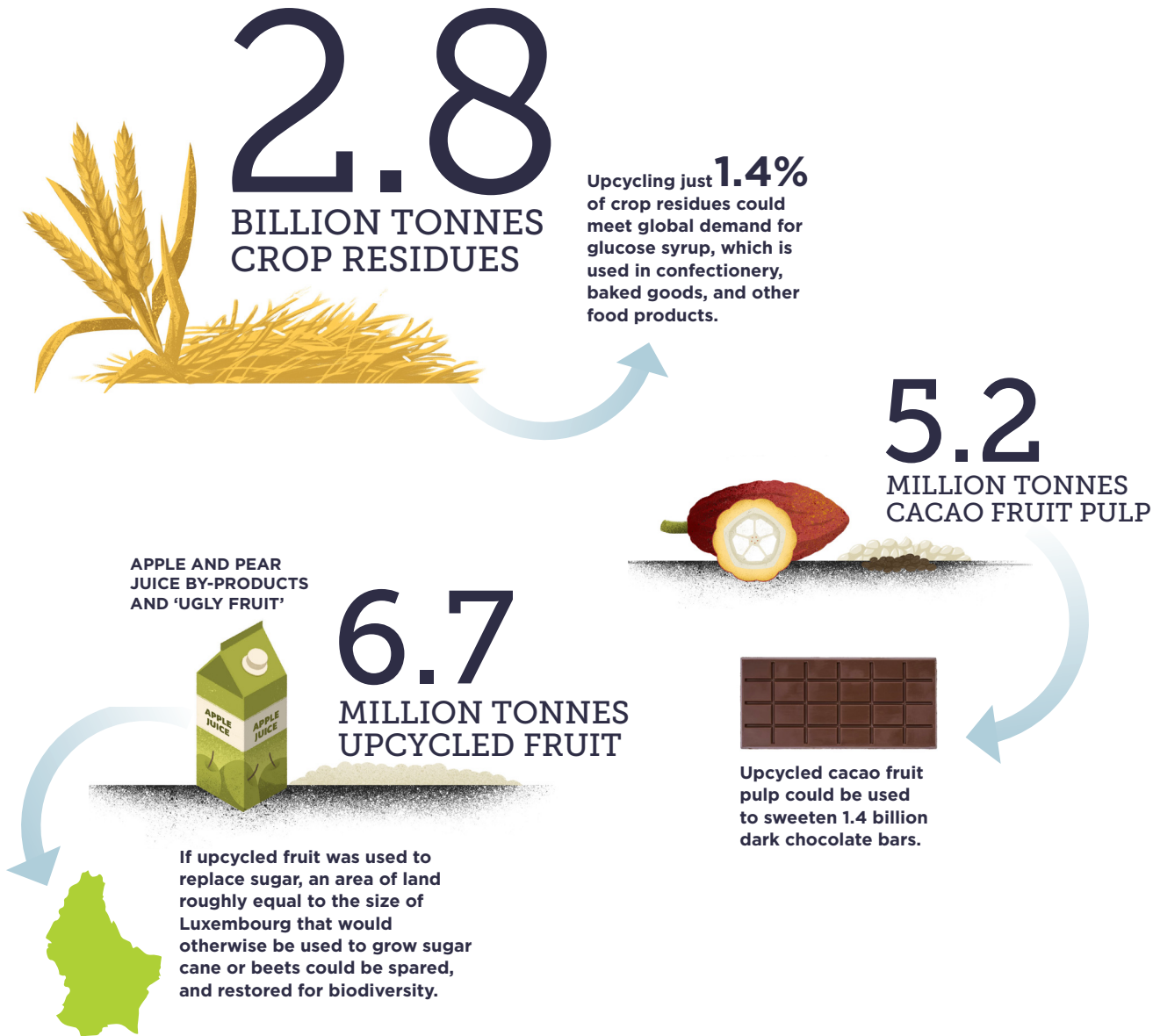
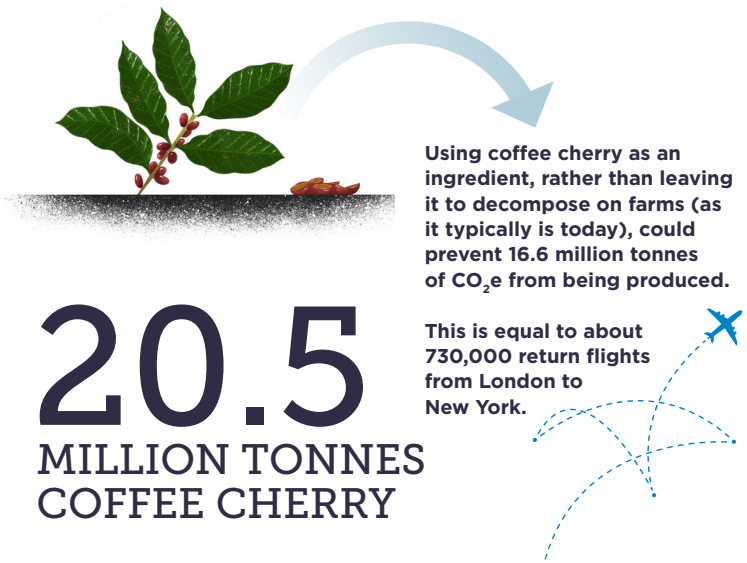
Upcycling offers a great solution for turning what otherwise would have been perceived as waste into something valuable. Where appropriate, by-products can be used as ingredients. However, in other contexts, by-products can also be transformed into high-value non-food products such as biomaterials and agricultural inputs like fertilisers, as well as animal feed. Factors such as available infrastructure, consumer preferences, and local demand determine which is the best option.

To explore this further, see Ellen MacArthur Foundation, [High value products from organic waste](#).

Figure 8

What if by-products were upcycled as sweeteners?

Four high-volume food by-products – fruit juice by-products, crop residues, cacao fruit pulp, and coffee cherries – present significant opportunities for transformation into upcycled sweeteners. These examples show the scale of the opportunity by volume per by-product





Regeneratively produced ingredients

What are regeneratively produced ingredients?

Regeneratively produced ingredients are those produced in ways that have positive outcomes for nature. These outcomes include, but are not limited to, healthy and stable soils, improved local biodiversity, and improved air and water quality. These outcomes can be realised by adopting a variety of context-dependent practices. There are several different schools of thought farmers may draw from to apply the best set of practices to drive regenerative outcomes on their land, including: regenerative agriculture, agroecology, organic, permaculture, agroforestry, and conservation agriculture.

Why shift to regeneratively produced ingredients?

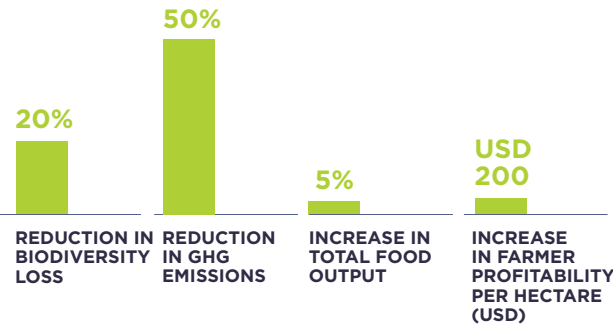
Shifting to practices that work in greater harmony with nature offers the potential to significantly contribute to both tackling climate change and building biodiversity. By ensuring the health of natural ecosystems, in addition to human health and economic benefits, the risks and costs associated with climate and environmental changes can be mitigated, more resilient supply networks can be created, and sustained supply of ingredients can be secured for the long-term. Contrary to common perception, the findings of this study indicate that following a transition period, regenerative production can also lead to higher total food output and increased farmer profitability.

For example, modelling conducted for this study on better sourcing of current ingredients – wheat, dairy, and potatoes – shows that shifting from conventionally produced ingredients to those produced with a bundle of practices supporting regenerative outcomes can reduce GHG emissions by 50% and biodiversity loss by 20%, while increasing total food output by 5% and providing farmers with an additional USD 200 per hectare per year in the modelled geographies.⁹²

Note: one possible set of practices for producing ingredients regeneratively (better sourcing) was modelled for each ingredient. The results presented here should not be considered as reflective of all possible outcomes for the modelled ingredients, which could differ depending on a number of factors, including: the specific practices implemented, the context or, for example, the density of cattle and trees in a silvopasture system.

Figure 9

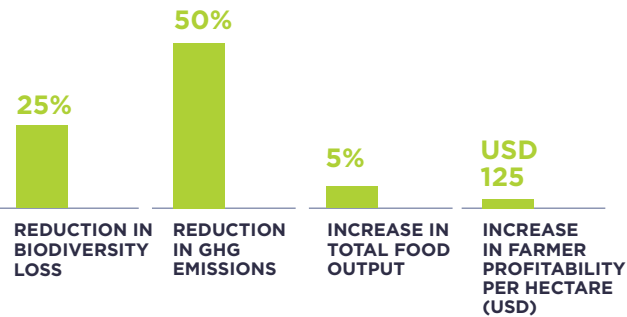
INCREASE IN THE BENEFITS OF USING REGENERATIVELY PRODUCED INGREDIENTS IN A PRODUCT RATHER THAN CONVENTIONALLY PRODUCED INGREDIENTS*



* Better sourcing of current ingredients can lead to reductions in both GHG emissions and biodiversity loss, and increased yields and profitability for farmers in the modelled geographies, compared with business-as-usual. Based on average data for the three modelled ingredients (per harvest for wheat and potatoes, and per year for dairy) in the UK and EU.



Figure 10
**INCREASE IN THE BENEFITS OF USING
REGENERATIVELY PRODUCED WHEAT
RATHER THAN CONVENTIONALLY
PRODUCED WHEAT IN A PRODUCT***



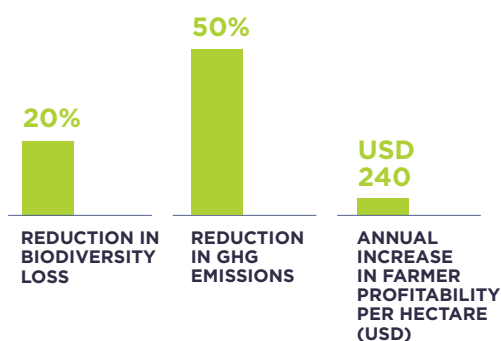
* Applying wheat production practices to support regenerative outcomes can lead to reductions in GHG emissions and biodiversity loss, and to increased yields and profitability for farmers in the modelled geographies. On average, per harvest, in the EU and UK.

Sourcing wheat produced with a bundle of practices (minimum-tillage, intercropping, and cover cropping) can lead to a 50% reduction in GHG emissions and a 25% reduction in biodiversity loss in the modelled geographies. The farm may see a reduction in yield and cash flow in the first year, but can break even in one to two years and achieve payback in year four. These timescales could be shortened further if opportunities such as equipment sharing, pooling seeding purchases, environmental subsidies, and a changing buyer-farmer dynamic can be leveraged. After a ramp-up time of approximately 10 years, the farmer may be able to make an additional USD 125 per harvest per hectare per hectare, and as a result of improved soil health and effective application of new practices, the farm may see a 5% increase in yields.⁹³



Figure 11

**INCREASE IN THE BENEFITS OF USING
REGENERATIVELY PRODUCED DAIRY
RATHER THAN CONVENTIONALLY
PRODUCED DAIRY IN A PRODUCT***



* Applying MIG and low-density silvopasture in the production of dairy can lead to reductions in both GHG emissions and biodiversity loss, on average, in the EU and UK.

Sourcing dairy produced regeneratively with managed intensive grazing (MIG) in a low-density walnut silvopasture system can reduce GHG emissions by 50% and biodiversity loss by 20% in the modelled geographies, with unchanged dairy yields (although research also indicates that grazing a greater diversity of plant species can increase milk production).⁹⁴ This system supports long-term farmer livelihoods with additional earnings of USD 240 per hectare per year.⁹⁵ In MIG systems, well-managed livestock play a key role in nutrient cycling and building healthy soils capable of sequestering increased CO₂ levels (see boxout 'The role of livestock in a nature-positive food system' on page 43). Diverse grasses and crops can be planted on pasture to optimise forage, and, mimicking migratory herds, livestock are grouped on areas of the pasture where they benefit from a diverse diet, trample-in plant matter and nutrients from their dung and urine, and are moved on frequently, enabling the pasture to regenerate.⁹⁶

While transition timescales are long, through enablers – such as transition finance mechanisms, supportive policy and carbon payment schemes, and strategic relationships with businesses – livelihoods for dairy farmers today can be supported and secured for generations to come.

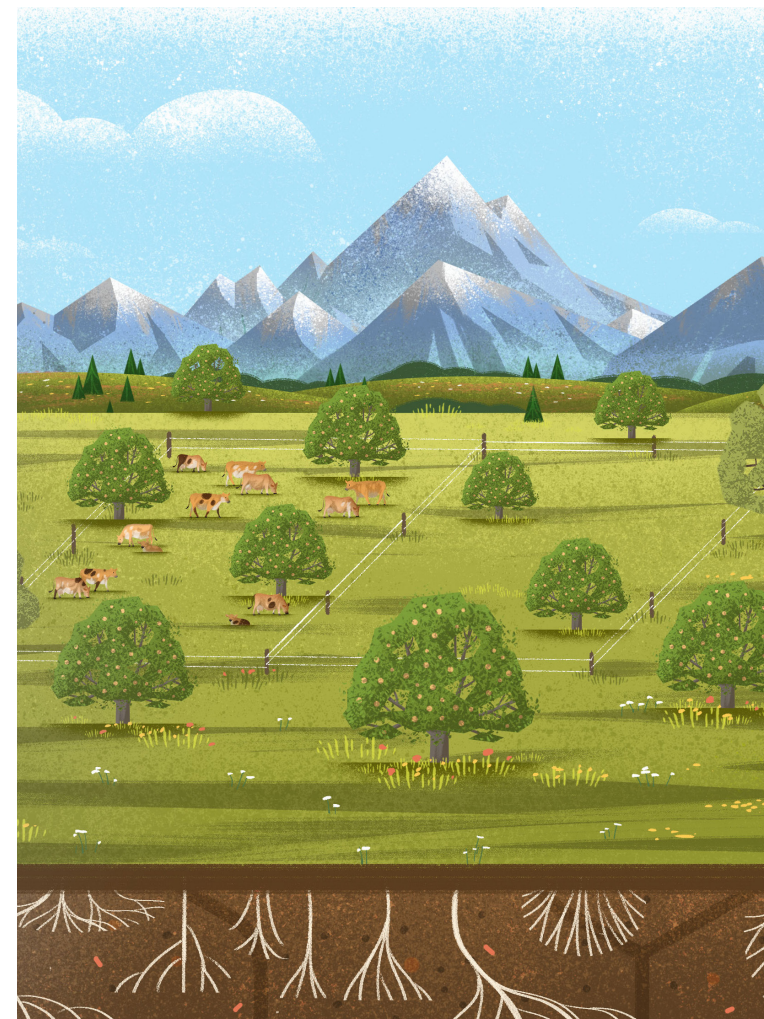
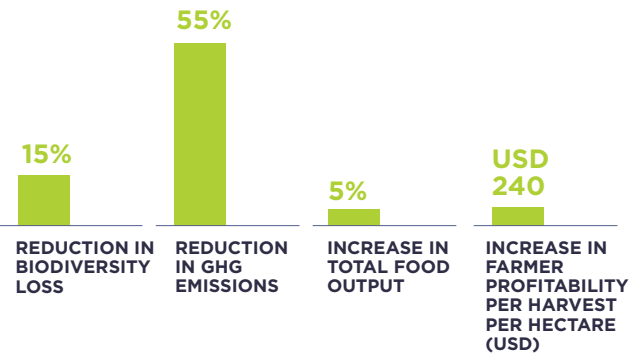


Figure 12
**INCREASE IN THE BENEFITS OF USING
REGENERATIVELY PRODUCED POTATOES
RATHER THAN CONVENTIONALLY
PRODUCED POTATOES IN A PRODUCT***



* Applying regenerative production to potatoes can lead to reductions in both GHG emissions and biodiversity loss, and improved profitability and yields for farmers, on average per potato harvest, in the EU and UK.

Sourcing regeneratively produced potatoes from a six-year rotation – which uses a combination of reduced tillage, a mustard rotation (as a green manure), leguminous cover crops, and animal manure (as an organic amendment) – can achieve a 55% reduction in GHG emissions and a 15% reduction in biodiversity loss in the geographies modelled.⁹⁷ Such an approach can cut farm costs by reducing the need for fertiliser and pesticides, as well as for machinery and fuel due to a shift to minimum-tillage. As soil health improves and pests are reduced by using mustard in the crop rotation, total food output on the farm can increase by 5%

or more. Through this combination of savings and increased yields, the economic outlook is promising: a potato farmer may make an additional USD 240 per hectare on average, per potato harvest.⁹⁸

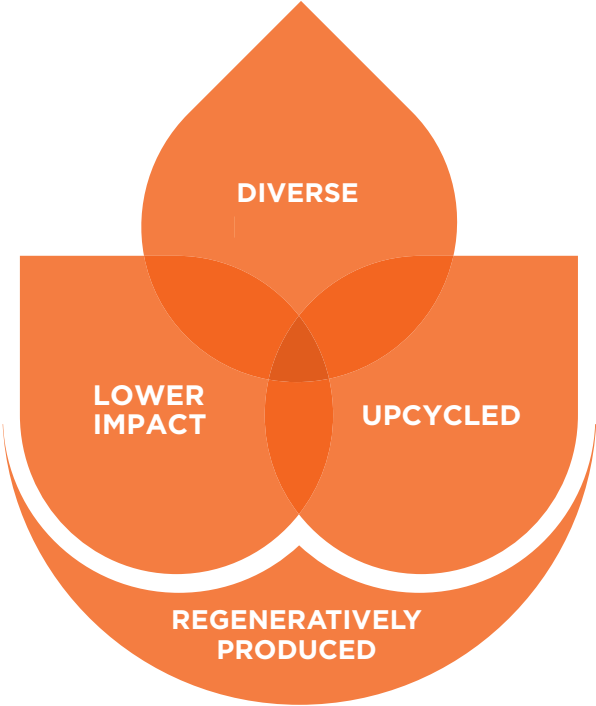
The above are examples of applying regenerative production to existing ingredients, but these principles can also be applied across diverse, lower impact, and upcycled ingredients – increasing the benefits to nature.

REGENERATIVE PRODUCTION AND NUTRIENT DENSITY OF FOOD

Efforts are underway to understand the connection between the way food is produced and its nutrient density. An emerging body of evidence suggests that regeneratively produced food has greater nutrient density, which is linked to improved soil health and greater diversity of soil microorganisms.^{99,100} Increasing accessibility to nutrient-dense food has been shown to have positive health outcomes for people.^{101,102} FMCGs and retailers may offer consumers these benefits by designing food products that use regeneratively produced ingredients. Mass spectrometry and other technologies may provide a cost-effective way to measure the nutrient density of individual food items and thereby provide greater transparency to consumers.^{103,104}



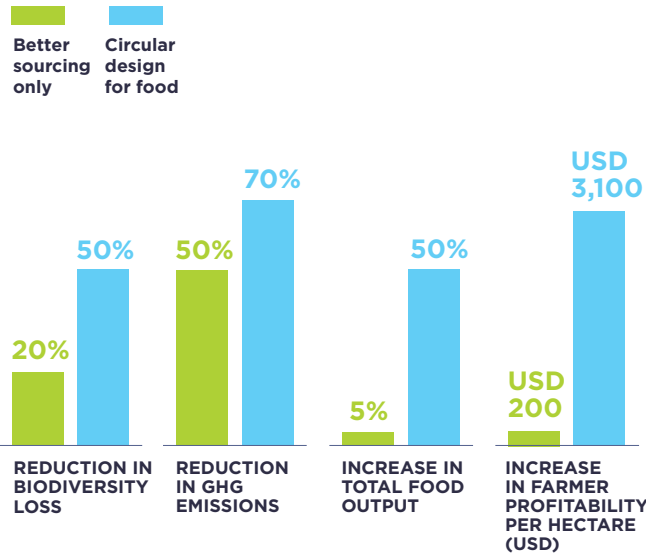
The full potential of the four design opportunities is realised when they are combined



Benefits can be further amplified by keeping the wider ecosystem in mind when sourcing and selecting ingredients. Aggregated results across three example ingredients – wheat, dairy, and potatoes – in the modelled geographies show that when the four design opportunities are appropriately combined, GHG emissions can be reduced by 70% and biodiversity loss can be reduced by 50%, compared with conventional production.¹⁰⁵ Total food output of the same land area could increase by 50%, while cash flow could increase by USD 3,100 per hectare on average, following a transition period.¹⁰⁶ These combined outcomes are significantly greater than simply better sourcing of current ingredients (where a set of practices supporting regenerative outcomes is applied), as illustrated in figure 13.

The opportunities can be combined both within a single product and across entire product portfolios. Exactly how they are combined is determined by the needs of the ecosystems from which ingredients are sourced. Analysis shows significantly better economic and environmental outcomes when applying circular design for food for all modelled ingredients compared with better sourcing of current ingredients alone.

Figure 13
CIRCULAR DESIGN FOR FOOD OFFERS SIGNIFICANT BENEFITS VERSUS BETTER SOURCING OF CURRENT INGREDIENTS ALONE*



* On average for three modelled ingredients (per harvest for wheat and potatoes, and per year for dairy) in the UK and EU.

Businesses can use circular design for food to accelerate the transition to a nature-positive food system

Transitioning to a nature-positive food system means the crops, livestock, and practices that are most suitable to improve agroecosystem health and resilience might not be the same ones that are produced or used in each farm location today. Today's crops, livestock, and practices are often legacies of an industrial farming system, focused on monocultures and commodity crops, that is detached from nature. Even with the best intentions

to produce food in ways that have regenerative outcomes, farmers currently face a system in which the economics work against them.

A nature-positive food system requires diverse species, varieties, and breeds. Shifting to regenerative farms that integrate more diverse crops and livestock in a given farm area means the volumes of a single ingredient will likely be lower than producing them in conventional monocultures on the same area of land. Farmers will likely have equal or higher total food outputs, but these will be spread across more ingredient types. Food products and ingredient sourcing models will therefore need to be designed around this evolving range of farm outputs, and FMCGs and retailers will benefit from

thinking at a landscape level rather than focusing on optimising a single ingredient or plot.

To create a nature-positive food system, close collaboration with farmers is vital to understand what specific landscapes need to thrive and therefore the types of ingredients that should be produced and the production practices that are most appropriate to apply. Once this is understood, it will be crucial to establish support mechanisms that enable the transition to more diverse landscapes, build ecosystem health, and assess the time horizons involved. After this, food products and portfolios can be redesigned to use the diverse range of ingredients that are or will be available.

CONVENTIONAL FOOD SYSTEM TRANSITIONING TO A NATURE-POSITIVE FOOD SYSTEM

Businesses can use circular design for food to create products with the landscape in mind. Pages 55-57 describe three illustrative examples of future food products designed for nature, and detail the estimated environmental, economic, and food output benefits.



Applying circular design for food can increase farmers' profitability

By using product design to realise the potential of cover-, inter-, and rotational-crops as ingredients, these integral components of regenerative farming systems become revenue streams for farmers. Through circular design for food, businesses can create a market for all outputs of the farm system. For example, intercropping wheat with other crops is a practice that can be used to build soil health and achieve other regenerative outcomes. However, many of these intercrops are commonly inedible. By diversifying ingredients in products, FMCGs and retailers can offer the economic incentive farmers need to intercrop with edible crops. For example, intercropping wheat with peas builds soil health because peas fix nitrogen in the soil, and the peas can also be sold as ingredients. Growing wheat and peas together using a set of practices that support regenerative outcomes can be profitable after just one year without any subsidies, whereas intercropping wheat with beneficial but inedible crops might take four years to reach profitability (See Figure 14).

In other cases, however, additional support mechanisms can accelerate the otherwise long period to profitability. For example, producing dairy milk with MIG and low-density silvopasture is profitable after a transition period of eight years, while the full investment is paid off after 16–20 years. Producing both dairy milk and plant-based alternative milks from the same farm in a densely planted

regenerative silvopasture system, as modelled for this study, takes longer to become profitable (10–15 years) and 61–68 years to completely pay off the higher initial investment. To shorten the payback period, farmers would benefit from financial support mechanisms to help them establish walnut trees and minimise costs until the trees reach maturity and begin producing nuts. While the investment costs are higher, designing milk and alternative products to use ingredients from integrated silvopasture systems can create significantly more positive environmental outcomes – potentially achieving net-zero emissions – than better sourcing of dairy alone (see Figure 15), in addition to supporting the livelihoods of future generations of farmers.*

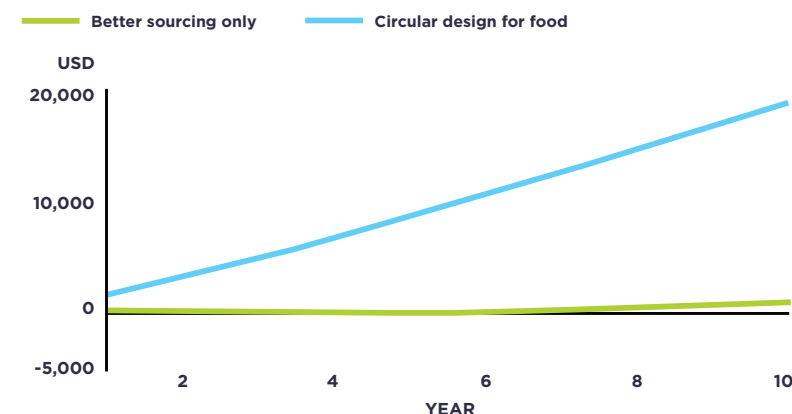
To mitigate financial risks for farmers facing longer payback periods when transitioning to regenerative production, FMCGs and retailers can implement support mechanisms to help ensure their income security. Ways in which FMCGs and retailers could work with farmers to accelerate this transition are described in more detail in Part 5.

The following pages 55–57 describe three illustrative examples of future food products designed for nature, and detail the estimated environmental, economic, and food output benefits.

*Note: one possible set of practices for producing the same ingredient to support regenerative outcomes (better sourcing) and one 'circular design for food' scenario was modelled for each ingredient. The results presented here should not be considered as reflective of all possible outcomes for the modelled ingredients, which could differ depending on a number of factors, including: the specific practices implemented; the context or, for example, the density of cattle and trees in a silvopasture system.

Figure 14

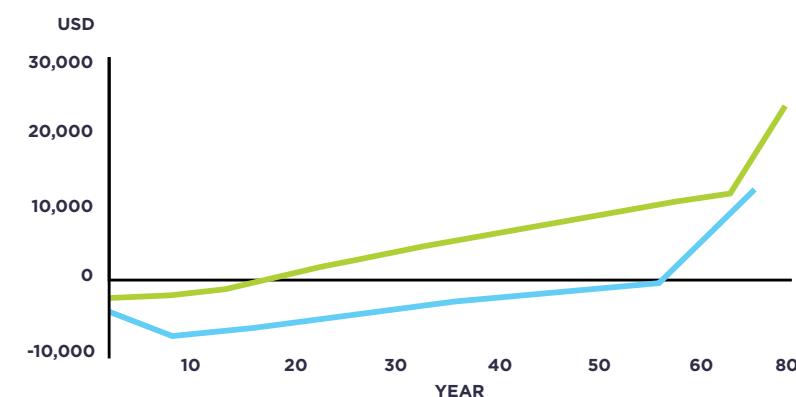
WHEAT – AVERAGE INCREASE IN FARMER PROFITABILITY PER HECTARE, CUMULATIVE (USD)



Circular design for food results in a greater increase in farmer profitability than better sourcing for wheat alone, on average, in the EU and UK.¹⁰⁷

Figure 15

DAIRY – AVERAGE INCREASE IN FARMER PROFITABILITY PER HECTARE, CUMULATIVE (USD)

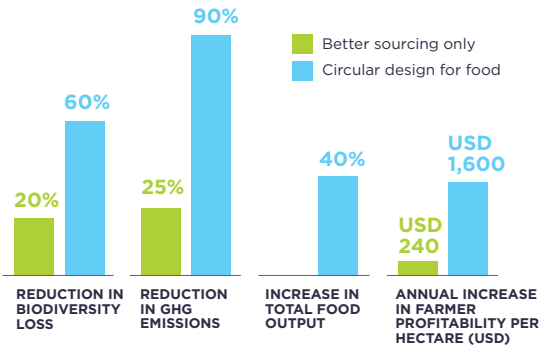


Despite providing better environmental benefits, circular design for food applied to dairy has a much longer payback period than better sourcing only, on average, in the EU and UK.¹⁰⁸

Circular design for food applied to a line of cheese products



The walnuts and cow's milk grown together symbiotically on silvopasture farms are fermented to result in a range of cheeses: roquefort made from walnuts, comté made from dairy milk, and a 'caseum' made from a blend of dairy milk and walnuts.



Circular design for food offers significantly greater benefits than better sourcing of current ingredients alone

CIRCULAR DESIGN FOR FOOD ACCELERATES NATURE-POSITIVE LANDSCAPE TRANSFORMATION



CONVENTIONAL PASTURE SYSTEM

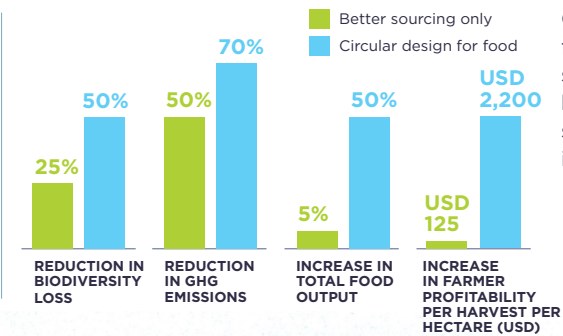
BETTER SOURCING OF CURRENT INGREDIENT REGENERATIVE MANAGED INTENSIVE GRAZING

REGENERATIVE SILVOPASTURE PRODUCING DAIRY AND WALNUTS

Circular design for food applied to a line of cereal products



Intercropped wheat and peas, grown with minimum-tillage and cover crops, are blended to make three cereal products: a classic cold cereal, hot cereal, and on-the-go bar. By using both wheat and peas in relative proportion to their output volume, farmers have a market for both crops produced per harvest per hectare.



Circular design for food offers significantly greater benefits than better sourcing of current ingredients alone

CIRCULAR DESIGN FOR FOOD ACCELERATES NATURE-POSITIVE LANDSCAPE TRANSFORMATION



CONVENTIONAL
WHEAT PRODUCTION

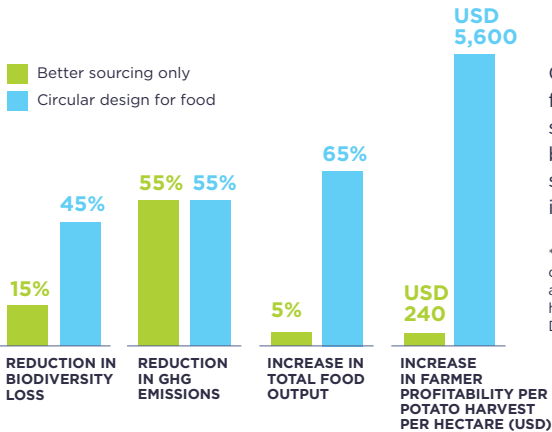
BETTER SOURCING OF CURRENT INGREDIENT
REGENERATIVELY PRODUCED WHEAT,
INTERCROPPED WITH CLOVER

REGENERATIVELY PRODUCED
WHEAT AND EDIBLE PEAS

Circular design for food applied to potatoes



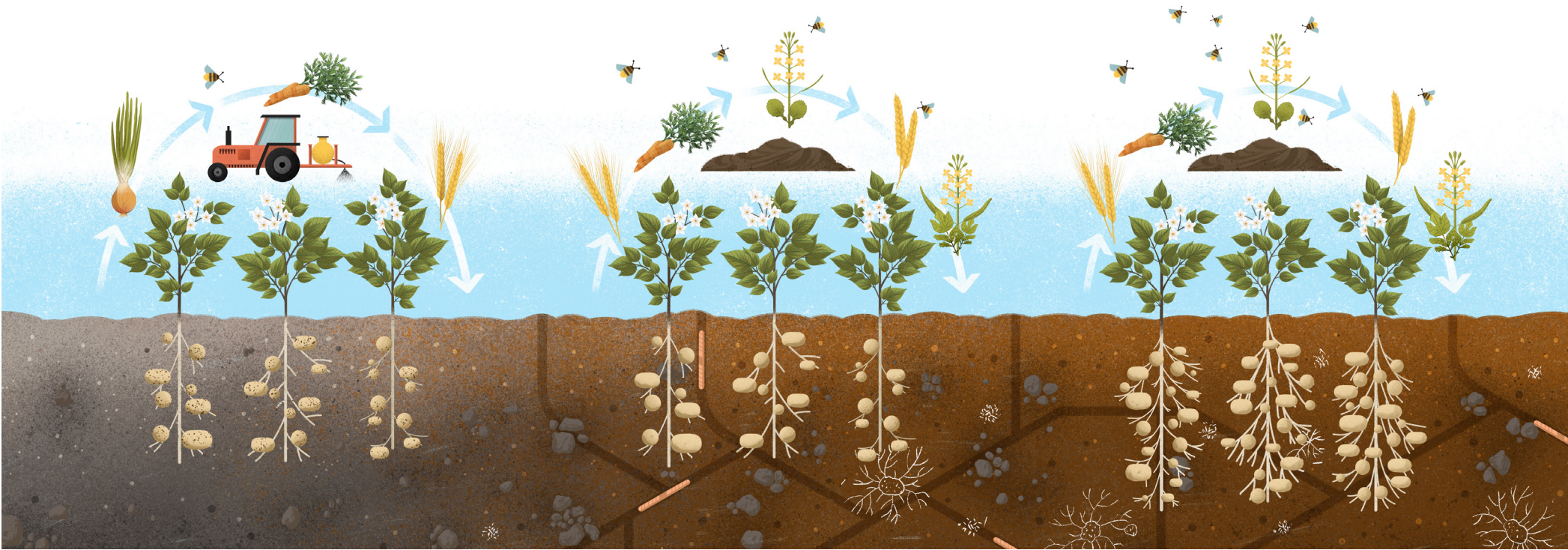
A range of diverse potatoes, including more pest-resistant varieties, grown with minimum-tillage, cover crops, and manure as organic amendment in six-year crop rotations – together with barley, carrots, rapeseed, wheat, and mustard - ensure resilient and delicious potatoes and multiple sources of revenue for farmers.



Circular design for food offers significantly greater benefits than better sourcing of current ingredients alone.

*Results are for high-yielding disease resilient variety only, and do not apply to diverse heritage varieties in the Down To Earth range.

CIRCULAR DESIGN FOR FOOD ACCELERATES NATURE-POSITIVE LANDSCAPE TRANSFORMATION



CONVENTIONAL POTATO PRODUCTION

BETTER SOURCING OF CURRENT INGREDIENT REGENERATIVELY PRODUCED CONVENTIONAL POTATO VARIETY

REGENERATIVELY PRODUCED DIVERSE POTATO VARIETIES

Public policies and funding: key enablers to bring circular design for food to scale

A conducive policy environment will be instrumental in rapidly scaling the uptake of circular design for food as well as enhancing the effectiveness of existing initiatives. For example, an increased use of upcycled ingredients can help the successful delivery of food waste reduction targets, while an increased use of low-impact and diverse ingredients, combined with regenerative production, can directly contribute to the climate resilience of the local geography.

A range of policy measures focused on different aspects of the food system can contribute to making circular design opportunities become the norm over time. For example:

Redirecting subsidies and sustainable finance incentives will help make the economics work for farmers transitioning to regenerative production

As indicated in the ingredient analysis for the EU and the UK conducted for this study, regenerative production can lead to higher yields and/or total farm outputs, environmental benefits, and improved farmer income after a transition period. A focused redirection and increase of public subsidies, with a medium- to long-term commitment, can provide the economic support farmers need to confidently embrace the

shift to regenerative production. It can, for example, shorten the time it takes a farmer to reach profitability, while providing a financial security net during the transition years.

In addition to public subsidies, policies can be devised to incentivise public and private investment in the sector by, for example, establishing sustainable finance frameworks such as the EU Taxonomy currently under development, and creating fiscal incentives for businesses choosing to review and improve their portfolio and sourcing practices.¹⁰⁹

Long-term commitment to public subsidies and public and private investments will be particularly important for food design decisions that can lead to the most ambitious environmental benefits, but are less profitable for farmers in the short-term. A case in point is the modelled example of silvopasture dairy systems, which could deliver net-zero emissions, but in the absence of public or private financial support would face a transition period of nearly 60 years before reaching profitability.

This redirection in subsidies and investments could be inspired by experiences from other sectors, such as renewable energy, where public subsidies played a pivotal role in supporting early movers when the sector was still not profitable until the market became more established.¹¹⁰

While current subsidies are still geared towards supporting conventional food production, opportunities to kick-start a shift towards regenerative

food production are presenting themselves. The new Common Agricultural Policy (CAP) and the development of the post-Brexit set-up in the UK are examples of how such opportunities may arise. Indeed, in the EU and UK, around EUR 65 billion is devoted to direct payments to farmers annually.¹¹¹ Currently, these payments are largely determined by the size of land holdings, while those set aside to reward climate and environmental action (30% of direct payments) have been considered ineffective both in scope and impact.^{112,113,114}

In the UK, the different nation states are now establishing their specific post-CAP set-ups. England, for example, has planned a complete phase-out of direct subsidies and has started to roll out the Environmental Land Management schemes (ELMs). These ELMs represent a new system which, by 2028, aims to see farms providing environmental and climate benefits, while sustaining profitability without public support.¹¹⁵ Farmers have been involved in the development of the new schemes through test and trial activities on an initial pool of eight standards, which can be applied at varying levels of ambition.¹¹⁶

In the EU, Member States are developing Strategic National Plans outlining priorities and instruments for the implementation of the CAP for the period 2023–27. As part of the new ‘green architecture’, in addition to rural development programmes, Member States will be able to allocate 25% of the direct income support to the implementation of eco-schemes, with direct payments rewarding farmers for environment and climate change actions that go beyond compliance

with the CAP's minimum standards.¹¹⁷ However, the eco-schemes remain voluntary for farmers to join and are subject to a two-year trial. If unused, part of the funds will be open for reallocation to other parts of CAP implementation, which do not necessarily contribute to environmental and climate goals.

An ambitious application of these schemes in the EU and the UK between 2023 and 2027 will therefore be key to kick-starting a significant transition. These schemes could meaningfully influence subsidy provision approaches and help shape future policies and mechanisms, so that regenerative food production becomes the default option supported by subsidies, rather than the exception. Political will and, in the case of the EU, Member States' adherence to the principles of the Green Deal, will be critical in harnessing the full potential of these policy measures and developing them further.

In the long-term, for subsidies and financial incentives to support regenerative outcomes, a shift from practice-based assessments to outcome-based approaches will be required. Establishing monitoring mechanisms with harmonised metrics recognised by public authorities, farmers, and businesses alike will enable impacts to be measured while enhancing knowledge of production practices that lead to regenerative outcomes in a specific context.

By emphasising outcomes, a shift to regenerative food production also holds the potential to enhance the impact of well-developed farming methods with established standards, such as certified organic

agriculture, that currently tend to emphasise inputs and production techniques.

Farmers are central actors in the transition. Technical assistance and training will be essential to engage and incentivise farmers to switch to, or enhance their use of, context-appropriate practices for regenerative outcomes

Measures that can support farmers and incentivise them to adopt regenerative practices include providing expertise through access to free farmer advisory services and agronomists, facilitating peer-to-peer exchange and knowledge-sharing opportunities, harnessing the potential of new digital tools, and promoting knowledge exchange with researchers. For example, the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) has promoted farmer-led interactive innovation projects since 2012, with a number of peer-to-peer exchanges and the development of a one-stop-shop website for agricultural innovation where users share information, tips, and research findings.¹¹⁸ By helping farmers to play an active and leading role in innovation, the EIP-AGRI mechanism is expected to be further strengthened as part of the Farm to Fork Strategy implementation.¹¹⁹

The regenerative transition also has the potential to generate new employment opportunities in rural areas across the globe.^{120,121} This is particularly relevant for regions such as the EU and UK, where the number of farms and people involved in agriculture is declining and the share of young farmers is low, with

the average farmer aged 51 and 59, respectively.^{122,123} Rural development policies aimed at strengthening the provision of services and opportunities in rural areas can play an important role in incentivising young farmers to start a new business, or take on and transform the family farm. Meanwhile, for older generations, greater access to services and infrastructure can lead to better quality of life and enhanced economic opportunities.

Research and innovation (R&I) policies will be important to increase knowledge and uptake of circular design for food across industry and in policymaking

R&I policies and funding can target all aspects of circular design for food, from ingredient innovation to farm-level regenerative production, and from testing solutions and increasing knowledge to uncovering new market opportunities for businesses. Programmes that link food design research with business opportunities supporting promising start-ups in the upcycling space, or initiatives that fund farm research and pilots can bring innovative ideas to life and accelerate the adoption of circular design for food.^{124,125}

Aligning R&I policies and funding with broader policy objectives and/or a 'mission-led' strategy, alongside creating the enabling environment for businesses, can ensure that R&I policies support and are complemented by broader efforts that can include research projects, field level pilots, private-public initiatives, and relevant policy or legislative measures.^{126,127}

International engagement that matches the scale of global food value chains is needed for a nature-positive food system

Trade policies and agreements, and international cooperation funding can be significant instruments to stimulate and incentivise circular design for food, while strengthening partnerships and commitments among like-minded countries.

The EU, for example, as the largest international trader of agricultural products, intends to include a chapter on sustainable food systems in all future trade agreements and strengthen cooperation in this area with countries where they already have an agreement in place, such as Japan.^{128,129,130}

The presence of a specific chapter on sustainable food systems and the integration of circular design for food principles in other relevant sector chapters (e.g. agriculture) could strongly enhance the cross-border trade of regeneratively produced goods, supporting the development of harmonised definitions and common standards.

The potential of governments and international institutions to transform the food system and promote circular design for food through international cooperation remains largely untapped.¹³¹ Key public investors – such as the EU, the FAO, the International Fund for Agricultural Development (IFAD), and the World Food Programme (WFP) – still fund primarily conventional production approaches. However, it

is now clear that although these approaches have enabled considerable population growth by increasing productivity, they have put significant strain on nature – fuelling all five key drivers of biodiversity loss, including climate change.¹³²

A shift away from funding conventional approaches would enable better support to partner countries and, at the same time, increase internal policy coherence. For example, it could result in clearer alignment with the principles of the EU's Farm to Fork Strategy (as laid out in chapter IV on international cooperation), or with the FAO's Common Vision for Sustainable Food and Agriculture.¹³³ In practice, international cooperation funds could be allocated to a range of transition opportunities. These opportunities for partner countries could include: capacity building within agri-food authorities on regenerative production; training of extension service advisors and farmers on context-specific practices that can support regenerative outcomes; the provision of financial support to small and medium businesses producing food products with diverse or upcycled ingredients; and fostering cooperation between international research teams on circular food system change.

These example measures chime with a range of the policy measures identified in the *Universal circular economy policy goals* developed by the Ellen MacArthur Foundation.¹³⁴ They serve to highlight the importance of aligning behind a common vision in order to adopt an integrated, cross-government policy approach that can establish an agreed direction of travel in the food system.



5. How FMCGs and retailers can take action



FMCGs and retailers can take action in five areas to make nature-positive food mainstream:



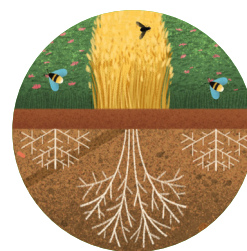
1. Create **ambitious and well-resourced action plans** to make nature-positive product portfolios a reality



2. Create a new **collaborative dynamic** with farmers



3. Develop **iconic products** to showcase the potential of circular design for food



4. Contribute to and use **common on-farm metrics and definitions**



5. Advocate for **policies** that support a nature-positive food system



1. Create ambitious and well-resourced action plans to make nature-positive product portfolios a reality

By putting in place product development strategies that combine the four circular design opportunities (diverse, lower impact, upcycled, and regeneratively produced ingredients) outlined in this report, businesses can transform their ingredient portfolios. Credible plans should include:

Clear goals to tackle climate change and biodiversity loss

Science-based, business-wide goals

Evidence-based goals that are bought into by the entire business provide critical direction for all other actions. Businesses can already align with established industry commitments, such as Race to Zero¹³⁵ – through which businesses aim to achieve net-zero carbon emissions by 2050 at

the latest – and an expanded set of Science-Based Targets for nature¹³⁶ (biodiversity, climate, freshwater, land, and ocean) expected in 2022. Initiatives like these provide frameworks and measurement tools for business leaders and operational managers to reorient priorities and activities in order to achieve nature-positive outcomes.

Time-bound goals to evolve ingredient portfolios

Establish a comprehensive set of goals for using more diverse, lower impact, upcycled, and regeneratively produced ingredients within a specific timeframe. These goals, although focused on ingredients, will also help to achieve business-wide goals in a mutually supportive way.

Assessment of current environmental and economic impacts at the farm-level

Establish a baseline of current ingredients and their impacts

Assess which ingredients are currently used to create product portfolios, in which volumes, and their impacts. To assess impacts, processes will need to be put in place to collect new data at the farm-level. This will require utilising consistent metrics that are aligned with business goals (e.g. on GHG emissions, biodiversity, water, farm economics) – see page 67 ‘Contribute to and use common on-farm metrics and definitions’ for further guidance.

Map ingredient supply channels

Once a baseline has been established for current ingredients, identify whether these are sourced directly or indirectly. Knowing this will allow businesses to determine which ingredients can be directly addressed with farmers and which require involvement from others in the current supply chain.

Development of new mechanisms that empower teams to design food products in line with ingredient portfolio goals

Renovation and innovation roadmaps

Establish pathways for achieving ingredient portfolio goals at the product level through a combination of renovating existing products and innovating new ones.

Training, criteria, tools, and processes to empower food designers

Empower and equip those involved in food design to ensure that circular design for food becomes the norm by providing the necessary training, decision-making criteria, tools, and processes.



2. Create a new collaborative dynamic with farmers

Forming strategic partnerships and strong working relationships with farmers is at the heart of circular design for food. Because regenerative farm systems are established according to their context, there is no universal pathway for every farmer to follow. By designing with farmers, FMCGs and retailers can embed evolving farm system realities in food design strategies over time.

FMCGs and retailers can:

Reshape relationships across the value chain

The path to creating a new collaborative dynamic with farmers varies according to the nature of a business' supply network, and may require making closer and more meaningful links with farmers. Whether through cooperatives, third-party suppliers, or directly with individual farmers, value chains will need to become more collaborative in order to

co-create nature-positive farm systems. By working closely with farmers, FMCGs and retailers can gain insight into how the mix and volumes of ingredients from the farms will evolve over time as they transition to regenerative production. Businesses can use this information to develop product portfolio strategies in line with circular design for food.

Make the economics work

As farmers shift from focusing on single crops to multi-crop regenerative farm systems, FMCGs and retailers can support them by establishing new buying models and contract terms. Doing so will help to create the necessary demand and supply coordination. Cost-sharing initiatives can also increase access to training, equipment, and inputs.

New buying models

This requires making the transition from sourcing an ingredient from a single plot to sourcing from a farm system. Regenerative farms produce a much more diverse range of ingredients, each at lower volumes, than farms that produce few ingredients grown conventionally on the same area of land. As a result, businesses will likely need to source more diverse ingredients from a single farm, and/or source a single ingredient from more farms.

New buying models can be set up by a single business or by multiple businesses, either in the food sector or not. New buying models can be applied to upcycled ingredients, for example, with one business buying by-products from another's manufacturing facilities, or one business purchasing a crop and

another the by-products of that crop. Given the need to coordinate supply across multiple buyers, digital tools that aggregate data about ingredient location, volume, availability, and on-farm impact would further enable these new buying models.

For example, Guima Café produces coffee in Brazil and is collaborating with Nespresso and reNature¹³⁷ to transition to regenerative production, and to produce a greater diversity of ingredients. Guima Café is now extending its range of farm outputs to include avocados, honey, rubber, and coffee, collaborating with new partners to diversify farm revenue streams by ensuring all these outputs are sold.

New contract terms

Based on the example ingredients analysed, the transition period can take as little as three years or up to 20 years before regenerative farms reach a profitable mature state. Farmers will therefore need income security to make the transition. FMCGs and retailers can build supplier relationships with a long-term view in mind. One way in which they can reflect this commitment is in contracts that provide greater security for farmers as they adopt new crops and practices that may lead to a short-term decline in output, and could otherwise be perceived as too risky. At the same time, contracts should have enough flexibility to allow both the farmer and the FMCG or retailer to evolve their production and sourcing as the farm and product markets change over time.

*For example, Danone has established long-term contracts with dairy farmers, helping alleviate short-term market volatility, thereby allowing them to adopt practices that can support regenerative outcomes.*¹³⁸

Cost-sharing initiatives

Adopting practices that can drive regenerative outcomes often requires equipment, new inputs (e.g. seeds, organic fertilisers, compost), and training that farmers may not have access to. FMCs and retailers can lower the capital investments needed for farmers to make the transition through cost-sharing initiatives, such as equipment pooling and input provision programmes.

*For example, PepsiCo is partnering with CCM Technologies to turn potato peel from their crisp factories in the UK into fertilisers that farmers can use to grow more potatoes.*¹³⁹

FMCs and retailers can also provide technical assistance, such as training programmes, to help farmers gain new knowledge and technical support around which practices are suited to their farms and will maximise regenerative outcomes for local ecosystems. The most successful technical assistance programmes often involve a range of relevant partners.

*For example, General Mills has set a goal to shift 1 million acres of agricultural land to regenerative food production by 2030, activating pilots across regions with partners such as Understanding Ag and the Soil Health Academy to address priority ingredients. Through these pilots, farmers acquire practical tools to adopt regenerative production including one-on-one coaching and technical assistance for three years.*¹⁴⁰

*For example, Grupo Carrefour Brasil launched the Small Farmers' Shipping Platform in 2020 and is running community projects with regional producers that include the provision of training and access to markets.*¹⁴¹

Facilitate knowledge-sharing between farmers

FMCs and retailers are also encouraged to highlight leading farming efforts to elevate pioneering farmers and/or landowners, facilitate knowledge-exchange, and inspire other farmers to adopt practices for regenerative outcomes. Through in-person networking and digital platforms, farmers in regions surrounding 'spotlight farms' can exchange knowledge and support one another as they transition to regenerative production.

*For example, reNature works alongside farmers and businesses to develop Model School Farms that show what regenerative agroforestry looks like for a target ingredient and provide valuable education to local farmers.*¹⁴²

While such models can be established by a single business or clusters of businesses and local partners, they can also be brought to life by private-public or third-sector partnerships.

For example, Leckford Estate¹⁴³ in England is a 1,100-hectare mixed farm owned by UK retailer Waitrose. Through its work with innovative farmers¹⁴⁴ and Linking Environment and Farming (LEAF)¹⁴⁵ membership, Leckford Estate employs farming techniques that help build biodiversity while growing ingredients and products that are mostly supplied to Waitrose. Learnings from the farm are then shared across the demonstration farms and other farmers in the LEAF network.



3. Develop iconic products to showcase the potential of circular design for food

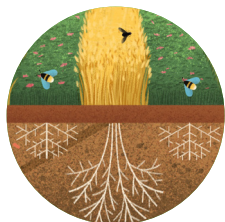
Redesigning portfolios and renovating core products at scale to capture the clear long-term economic and environmental opportunity will take time. To get started and build momentum, FMCGs and retailers can show what is possible through new products that bring circular design for food to life. This can allow businesses to create space for designers to experiment and learn, test new concepts with consumers, gain frontrunner advantage, and build a compelling business case.

Iconic products designed for nature should set a new level of ambition for food to help tackle climate change and build biodiversity. As well as being nutritious, tasty, and widely recognisable,

these products should provide new and accessible food experiences. They should inspire other FMCGs and retailers to use circular design for food to rethink their own product portfolios.

By leveraging marketing and in-store positioning to share the positive impact stories of these products with consumers, brands can build market share and capture consumer attention with products that are part of a nature-positive system. This new wave of product innovations can set the benchmark for the industry in different food product categories.

By bringing iconic products to market, the business case for embedding circular design for food into product creation across the industry can be made more clearly to internal business stakeholders as well as external stakeholders, such as investors and policymakers. This can then trigger further momentum within the company to accelerate circular design for food throughout their portfolios. Through the development of iconic products, businesses can also create space for designers to experiment and innovate, while gaining a deeper understanding of what additional resources and tools are needed.



4. Contribute to and use common on-farm metrics and definitions

To design products that allow nature to thrive, new metrics and definitions are needed to determine what qualifies as regenerative production, measure farm-level impacts of product design decisions, track progress towards company targets, and provide stakeholders and customers with accurate information on product benefits. Businesses can play a key role in developing and applying such metrics and definitions, while considering local contexts, by aligning with initiatives like the Global Farm Metric (see box on this page for more information).¹⁴⁶

By monitoring common metrics on all supplying farms and putting systems in place to enable information from farms to be shared with FMCGs and retailers purchasing from them, businesses can measure the environmental impacts of their portfolios across metrics such as GHG, biodiversity, and water. This will enable the accurate reporting of progress against business-wide goals.

Businesses can advocate for widespread adoption of common on-farm metrics by governments, industry, and farmers to measure ingredient production impacts across geographies. This could further benefit businesses by:

- Ensuring governments can appropriately allocate subsidies to incentivise regenerative production, develop trade agreements that favour products designed using these ingredients, and award ecosystem service payments
- Enabling investors to use common criteria to guide decision-making that provides preferential access to finance for farmers undertaking regenerative production

AN EXAMPLE OF COMMON METRIC DEVELOPMENT

The [Global Farm Metric](#) (GFM) builds on five years of work by farmers and the Sustainable Food Trust to develop a harmonised metric for farm system impacts. The GFM is a whole-farm metric that measures societal, environmental, and economic impacts, assessed across 11 categories:

- Soil
- Water
- Air and climate
- Productivity
- Human capital
- Social capital
- Biodiversity
- Plant and crop health
- Animal husbandry
- Nutrient management
- Energy and resource use

Each of these categories has a set of three indicators assigned to it.

Rather than seeking to become a certification programme, the GFM aims to establish a common framework to measure impacts globally and provide a self-assessment tool that farmers and land managers can use to calculate a score indicating impacts across categories. This can then be used by buyers purchasing ingredients, policymakers allocating subsidies, and investors. The GFM is currently in development with involvement from diverse organisations and stakeholders, ranging from farming groups and governments to NGOs and major industry players.



5. Advocate for policies that support a nature-positive food system

As governments progressively recognise the critical role food system transformation can play in tackling climate change and biodiversity loss – thereby achieving a number of the United Nations' Sustainable Development Goals – businesses can accelerate policy development by advocating for measures that support circular design for food and a nature-positive food system.

In the framework of the Farm to Fork Strategy, the Code of Conduct¹⁴⁷ is an example of a voluntary initiative aimed at creating a common system and methodology to track and monitor sustainability throughout the food value chain, based on principles shared by a broad range of stakeholders.

By advocating for the right policy landscape, businesses can support the shaping of measures that are in line with their climate and biodiversity goals and will support their achievement. Danone,

for example, advocates for policy changes that incentivise the uptake of practices that have regenerative outcomes, reduce chemical inputs, and support farmers in the transition.¹⁴⁸

Joint industry initiatives and collaborations can further strengthen and accelerate industry-led actions and help bring them to scale. In the plastics sector, for example, more than 100 businesses committed to engage constructively with government and other stakeholders for the establishment and improvement of Extended Producer Responsibility policies to create a level playing field and accelerate the transition to a circular economy.¹⁴⁹

Examples of policy measures that governments can implement and businesses can actively support include:

- Shifting incentives away from conventional food production towards regenerative outcomes and providing support to farmers in the transition
- Funding research to increase knowledge and application of circular design for food opportunities at farm- and business-level
- Using trade and international cooperation instruments to ensure a level playing field

Drawing on the *Universal circular economy policy goals* and the vision of a nature-positive food future based on circular design, a broad set of measures can scale the sector's transition.¹⁵⁰

Redesigning
food for a
nature-positive
future is possible.



What role
will you play
to make it
happen?

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The Ellen MacArthur Foundation, a UK-based charity, develops and promotes the idea of a circular economy in order to tackle some of the biggest challenges of our time, such as plastic pollution, climate change, and the loss of biodiversity. In a circular economy, business models, products, and materials are designed to increase use and reuse, creating an economic system in which nothing becomes waste and everything has value. Increasingly built on renewable energy and materials, a circular economy is distributed, diverse, and inclusive. The Ellen MacArthur Foundation collaborates with and inspires, businesses, organisations, and other key actors to accelerate the transition to a circular economy.

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Endnotes

- 1 Chatham House, *Food system impacts on biodiversity loss* (2021)
- 2 Technical Appendix, p.20
- 3 FAO, *The world of organic agriculture* (2021)
- 4 Unilever, *Unilever's purpose-led brands outperform* (11th June 2019)
- 5 *Race to Zero*
- 6 *Science-Based Targets initiative (SBTi)*
- 7 *Science-Based Targets (SBTs) for nature*
- 8 FAO, *What is agrobiodiversity?* (2004); Crop Trust, *Crop Trust Magazine* (2019)
- 9 *One Planet Business for Biodiversity Initiative (OP2B)*
- 10 Future market insights, *Products from food waste market – key findings* (2019)
- 11 Overall averages across ingredients analysed (wheat, dairy, potatoes) in the EU/UK following transition period, when combining design opportunities as appropriate. The % changes are compared with business-as-usual for 2030. Profitability is for 'steady state', which is defined as the year in which the farm system reaches maturity: when yields and annual economic returns stabilise. This is different for each ingredient. See technical appendix for further details.
- 12 Ellen MacArthur Foundation, *The nature imperative: how the circular economy tackles biodiversity loss* (2021)
- 13 Crippa, M., Solazzo, E., Guizzardi, D., et al., *Food systems are responsible for a third of global anthropogenic GHG emissions, Nat Food 2, 198–209* (2021)
- 14 Boston Consulting Group, *The biodiversity crisis is a business crisis* (2021)
- 15 European Commission, *A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system* (2020)
- 16 National Food Strategy, Independent Review, *The plan* (2021)
- 17 Department for Environment, Food & Rural Affairs, *Environmental Land Management and Public Money for Public Goods* (2021)
- 18 FAO, *Update on the scaling up of Agroecology Initiative* (2020)
- 19 FAO, *Update on the scaling up of Agroecology Initiative* (2020)
- 20 Ellen MacArthur Foundation, *The Milan food policy – collaborating to change local food systems* (2019)
- 21 Ellen MacArthur Foundation, *Circular economy for food in São Paulo* (2021)
- 22 Unilever, *How we will grow our ingredients in harmony with nature?* (22nd April 2021)
- 23 PepsiCo, *PepsiCo unveils ambitions new agriculture goals* (4th April 2021)
- 24 Walmart, *Walmart sets goal to become a regenerative company* (21st September 2020)
- 25 World Benchmarking Alliance, *Assessing the world's 350 most influential food and agriculture companies on their commitment* (December 2020)
- 26 World Benchmarking Alliance, *Assessing the world's 350 most influential food and agriculture companies on their commitments* (December 2020)
- 27 Technical Appendix, p.20
- 28 Smart Protein, *Plant-based foods in Europe* (September 2020)
- 29 CNBC, *Oatly IOP: OATLY starts trading on Nasdaq* (May 2021)
- 30 Unilever, *Unilever's purpose-led brands outperform* (11 June 2019)
- 31 European Commission, *Farm to Fork Strategy – Sustainable Food Consumption* (2021)
- 32 Heinz, *Tomato ketchup: 50% less sugar and salt*
- 33 Nestlé UK, *Nestlé Confectionery UK removes all artificial colours, flavours and preservatives from its products* (1st March 2012)
- 34 Willett, W., et al., *Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems, The Lancet, 393(10170)* (2019), pp.447–492
- 35 Chatham House, *Food system impacts on biodiversity loss* (2021)
- 36 Ellen MacArthur Foundation, *Completing the picture: how the circular economy tackles climate change* (2019)
- 37 Ellen MacArthur Foundation, *The Nature Imperative: How the circular economy can tackle biodiversity loss* (2021)
- 38 Ellen MacArthur Foundation, *Cities and circular economy for food* (2019)
- 39 Ellen MacArthur Foundation, *Food: two circular investment opportunities for a low-carbon and prosperous recovery* (2020)
- 40 Dasgupta, P., *The economics of biodiversity: the Dasgupta review*, London: HM Treasury (2021)
- 41 Ellen MacArthur Foundation, *Upstream innovation: a guide to packaging solutions* (2020)
- 42 Soil health, water, and agroecosystem health and resilience are other relevant metrics that, if measured, could give a more comprehensive measure of regenerative outcomes, but were not included for analysis in this study.
- 43 GWP* was investigated as a possible alternative to GWP₁₀₀, but was not used. See technical appendix p.7 for more detail
- 44 CISL, *Measuring business impacts on nature* (2020)
- 45 Modelling of farmer profitability is high level and indicative. See technical appendix p.8 for more details.
- 46 Technical Appendix, p.6
- 47 Technical Appendix, p.20
- 48 FAO, *What is agrobiodiversity?* (2004); Crop Trust, *Crop Trust Magazine* (2019)
- 49 IPBES, *Summary for policymakers of the global assessment report on biodiversity and ecosystem services* (2019)
- 50 The Future Market, *The future of the potato*
- 51 Ristaino, et al., *The persistent threat of emerging plant disease pandemics to global food security*, Proceedings of the National Academy of Sciences, ISSN: 2250-1762, 118 (23) (2021)
- 52 CIP International Potato Center, *Case for investment: climate change adaptation*
- 53 Hoffman, I., *Climate change and the characterization, breeding and conservation of animal genetic resources* (May 2010)
- 54 The Livestock Conservancy, *Pineywoods Cattle* (no date)
- 55 The Cattle Site, *Cattle Breeds – Devon* (no date)
- 56 Gruber, K., *Agrobiodiversity: the living library*, Nature (27th April 2017)
- 57 Herrero, et al., *Farming and the geography of nutrient production for human use: a transdisciplinary analysis*, The Lancet Planetary Health, 1 (2017), e33–e42
- 58 Knorr, *Eat for good with Knorr's Future 50 Foods cookbook*
- 59 Reawakened, *What (and who) does agrobiodiversity look like?*
- 60 Slow Food, *Ark of taste*
- 61 FAO, *The 10 elements of agroecology* (2018)
- 62 IIED, *The spice of life: the fundamental role of diversity on the farm and on the plate* (2018)
- 63 Reawakened 25, *Small millet case study* (2021)
- 64 New Dairy, *The plant-based dairy map* (2021)
- 65 Technical Appendix, p.30–31
- 66 Verduci, et al., *Cow's milk substitutes for children: nutritional aspects of milk from different mammalian species, special formula and plant-based beverages* (2019)

- 67 Data shown here for each plant-based milk is the total output of milk (e.g. oat milk) per hectare based on typical composition, not the yield of the base ingredient (e.g. oats) whereas GHG emissions are based on the raw ingredient (e.g. oats). Protein adjusted numbers are shown in the technical appendix, p.29–30
- 68 Mottet, et al., *Livestock: On our plates or eating at our table? A new analysis of the feed/food debate* (2017)
- 69 Poore, J., and Nemecek, T., *Reducing food's environmental impacts through producers and consumers*, Science (2018)
- 70 Technical Appendix, p.22–24
- 71 In 'steady state', which is defined as the year in which the farm system reaches maturity: when yields and annual economic returns stabilise. This is different for each ingredient. For potatoes, all figures are for the potato year within a six-year rotation. See technical appendix p.38–41 for further details.
- 72 0.33–1.8 tCO₂e/ha from Crews, T. E., Carton, W., and Olsson, L., *Is the future of agriculture perennial? Imperatives and opportunities to reinvent agriculture by shifting from annual monocultures to perennial polycultures*, Global Sustainability 1 (2018), e11, 1–18.1
- 73 From data provided by How Good
- 74 Business Innovation Observatory, *Sustainable, safe and nutritious food* (2015)
- 75 *SuSeWi*
- 76 *Spireaux*
- 77 Halloran, et al., *Edible insects in sustainable food systems* (2018)
- 78 FAO, *Edible insects, future prospects for food and feed security* (2013)
- 79 European Commission, *Food safety: approval of first insect as Novel Food* (2021)
- 80 *Ynsect*
- 81 Protifarm, *Our AdalbaPro products*
- 82 Upcycled Food Definition Taskforce, *Defining upcycled foods* (2020)
- 83 FAO, *Food waste footprint: impact on natural resources, summary report* (2013)
- 84 WWF-UK, *Driven to waste: The Global Impact of Food Loss and Waste on Farms* (2021)
- 85 *Renewal Mill*
- 86 *Comet Bio*
- 87 Interview with EverGrain (conducted 24th February 2021)
- 88 Coffee Cherry Co., *Sustainability*
- 89 Koa, *Impact*
- 90 Member Directory, *Upcycled Food Association*
- 91 Future Market Insights, *Products from food waste* (2019)
- 92 In 'steady state', which is defined as the year in which the farm system reaches maturity: when yields and annual economic returns stabilise. Aggregated average across the three ingredients. See technical appendix for further details
- 93 In 'steady state', which is defined as the year in which the farm system reaches maturity: when yields and annual economic returns stabilise. Aggregated average across the three ingredients. See technical appendix for further details
- 94 Roca-Fernández, A., et al., *Pasture intake and milk production of dairy cows rotationally grazing on multi-species swards* (2016)
- 95 In 'steady state', which is defined as the year in which the farm system reaches maturity: when yields and annual economic returns stabilise. Aggregated average across the three ingredients. See technical appendix for further details
- 96 Savory Institute, *Managing the complexities of land and livestock*
- 97 Technical Appendix, p.37–40
- 98 Technical Appendix, p.41–43
- 99 California State University (CSU), Chico – Center for Regenerative Agriculture and Resilient Systems, *Could regenerative agriculture increase the nutritional quality of our food?*
- 100 Jones, C., *Soil Restoration: 5 core principles* (2017)
- 101 Troesch, B., et al., *Increased intake of foods with high nutrient density can help to break the intergenerational cycle of malnutrition and obesity* (2015)
- 102 FAO, *Nutrition and food systems: a report by the high-level panel of experts on Food Security and Nutrition* (2017)
- 103 *Bionutrient Food Association*
- 104 *Periodic Table of Food Initiative*
- 105 Technical Appendix, p.10–17
- 106 In 'steady state', which is defined as the year in which the farm system reaches maturity: when yields and annual economic returns stabilise. Aggregated average across the three ingredients. See technical appendix for further details
- 107 In 'steady state', which is defined as the year in which the farm system reaches maturity: when yields and annual economic returns stabilise. See technical appendix p10–12 for further details.
- 108 In 'steady state', which is defined as the year in which the farm system reaches maturity: when yields and annual economic returns stabilise. See technical appendix p13–15 for further details.
- 109 European Commission, *EU taxonomy for sustainable activities* (2021)
- 110 Nicolini, M., and Tavoni, M., *Are renewable energy subsidies effective? Evidence from Europe*, Renewable and Sustainable Energy Reviews (July 2017), pp.412–423
- 111 Laborde, D., Mumun, A., Martin, W., Piñeiro, V., and Vos, R., *Modeling the impacts of agricultural support policies on emissions from agriculture*, International Food Policy Research Institute (2020)
- 112 European Commission, *Sustainable land use (greening)* (2021)
- 113 European Court of Auditors, *Special Report 21/2017: greening: a more complex income support scheme, not yet environmentally effective* (2017)
- 114 European Court of Auditors, *Special report 16/2021: Common Agricultural Policy and climate: half of EU climate spending but farm emissions are not decreasing* (2021)
- 115 DEFRA, *Environmental Land Management Schemes* (2021)
- 116 DEFRA, *Guidance on the Sustainable Farming Incentive pilot* (2021)
- 117 European Commission, *Future of the Common Agricultural Policy* (2021)
- 118 Agricultural Knowledge and Information Systems, *Stimulating creativity and learning* (2018)
- 119 European Commission, *Evaluation study of the implementation of the European Innovation Partnership for Agricultural Productivity and Sustainability* (2016)
- 120 SYSTEMIQ, Club of Rome, *A system change compass – implementing the European Green Deal in a time of recovery* (2020)
- 121 Herren, H., Bassi, A., Tan, Z., Binn, W., *Green jobs for a revitalized food and agricultural sector*, Natural Resources Management and Environment Department Food and Agriculture Organization of the United Nations (2012)
- 122 European Commission, *Young farmers in the EU – structural and economic characteristics*, EU Agricultural and Farm Economic Briefs, no.15 (2017)
- 123 Henriques, M., *The ageing crisis threatening farming*, BBC – Follow the Food
- 124 European Institute for Innovation and Technology, *Global Food Venture Programme* (2021)
- 125 European Institute for Innovation and Technology, *Food Circle Lab: a hub to scale up circular food startups in Flanders* (2021)
- 126 UK Research and Innovation, *Transforming food production challenge* (2021)
- 127 European Commission, *Mission area: soil health and food* (2021)
- 128 European Commission, *Trade Policy Review: an open, sustainable and assertive trade policy* (2021)
- 129 Council of the European Union, *Draft Council Conclusions on the EU's priorities for the 2021 United Nations Food Systems Summit* (2021)
- 130 European Commission, *Agreement between the European Union and Japan for an economic partnership* (2019)

-
- 131 CIDSE, *Finance for agroecology: more than just a dream? An assessment of European and international institutions' contributions to food system transformation* (2020)
- 132 Ellen MacArthur Foundation, *The nature imperative: how the circular economy tackles biodiversity loss* (2021)
- 133 FAO, *Building a Common Vision for Sustainable Food and Agriculture* (2017)
- 134 Ellen MacArthur Foundation, *Universal circular economy policy goals: enabling the transition to scale* (2021)
- 135 *Race to Zero*
- 136 *Science Based Targets for nature*
- 137 reNature, *Guima Brazil: where it all started*
- 138 Danone, *For a regenerative future* (2021)
- 139 PepsiCo UK, *We're cutting carbon emissions by bringing potatoes full circle* (2020)
- 140 General Mills, *We will advance regenerative agriculture on 1 million acres of farmland by 2030*
- 141 Grupo Carrefour Brasil, *2020 annual sustainability report* (2020)
- 142 reNature, *Model farms*
- 143 Leckford Estate, *The Waitrose & Partners Farm*
- 144 Innovative Farmers, *About Innovative Farmers*
- 145 Linking Environment And Farming (LEAF), *What we do*
- 146 Sustainable Food Trust, *Global Farm Metric* (2021)
- 147 European Commission, *EU Code of Conduct on Responsible Food Business and Marketing Practices* (2021)
- 148 Danone, *Call to action for a common food policy 2020-2024* (2020)
- 149 Ellen MacArthur Foundation, *Extended Producer Responsibility - a necessary part of the solution to packaging waste and pollution* (2021)
- 150 Ellen MacArthur Foundation, *Universal circular economy policy goals: enabling the transition to scale*, (2021)