Nature-positive futures

Food systems as a catalyser for change

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The content of this Mansholt lecture came about through a wide science-policy consultation process. Existing 'seeds of innovation' in the biodiversity climate-food nexus were collected in a WUR-wide dialogue on 10th May 2022, which involved some 150 interdisciplinary experts. These seeds were collated into interventions for nature-positive futures, in an interdisciplinary workshop of WUR colleagues on 13th May 2022. They were further clustered into five entry points for nature-positive changes to the food system. The resulting entry points and interventions were discussed with several EU policy makers in another workshop in Brussels on 30th June 2022. We thank everyone involved in this process for their input.

Foreword

Every year in Brussels Wageningen University & Research (WUR) organises the Mansholt lecture to inspire European policy makers and other stakeholders in the domains of agriculture and food. The lectures are framed around innovations that can enhance the quality of our food systems. Previously WUR has presented its visions on the common agriculture & food policy, circular agriculture, the protein transition and digital agriculture. This year, we present pathways and interventions for nature-positive futures that could enable the food system to become a major game changer in addressing the interconnected challenges of biodiversity loss and climate change.

As European Commissioner for Agriculture, Wageningen alumnus Sicco Mansholt began formulating a European agricultural policy driven by the joint aims of preventing food scarcity and providing viable incomes for European farmers in the 1950s. When implemented through policy his ideas transformed Europe to a net exporter of food, however, the intensification of European agricultural practice came at a high price; greenhouse gas emissions, environmental pollution, destruction of fertile soils and loss of biodiversity threaten human wellbeing.

Whilst his early influence on agricultural policy is still visible today, following retirement he began to see the negative consequences and started lobbying to adjust policies towards more sustainable practices. This Mansholt lecture sets out the pathway to sustainability and provides inspiration for the realisation of the European Green Deal and the implementation of the Farm to Fork and Biodiversity Strategies.

The journey into a nature-positive future will not be easy. It will require courageous leadership and sectoral collaboration in a continuously changing world. This lecture reveals that Europe is already cultivating the seeds of change, and that we can forge the necessary collaborations to move forward more effectively together. Finding answers together is the motto of WUR and we believe policy, science, business and society must now become travelling companions on this new journey.

Sjoukje Heimovaara,
President Executive Board of Wageningen University & Research

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Executive Summary

Wageningen University & Research (WUR) organises the Mansholt lectures to provide inspiration for European policy makers and other stakeholders in the domains of agriculture and food. This year, we set out pathways and tipping interventions for nature-positive futures in the food system. We provide our perspective of how the food system can positively contribute to solving the urgent and interconnected challenges of biodiversity loss and climate change.

Currently, the food sector is the single largest greenhouse gas emitter in the world, accounting for some 30% of all emissions. Moreover, agriculture is responsible for 80% of global deforestation – a major cause of global biodiversity decline – and accounts for 70% and 50% of terrestrial and freshwater biodiversity loss respectively. These numbers evidence the global food system as a main driver of the climate and biodiversity crises we face. However, the food system is also increasingly a main victim of the same crises. Increasing frequencies of drought or floods, infertile soils or the lack of pollinators already reduce and destabilise food production, and this will likely grow worse in the future if we do not act urgently and collectively. Biodiversity loss and climate change are inextricably linked. All life on Earth depends on and affects climate regulation. However, climate change is already dramatically reducing the functioning of our ecosystems and will lead to increasing rates of biodiversity loss. This biodiversity loss will reduce the ability of ecosystems to regulate temperature, water availability and greenhouse gas emissions, ultimately driving further climate change. Biodiversity loss and climate change should therefore be treated as strongly coupled global crises.

We present five interlinked entry points and their practical nature-positive interventions that together can accelerate the development of nature-positive food systems in Europe, enrich biodiversity and enhance the climate regulation delivered by ecosystems. Each entry point represents a 'sub-system' for transitioning towards nature-positive food systems, and begins by describing a nature-positive outcome for this sub-system. The entry points are: 1. Diverse fields and farms; 2. Biodiverse landscapes and seascapes; 3. Connected communities; 4. Sustainable food and diet; and 5. Inclusive finance and trade. We systematically review how the interventions relate to the EU Farm to Fork Strategy and the Biodiversity Strategy to 2030. Many of the proposed interventions are already clearly articulated in the current EU strategies, and here we support rapid and comprehensive implementation of these policy strategies. Two interventions related to entry point

‘Connected communities’ have no provisions made by either of the strategies and constitute gaps in current EU policy that require attention.

Importantly, none of the interventions identified (or the associated strategic policies) will alone lead to the urgently required transformation toward a nature-positive food system. We argue that various combinations of interventions from different entry points that work synergistically are required to trigger the change towards nature-positive food systems. In exploring the linkages between different combinations of interventions, we found that legally binding governmental regulations were the most frequently highlighted triggers of system change. Over-reliance on voluntary incentives or subsidies have been too slow and ineffective on their own. Simultaneous implementation of different interventions from the five entry points can set up mutually reinforcing positive feedback loops, triggering the necessary chain reactions towards nature-positive food systems. We illustrate these chain reactions with three exemplary nature-positive pathways – for agriculture and food; for an economy of wellbeing; for food, culture and learning – that show how combinations of interventions can build momentum and tip the system.

It is also clear that we can only solve the biodiversity, climate and food crises in time if we do it together. Social-environmental changes are greatly facilitated if coalitions of leaders are formed that are united by common interests, ideas and values. Single organisations or leaders seldom have the necessary resources on their own. We therefore conclude by identifying four priority actions for each of a number of different stakeholder groups – the European Commission and Member States, sub-national authorities, the financial sector, the food industry, farmers and consumers, and academia. We believe that these different stakeholders should all take up their responsibilities for developing a safe and just future for all and lead collaborative coalitions of actors towards a nature-positive future. We from WUR will actively contribute to developing the science and practice that will support every step of this collaborative journey.

1 The promise of nature-positive food systems

We are living in uncertain times. The recent crises caused by the COVID-19 pandemic, the Russian-Ukrainian war, extreme drought this spring, extreme tropical temperatures all over Europe this summer leading to breaking glaciers and forest fires. Whilst these crises all have different origins and play out in different places and across different time scales, they all provide us with a heightened awareness of the potential for the world to change rapidly with great consequences for our daily lives. They have increased our understanding of the importance of food, how it is produced and where it comes from. Furthermore, these crises have resulted in a growing consensus that human-induced climate change and biodiversity loss are driving these current societal uncertainties.

Biodiversity* is the safety net for climate regulation

All life on Earth depends on and affects climate regulation. However, climate change is already dramatically reducing the functioning of our ecosystems and will lead to increasing rates of biodiversity loss. This biodiversity loss – further exacerbated by other human drivers – will reduce the ability of ecosystems to regulate temperature, water availability and greenhouse gas emissions, ultimately driving further climate change[1]. Biodiversity loss and climate change are therefore inextricably linked: they have mutually reinforcing feedback loops[2], and are also both caused by unsustainable human practices. They should therefore be viewed and treated as strongly coupled global crises.

The global food system is both a key driver and victim of climate change and biodiversity loss

Globally, the food sector is the single largest greenhouse gas emitter in the world, accounting for some 30% of all emissions[3]. Agriculture is responsible for 80% of global deforestation – a major cause of global biodiversity decline – and accounts for 70% and 50% of terrestrial and freshwater biodiversity loss respectively[4]. These numbers certainly evidence the global food system as a main driver of the climate and biodiversity crises we face. However, the food system is also increasingly a main victim of the same crises. Increasing frequencies of drought or floods, infertile soils or the lack of pollinators already reduce and destabilise food production, and will likely grow worse in the future. The diversity of our crops and livestock in the food system is also alarmingly narrow, with about 66% of our diets consisting of just nine crop species[5]. Furthermore, the conservation status of wild relatives of crops and domesticated livestock is in decline[6], further reducing the critical reservoirs of genes and traits that may boost resilience against future climate change, pests and pathogens[5]. The current unprecedented biodiversity loss is thus critically undermining the global food system.

A transformation to nature-positive food systems is urgently required

The negative effects of climate change and biodiversity loss on the food system call for an urgent reconsideration of the role of nature in the food system[7]. A nature-positive food system can contribute simultaneously to tackling both biodiversity loss and climate change challenges (Box 1). Its success is essential for the livelihood of

* Biodiversity is the part of nature that is alive, and includes every living thing on Earth, humans too; nature is all biodiversity together with the non-living systems – the soils, water, climate, mountains and all other inanimate components – that comprise our planet.

our planet, food security in the future, human health and social well-being. It will require a systemic approach, which considers the interlinked goals of biodiversity conservation, climate change adaptation and mitigation, food security and human wellbeing – from global to local scales, acknowledging social-cultural contexts and rights. Food systems are complex systems that need to meet multiple demands across fields, farms, regional rural and urban landscapes, seascapes, and a myriad of national and international political and financial boundaries. Furthermore, there are multiple people that interact across food value chains, from primary producers to food processors, distributors, traders, financers and consumers. Transformation towards a nature-positive food system will thus be a major societal challenge, requiring integrated concerted actions from all actors involved, understanding how actions interact across different places and people, and proactively navigating the dilemmas and tensions that inevitably arise.

Box 1: 'Nature-positive': good for biodiversity, climate and people

Global consensus is increasing: "our world must not only become net zero, but also nature-positive, for the benefit of both people and the planet"[8]

Being 'nature-positive' means creating a world where we halt and reverse the destruction of nature by 2030, with recovery by 2050[9]. Becoming nature-positive also needs to engage with the specificities of people's needs, culture and rights[10]. This will allow thriving biodiversity, ecosystems and nature-based solutions to play a critical role in halting climate change and allow people – now and in the future – to flourish.

The concept of nature-positive signals a paradigm shift in how countries, businesses, investors and consumers value nature. It goes beyond simply 'minimising harm' to nature, to enriching biodiversity and enhancing the capacity of ecosystems to regulate climate and provide other important services.

Nature-positive approaches *share space with nature* on farms and *spare space for nature* in the landscape

Farming with nature rather than against it does not mean farming systems going back to the past. Innovative farmers, working at different scales are demonstrating that it is possible to produce similar amounts of good quality food, when implementing agro-ecological principles, such as increased diversity of crops, smaller fields, and connected landscape elements like hedgerows[11]. Farmer ingenuity, helped by technological innovations, is emerging to manage the increased complexity[12] of nature-positive farming. Next to *sharing space* with nature on fields and farms, *sparing space for*

nature across the rest of the landscape is also important for restoring the earth's safety net. Halting the expansion of agriculture into intact ecosystems is a first critical step in halting the loss of biodiversity and mitigating climate change. It is also likely to help stabilise hydrological cycles[13]. However, on a global scale, being nature-positive will also require restoring already degraded land- and seascapes. For example, evidence suggests that restoring 15% of land in global priority areas could avoid 60% of expected species extinctions and contribute to sequestering 30% of the total atmospheric CO_2 increases since the Industrial Revolution[14]. Nature-positive approaches that target soil health across the landscape are also beneficial for climate adaptation and mitigation[15]. With a relatively small amount of initial restoration effort, the intrinsic resilience of nature will allow recovery of species, particularly when approaches focus on creating functional ecological connectivity within diverse landscapes.

Nature-positive approaches can provide multiple societal benefits

This is especially true when implemented with sensitivity to social-cultural contexts and rights[16]. Nature-positive approaches often have a multitude of spin-off benefits for society. COVID-19 highlighted the value of nature-positive spaces for recreational and mental health, and how nature and food are a core part of cultural identity. These values of nature and food are often overlooked in policy and decision making in favour of more market-based values, such as agricultural yield. Broadening decision making to reflect the diverse ways people interact with and value food and nature is critical to food system transformations[17].

The European Green Deal sets out a clear and ambitious vision that supports nature-positive futures

The Farm to Fork Strategy and the EU Biodiversity Strategy for 2030 lie at the core of achieving a vision of a fair and prosperous society. These strategies are highly complementary and together outline future visions for the benefit of the planet and its people. The EU has a global responsibility to lead the way without delay. The EU is the world's largest agri-food exporter in economic terms, but when considering nutritional value, the EU consumes more than its fair share[18]. The EU is the second-largest importer of products linked to tropical deforestation, driving climate change, biodiversity loss and social injustices. Fast-tracking the proposed EU regulations to minimise EU-driven deforestation and forest degradation is an important opportunity for urgently addressing these globally-linked trade issues.

The speed towards nature-positive futures is too slow and the scale too limited

There is an increasingly small window of opportunity to respond to the crises of climate change and curb biodiversity loss before it becomes too late, as many scientists and policy makers have warned[19]. We need to act now to limit our global temperature to 1.5°C by 2050 and to bend the curve for biodiversity[20]. Transitioning to nature-positive food systems has already been identified as a critical pathway for transformative change[2], but it needs more than just words. It requires immediate and concerted effort to create enabling conditions that trigger and accelerate cascading positive actions on the ground. A mix of interventions (e.g. regulations, financial incentives, communications), tailored to specific contexts, is needed to simultaneously place pressure on the system to change and to create inspiration for change.

The concept of systemic tipping points can be used to accelerate change

A tipping point can be viewed as a critical point in a system where targeted interventions lead to self-reinforcing positive-feedback loops that spread rapidly,

leading to large and long term ways in which the system operates[21] (Figure 1). Such transformative changes usually imply shifting societal and individual norms. These changes are often facilitated by 'agents of change' – formal or informal leaders – who can shift public perception and build momentum to trigger change. While it is often difficult to predict exactly when this will occur, interventions can be designed to equip agents of change with enabling conditions that help to trigger this shift of norms in their actor networks. These 'tipping' interventions are often context specific in place or with regard to the topic under consideration. For example, similar interventions may work out differently in France than in Germany or Spain, due to different crops or cropping systems, landscapes, cultures, and food chains. Still, we believe that the tipping interventions can serve as guidelines for change, if connections with people across local and global scales and sectors are encouraged. Local engagement is a key for making change happen as the interventions can only be implemented on the ground. At the same time, policy support at national, regional and global levels provides an enabling environment for this change to occur.

In this lecture, we focus on nature-positive food systems in Europe, with a mainly terrestrial focus. In Chapter 2, we outline five interconnected entry points triggering change: 1 diverse fields and farms, 2 biodiverse landscapes and seascapes, 3 connected communities, 4 sustainable food and diet, and 5 inclusive finance and trade. For each entry point, we have developed several practical interventions and relate these to the Farm to Fork and Biodiversity strategies. In Chapter 3, we consider several interactions between these interventions that can trigger cascading positive chain reactions towards nature-positive food systems. These changes will not happen without collaboration across people, places, sectors and scales. In Chapter 4, we outline the formal and informal 'agents of change' who can lead these changes through forming collaborative actor networks. Such social coalitions will help to put concern for equity of outcomes at the centre, rebalance narrow values and power concentrations in current food systems, and build enabling conditions for positive tipping points towards a nature-positive food system that is inclusive and adaptive to the needs and aspirations of everyone.

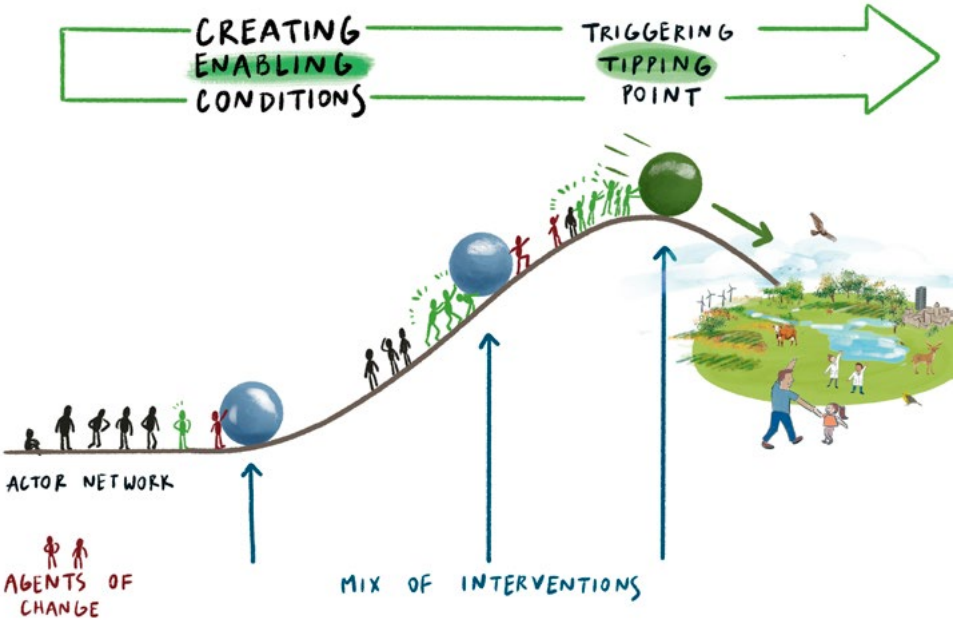


Figure 1: System tipping dynamics to achieve nature-positive futures. Agents of change and a mix of interventions create enabling conditions that mobilise actor networks and trigger tipping points that accelerate transformative change. Importantly, there are many pathways to trigger such change, and these interact across people and places. Therefore, different mixes of interventions need to be activated and adjusted over time to ensure that the transition to nature-positive futures remains sustainable and ethical (after Lenton[22])

2 Entry points and their tipping interventions for nature-positive food systems

We present five interlinked entry points and their practical interventions that together accelerate the development of nature-positive food systems in Europe. Each entry point represents a 'sub-system' for transitioning towards nature-positive food systems, and begins by describing a nature-positive outcome for this sub-system. The entry points have been formulated as if the nature-positive future has already come about.

Linked to the nature-positive outcome of the five entry points, we describe how the associated interventions fulfil different functions in triggering the required change, such

Collecting 'seeds of innovation' in a WUR-wide dialogue, 10 May 2022

as to inspire collective action, stimulate behavioral change, foster innovation, overcome political lock-ins and restructure economies. In system tipping dynamics, different interventions are recognised, ranging from 'shallower' reactions to events or improvements to existing system functions and efficiencies, to 'deeper' interventions that seek to re-design system structures and shift societal norms and values[23]. Some proposed interventions emphasise short term reactionary measures (e.g. subsidies, disclosure of environmental impacts), which help us cope with crises or pave the way for deeper change (e.g. restructuring institutions and norms).

Clustering seeds into interventions and entry points, 13 May 2022

Figure 2 Five entry points where interventions can be made that together will accelerate the transformation towards nature-positive food systems in Europe. These entry points represent five specific 'sub-systems' that are critical for achieving the transformation to nature-positive food systems: 1 diverse fields and farms, 2 biodiverse landscapes and seascapes, 3 connected communities, 4 sustainable food

and diet and 5 inclusive finance and trade. Importantly, these interventions interact within and across entry points and have the potential to trigger positive feedback loops that cascade nature-positive changes through the food system. Individual interventions identified are thus more likely to be effective and rapidly adopted if implemented simultaneously by a network of actors in all parts of the food chain.

Entry point #1 Diverse fields and farms

Principles from agroecology have become mainstream farming practice to produce sufficient and healthy food for all, while serving the planet and its people. Farmers manage almost closed cycles of nutrients and hardly use pesticides on a wide diversity of crop species that are grown in smaller field systems. These agroecological practices have promoted technological innovations to manage the increased diversity and complexity. Enhancing the provisioning of ecosystem services is an essential part of the farmer's income, in particular those related to soil health, water retention, carbon sequestration and conservation of edible wild species. Creating landscape elements and cultivating species–rich grasslands represent the sharing of the cultivated landscape with nature. Altogether, this has provided an appealing future perspective empowering a new generation of farmers, including women and youth, to contribute sustainably to the future.

1.1 Reduce fertiliser and pesticide use

Boundaries of a planetary safe space must be set strictly by government regulation to reduce negative environmental impacts. Use of artificial fertiliser and pesticides should therefore become severely restricted. Such restrictions need to be implemented in conjunction with stimulating agroecological principles that work with ecological processes and technological innovations to control pests and diseases, and promote soil fertility and health. Bringing in this combination of agroecology and technological innovation is likely to be far more effective than focusing on either of these in isolation.

1.2 Invest in "minor" crops

In the European Union, cereals, maize (grain and silage), oilseed rape, and sunflower together cover 92% of the arable land area, resulting in short rotations (3–4 years on

conventional farms) dominated by cereals, maize, and rapeseed in the north, and maize and sunflower in the south[12,24]. Broadening the number of our crops, including legumes, is essential for enhancing the narrow base of diversity of the food system[5]. Leguminous crops play a large role in enhancing soil nutrients and in the protein transition.

1.3 Implement agroecological principles

This will create farming systems that deliver biodiversity as an inherent part of the day to day implementation of farm management[25-27]. Examples of such principles are: increasing crop diversity in time and space, creation of small-sized fields with hedges or flower strips, circular manure use, cover cropping and extensively managed grassland systems. As a guideline, a minimum of 10% of agricultural land shares space with nature, such as hedgerows, trees and flower strips[28-30]. Three steps are needed to implement agroecology: 1) Remove regulatory barriers, 2) Provide investment subsidies to overcome lock-ins and transitions costs from current production system 3) Promote performance-based rewards for ecosystem services and landscape management, for example with the aid of Key Performance Indicators.

1.4 Boost technological innovations for agroecological farming

Tools (robotics, imaging technology, small machinery) should be designed specifically for agroecological settings where biodiversity is an asset, ecological cycles are fostered, and complexity is embraced[31].

1.5 Stimulate co-innovation with agroecological farmer groups

Invest in building learning networks that provide a deeper understanding and positive rationale for agroecological culture[32] and provide education programs and courses for farmers on eco-skills[33]. Set up demonstration farms of the future to provide inspiration for learning and good practices and independent extension services to spread the newest scientific agroecological insights[34].

Entry point #2 **Biodiverse landscapes and seascapes**

People are living in harmony with nature. Biodiverse landscapes and seascapes provide nature's safety net for climate regulation. Our future landscapes are diverse, multifunctional and healthy. Sharing space with nature - on farms, in cities, and with energy and transport systems - leverages our potential to mitigate and adapt to a changing climate. In addition sparing space for nature (through concerted protection and restoration efforts) enhances nature's vital role in regulating climate. Our resilient landscapes invite people to recreate outdoors and connect to each other and to nature.

2.1 **Strengthen protection of natural habitats in Europe & telecoupled regions**

Both in protected areas as well as by creating a functional network of remaining (semi-natural) habitats. Meta-population theory has indicated that a threshold of 20% of seminatural habitat in (agricultural) landscapes will (re)-create a mosaic of natural habitats, where populations of different species become reconnected[29]. This requires halting further expansion of intensive agriculture and other damaging land uses into (semi-)natural habitats, and setting clear nature protection targets. Protection targets should also include deforestation and forest degradation caused in telecoupled regions, which are linked to the production and consumption of commodities imported into Europe (e.g. soy, beef, palm oil, wood, cocoa and coffee).

2.2 **Restore nature**

Restoring nature is essential in order to stabilise climate and hydrological cycles and to reinvigorate nature as a safety net for climate change. Farmers, with their local knowledge of soil and water processes, play a key role in this landscape level

planning and management. Creating room for rivers is a particularly important nature-positive approach. River corridors provide natural networks in the landscape to connect species populations[35]. These water adaptations will create space for nature in the landscape and the potential for revegetating and reforesting eroded slopes.

2.3 Implement nature-based solutions in multifunctional landscapes

Nature-based solutions work with and enhance nature as a means for addressing societal challenges, such as biodiversity loss, climate change, poverty and hunger[16]. Large-scale implementation of nature-based solutions has the potential to contribute towards one third of the target to reach the Paris Agreement Goals, thereby also benefiting global food security. In addition to the development of nature-positive farming approaches (entry point #1), nature-based solutions can

stimulate the development of nature-positive urban and rural landscapes[36,37]. This includes, for example, setting building regulations that are carbon neutral, climate resilient and nature positive; development of inspiring demonstration projects such as large-scale carbon neutral buildings incorporating city food production; expanding greening subsidies; stimulating erosion control and water conservation with (agro-)forestry, and fostering city-wide and between-city initiatives. Nature-based solutions should always be implemented with consent of local communities, and benefit disadvantaged communities as much as economically prosperous ones.

2.4 Integrate landscape governance across sectors

Transformations at the landscape level require inclusive engagement across multi-stakeholder groups with diverse views, from local neighbourhoods to national and transnational level. Involvement of those who live in the landscape is critical for negotiating the pros and cons of implementations. Integrated landscape planning is not only about optimising various functions in the landscape, but also about acknowledging and addressing different values, conflicts and burdens of decisions, many of which will be equally legitimate but irreconcilable[38-40].

2.5 Develop coherent regulations of public goods related to ownership of land

A coherent governance framework to regulate public goods related to ownership of land is currently limited, leading to unclear responsibilities, land exploitation and land degradation. Regulations addressing transition risks, responsibility, monitoring and finding fair and equitable solutions will provide coherence across sectors on restrictions and obligations to protect land and its resources and how to use them. Ensuring equitable access of land ownership to women, youth and emerging farmers is a particularly important aspect for stimulating nature-positive food systems.

Entry point #3 **Connected communities**

Food connects communities to each other and nature. People know and value what it takes to produce food, and care about how this may impact biodiversity, climate change and social rights. Governments foster a healthy food environment, which enables 'consumers' to practice active food citizenship*. This is supported through local food initiatives, which connect producers and consumers and mobilises collective action towards nature-positive food systems. Agroecological practices are tailored to local landscape constraints and community needs. This provides a strong ecological foundation for producing nutritious food that fosters equity, access, resilience, relational value, nature connectedness and stewardship, and sustainability. Governments boost coordinated networks of initiatives, which facilitates learning among diverse communities about global implications and interdependencies, fostering an outward view that builds global solidarity. These networks build critical momentum towards viable alternative business models that challenge the concentration of power in current agri-food systems and level the playing field.

3.1 **Empower diverse stakeholders to participate in decisions**

This requires meaningful participation in decisions regarding food, cities, landscape and nature (both cross-scale and cross-sector decisions). Tackling the biodiversity and climate crises is often constrained by those who benefit from business-as-usual strategies. Diversifying and legitimising voices and values in decision making processes

* Food citizenship re-positions 'consumers' from passive receivers of food delivered by agri-business, to responsible and collective groups of citizens and producers, who actively participate in the configuration of food systems. Food citizenship is often associated with local, short supply chains with more personalised relations and participatory forms of governance.

can push decisions in a way that breaks these lock-ins[17]. Current government roles, decision making processes and policy should be screened for lack of inclusion, to promote community formation and locally-led governance structures that are part of a broader governance network. This will help to connect different communities to where and how their food and landscape are produced[41,42]. The negotiation of choices and finding equitable ways to help transitions to nature-positive food systems will be an important part of this process.

3.2 Boost networks of local nature-positive food initiatives

This enables people to become more engaged in how and where their food is produced and the associated environmental impacts it may entail[43]. This informal learning can be done by facilitating inspiring and engaging initiatives, such as local

markets, food forests, community gardens, biodiversity festivals, collaborative walks, gardening courses, and wild food cooking events.

3.3 Invest in education on biodiversity, climate, food and planetary diet

Education can inspire changes in behaviour and accelerate changes in norms and values. It can also improve the quality and depth of engagement in participatory decision making regarding food and nature. Every scholar and student should learn about the importance of nature for the functioning of the planet and human health, and about systems interactions. They should learn about the benefits of diverse planetary diets, which limit environmental impacts, but draw on diverse nutritious foods in different cultures[4,44]. Nature and planetary diets should be integrated into formal curricula at schools and universities. Training for professionals in the food system should be developed to educate people on the interdependencies between food, biodiversity and climate in different systems and how to act to minimise environmental impacts. Informal nature education should be supported to provide nature experiences for children and adults (link to #3.2).

3.4 Support public debate and dialogue on sustainability

The ecological crises and how to act as an individual are complex, multifaceted and heavily opinionated. Facilitated dialogues can help to surface value conflicts among people and develop norms more conducive to a nature-positive world. Equal access to information is a baseline, and will facilitate dialogues where values and norms regarding sustainability are being developed collectively. Such learning spaces are not only about facts and figures, but also about connecting people through exploring their emotions and values, and helping them to make sense of the range of conflicting collective viewpoints[45].

Entry point #4 **Sustainable food and diet**

Food is regarded as deeply cultural and social, and sustainability of the pathway that brings food to the plate is a core value. People care about the environmental impacts of their food and their own health, and make nature-positive decisions with regard to their diet. National Dietary Guidelines, customised to local context, provide clear guidance for people and businesses on sustainable and healthy diets. People eat significantly less meat and animal-based products, and value the diversity of plant-based products that are readily available and affordable. Governments provide a healthy food environment* that eases making nature-positive food choices through expanding access to affordable, sustainably-sourced food, connecting producers and consumers via local food initiatives and transparent labelling of the environmental impact and traceability of all food products.

4.1 **Develop National Dietary Guidelines that integrate the health of people and the planet**

These should be adapted to the biophysical limits of ecosystems, food availability and cultural needs in different regions. The National Dietary Guidelines provide key public health policy that forms a bridge between global guidelines and customised country advice on healthy diet and lifestyles. They can raise awareness, influence

* A food environment refers to the physical, economic, political and socio-cultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food. It mediates how people acquire and use food in their daily life[46]

policy, guide the private sector and inform consumer choice[44]. Development of these guidelines should be a shared responsibility between governmental authorities in health, cities and the environment. Adoption of these guidelines should be resourced by government and supported by public campaigns, in education (#3.3) and initiatives that spread awareness of their existence.

4.2 Make healthy and sustainable food convenient for all

Healthy and sustainable food must become the easy choice in daily practice. This requires design of foodscapes in public areas consisting of 1) governmental restrictions regarding unhealthy practices in priority areas (e.g. schools, transport hubs) and in commercials, 2) making the affordable, sustainable and healthy option cheaper, easier and more attractive, in co-creation with retailers, restaurants and caterers[46].

4.3 Install regulations to stimulate a shift towards a planetary diet
Meat and dairy would thus be consumed in significantly smaller proportions than whole grains, fruits, vegetables, nuts and legumes. Such regulations entail implementation of higher taxes on meat, fish and dairy in concert with implementation of lower taxes on vegetables, sustainable and seasonal products.

4.4 Implement transparent labelling on the environmental impact of food
Implement regulations that require food process and retail companies to track, trace and declare the environmental impact of their food along the entire value chain.

4.5 Reduce food loss and waste across the entire food chain
Set targets and actions for all stakeholders in the food and catering industry to reduce food waste along the chain[47]. This includes the widening of specifications for sourcing of raw materials. This can be supported through innovative technologies such as circular technologies, food sharing apps and markets, and engagement in local food chains.

Entry point # 5 **Inclusive finance and trade**

All stakeholders in the food chain take responsibility for engaging in nature-positive practices. Environmental impacts are reflected in prices of products, and negative impacts are not shifted to other parts of the world or next generations. Safeguarding biodiversity is explicit in global trade agreements and regulations. Positions of diverse views of producers and consumers are respected and included in decision making, giving power to alternative practices, diversifying the food system, and unlocking present-day concentrations of power.

5.1 **Stop harmful economic investments and economic activities**

Current ongoing investments in fossil fuels, harmful area-based agricultural subsidies and unsustainable extractive practices (e.g. overfishing[48]) which all pose serious obstacles to a nature-positive and climate-proofed food system should be banned as soon as possible.

5.2 **Promote the development and adoption of nature-positive food systems**

The positive impacts of nature-positive business models and entrepreneurship should be reflected in the financial returns of those activities. Policy instruments can align incentives towards nature-positive outcomes. For example, environmental

subsidies, payments for ecosystem services or (potentially) tradable permits can be used to stimulate good practices (1.2, 1.3, 2.2), while taxation of activities harmful to nature, fees and charges can phase out harmful practices (1.1, 4.5, 5.1). Business models that promote equity (e.g. inclusion of gender and youth in agriculture) should also be encouraged.

5.3 Accelerate accounting and disclosure of environmental-financial risks in food systems

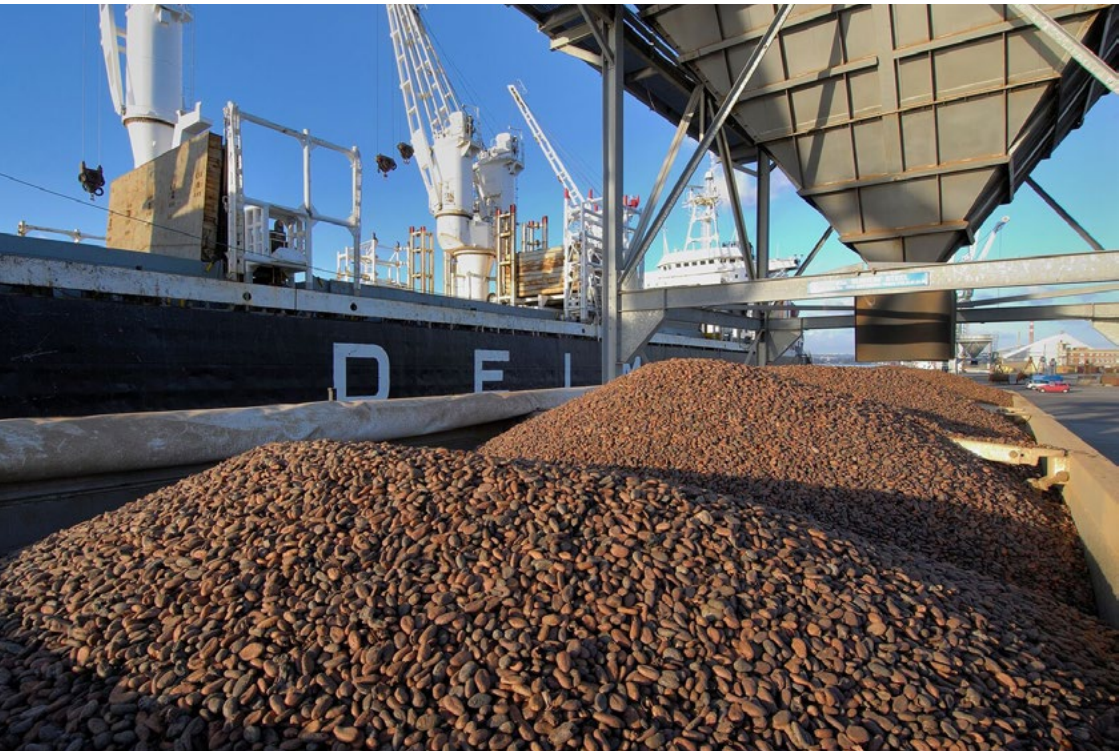
Provide clear benchmarks for evaluating the negative and positive contributions of businesses and investors to climate change and biodiversity. Such disclosure and transparency should also seek to address tax avoidance and evasion, especially by transnational corporations in order to enforce accountability of businesses.

5.4 Design international trade and tax policies that internalise environmental costs

These policies should also not shift impacts to other regions of the world[49,50]. Governmental regulations accelerate implementation of true pricing. This is only possible if transparency and accountability of businesses and investors is increased and the activities of transnational corporations are made more traceable, especially those that are linked to commodity-driven deforestation (e.g. soy, beef, palm oil, coffee, cocoa) or ocean over-exploitation.

5.5 Nature-positive public procurement and investment

By using their purchasing power, governments can lead by example. Clear and verifiable criteria for supporting nature-positive and climate-neutral products and services in the public procurement process[51] should be developed and implemented without delay. Public investments help achieve targets in Paris Agreement, CBD and SDG agendas, and biodiversity outcomes.



How do the interventions relate to the EU Farm to Fork Strategy and Biodiversity Strategy for 2030?

We linked the interventions identified in this chapter with the interventions in the EU Farm to Fork Strategy and the Biodiversity Strategy to 2030 (Table 1). The table shows that *most of the proposed interventions are already clearly articulated in the EU strategies*: of the 24 interventions, 18 (75%) are strongly covered – many in both strategies. There are four interventions that are somewhat covered, with elements present but not comprehensively articulated (16%). Only two, yet important, interventions have no provisions made by either the EU Farm to Fork Strategy or the Biodiversity Strategy for 2030, and constitute gaps in current EU policy that require attention.

The two gaps are: empowering diverse local stakeholders to participate in cross-scale and cross-sector decisions (3.1) and supporting public debate and dialogue on values and norms conducive to sustainability (3.4). These interventions are both part of the entry point for 'Connected communities' which is proposed as a 'deeper' intervention for shifting norms and values for achieving transformations. While knowledge institutes, NGOs and businesses can help to fill this gap for now, the Commission's role in formalising these interventions in future strategies should be strongly considered. Formalising closer engagement with local citizen groups and grassroots communities is important in order to rebalance concentration of power in the agri-food business. Processes of knowledge weaving[52] and deliberative democracy[53] exist to bring in voices of formal and informal community and neighbourhood leaders, spiritual leaders, leaders of activist groups and social movements, numerous grassroots initiatives and peasant farmers. These leaders need to be networked into the public decision-making processes, as well as into social coalitions.

Farm to Fork	
Sustainable Food Production	SP
Food Security	FS
Sustainable Food Processing, Wholesale, Retail, Hospitality and Food Services Practices	SC
Sustainable Food Consumption and Facilitating the shift to Healthy ustainable Diets	SD
Food Loss and Waste	FLW
Food Fraud in the supply chain	FF
EU & Global Transition	T

Biodiversity	
Protect Nature	P
Restore Nature	R
Enable Transformative Change	T
EU Action to Support Biodiversity Globally	G

Strongly articulated

Elements present

Entry point #1: Diverse fields and farms	Farm to Fork strategy	Biodiversity strategy
1.1 Reduce fertiliser and pesticide use	SP	R
1.2 Invest in "minor" crops	(SP)	
1.3 Implement agroecological principles	SP	R
1.4 Boost technological inn ovations for agroecological farming	(T)	
1.5 Stimulate co-innovation with agro-ecological farmer groups	(T)	(T)
Entry point #2: Biodiverse landscapes and seascapes		
2.1 Strengthen protection of natural habitats in Europe and telecoupled regions	T, GT	P
2.2 Restore nature	SP	P, R
2.3 Implement nature-based solutions in multifunctional landscapes	SP, T	R, T
2.4 Integrate landscape planning across sectors at municipal level		(P, R, T)
2.5 Develop regulations of public goods related to ownership of land	(SP)	(T)
Entry point #3: Connected communities		
3.1 Empower diverse local stakeholders to participate in decisions		
3.2 Boost networks of local nature-positive food initiatives	SP, SC, SD	T
3.3 Invest in education on biodiversity, climate, food and planetary diet	SD	T
3.4 Support public debate and dialogue on sustainability		

Entry point #4: Sustainable food and diet	Farm to Fork strategy	Biodiversity strategy
4.1 Develop National Dietary Guidelines that integrate the health of people and the planet	SD	
4.2 Make healthy and sustainable food convenient for all	FS, SC, SD	
4.3 Install regulations to stimulate a shift towards a planetary diet	SD	
4.4 Implement transparent labelling on the environmental impact of food products	SD, FF, G	G
4.5 Reduce food loss and waste across the entire food chain	FLW	
Entry point #5: Inclusive finance and trade		
5.1 Stop harmful economic investments and economic activities	SP, SC	T
5.2 Promote the development and adoption of nature-positive food systems	SP	R, T
5.3 Accelerate accounting and disclosure of environmental-financial risks in food systems	T	T
5.4 Design international trade and tax policies that internalise environmental costs	T	T, G
5.5 Nature positive public procurement and investment	SD	T

3 Interactions among interventions to accelerate change

None of the interventions identified in Chapter 2 alone will lead to the urgently required transformation to a nature-positive food system. We will *need a mix of interventions from different entry points that work together at different spatial and temporal scales to collectively transition towards nature-positive food systems*. Such combinations of interventions will consist of the so-called shallower and deeper interventions[23]. Examples of shallower interventions include development of agroecological robotics (1.2) and reducing food waste (4.5). However, shallower interventions are constrained by existing system design (e.g. institutions, economies, politics), and the dominant societal norms and values that perpetuate these structures. Combinations of these shallower interventions with deeper ones that target large-scale structural issues at the root of the crises therefore offer more powerful triggers for change. Examples of deeper interventions include stimulation of co-innovation in agroecological farmer networks (1.5), formal and informal education on nature, climate and planetary diets (3.3), and redesigning trade and tax policies (5.4).

In exploring the linkages between interventions for this Mansholt lecture, we found that that legally-binding governmental regulations were considered the most frequently highlighted triggers of system change. Over-reliance on voluntary incentives or subsidies have been too slow and ineffective on their own[54]. Subsidies reproduce the current norm by stimulating the exception; regulations change the norm. Preferably, regulations reflect what is (increasingly) considered normal in society, because enforcing regulations relies on society's support. Enabling communities that are aligned to nature-positive food and public good to influence decisions regarding food systems is vital for gaining support for the regulations and removing power concentrations[17]. It can also open discussion between people with diverse worldviews, to stimulate learning about different nature-positive futures, the consequences they may have on different groups, and how to resolve some of these consequences together. Such social learning is a 'deeper' intervention and heightens relational value among people, nature and food. This can ultimately help to induce a shift towards more sustainable societal values and norms[55]. Simultaneous implementation of combinations of interventions from the five entry points can set up mutually reinforcing positive feedback loops, triggering chain reactions that accelerate pathways to nature-positive food systems (Figure 1). We illustrate these chain reactions below in three exemplary pathways that show how combinations of interventions can synergise, build momentum and tip the system.

Nature-positive pathways for agriculture and food

Clear regulations that reduce fertiliser and pesticide use (1.1) will trigger the need for change in fields and on farms. Creating a level playing field within the EU, such a trigger will spark new innovations (1.4) for helping farmers to work with nature rather than against it. Stimulating agroecological innovation in farmer groups (1.5) is shown to accelerate peer-to-peer learning and enhance the spread of agroecological practices (1.3)[33,56]. However, this combination of interventions within the entry point of 'diverse fields and farms' is unlikely to lever the change towards nature-positive food systems on its own. Creating a nature-positive future requires simultaneous interventions from different entry points. For 'diverse fields and farms' to be successful there must be a demand for diverse and sustainably-produced food. National and local governments can provide a push by implementing interventions related to diverse and sustainable diets: by boosting local sustainable food initiatives (3.2), by enhancing education on planetary and human health (3.3), by delivering planetary diet campaigns and regulations (4.1 and 4.3), and by demanding local and sustainably-sourced food in public procurement (5.5). The financial sector, supported by government regulations, has a critical role to play in

stimulating nature-positive food systems through systemic risk assessment of the environmental impact in food chain investments and requiring open disclosures of harms (5.3). They can also work in public-private-civil society coalitions to incentivize good practices through performance (5.2). Regulations to reduce harmful subsidies (5.1) will add impetus to this motivation. The food industry will need to respond to these signals and develop new business models (5.1). They will need to find ways to process and market 'minor' crops and to cater for diversified raw materials grown in diversified systems (1.2), to widen the base of the diet, but also to broaden the opportunities for farmers in their crop rotations. Engaging local communities in sustainable food practices will help to shift collective societal values towards nature-positive food (3.2). Coordinated networks of local initiatives, empowered within local to global decision-making processes (3.1), has the potential to accelerate this process. This braid of interventions together will further stimulate agroecological practices in the European food system, which is a major contribution of agriculture and the food system to a nature-positive future.

Nature-positive pathways towards an economy of wellbeing

A healthy planet, where people live in harmony with nature and its benefits, requires a paradigm shift of our economies, which acknowledges and embeds environmental benefits and costs into products, commodities and activities. Creating incentives to internalise environmental costs by the financial and agri-food sectors is critical, but long term, and should therefore be triggered sooner rather than later (5.4). An important incentive is to accelerate accounting and disclosure of environmental-financial risks in food systems (5.3). Setting clear benchmarks is only the first step towards acknowledging the true costs and value of food[57] (5.4). It is essential to avoid shifting impacts to other regions of the world, especially with products associated with tropical deforestation and habitat degradation (2.1).

Interventions related to accounting of environmental-financial risks (5.3) and true pricing (5.4) will be key interventions for changes in the entry point 'biodiverse landscapes and seascapes'. A reform of the tax system could imply lowering of taxes on goods and practices that are nature-positive. In addition, taxes paid for environmentally harmful practices should be re-invested into nature-positive strategies, including nature protection (2.1) and ecosystem restoration (2.2). Awareness and resulting acts of responsibility by the financial sector for the planetary boundaries, whether or not enforced by governmental regulations (5.1, 2.1), will lead to biodiverse landscapes and seascapes (2-1-2.5). Additional effects of true pricing (5.4) will be reduced food loss and waste (4.5) and sustainable diets

(4.3 and 4.4). 'Diverse fields and farms' also provide an essential building block for powering the 'biodiverse landscapes and seascapes' entry point as it will provide a basic infrastructure to rebuild and restore nature in the landscape.

Nature-positive pathways for food, culture and learning

Local governments can create positive opportunities for nature-positive food by giving attention to the way food is zoned in the cities and by fostering partnerships with retailers, restaurants and caterers to create food environments where healthy, sustainable and diverse food is the easy and affordable choice (4.2). This can be achieved by public procurement programmes (5.4) and through support to small and medium-sized enterprises and initiatives such as local markets, food and culture festivals that focus on nature-positive (3.2). Local initiatives reconnect urbanites to farmers and to the ways their food is produced, further stimulating agroecological entrepreneurship (1.2) and viable agroecological business models (5.2). The challenge of being too local is avoided by actively coordinating networks of local food initiatives at diverse levels of organisation, from local to global (3.2).

By being embedded in a network, people have a voice within food governance decisions (3.1). For example, it allows local farmers to become actively involved in discussing transition risks that they bear with actors in other parts of the value chain, and to be part of the negotiation for tailored approaches to deal with these burdens. These networks and empowered communities generate informal co-learning process (3.4), agroecological entrepreneurship (1.3), and boost the emergence of new partnerships and diverse international brands that are supported by transparent labelling (4.4). Local governments are also key in transforming education, and complement the formal nature-positive curricula through making it possible for people to experience the values of nature, food and connectedness in their own neighbourhoods (3.3).

Nature-positive education in tertiary curricula will, for example, power eco-skilled farmers and food industry to activate further agroecological practices (1.2), supported by technological innovations (1.4). Informal and formal learning together also instils a deep respect for traditional cultures, nature and the way food is produced, which stimulates a demand for a planetary diet. This demand is supported by clear national dietary guidelines (4.1) and a healthy food environment (4.2). Respectful sharing among diverse knowledge systems (3.4) and governance systems (3.1) recognises the rights of local producers and indigenous peoples with respect to territories, resources and knowledge.

4 Leading towards nature-positive futures

We can only solve the biodiversity, climate and food crises in time if we do it together. Immense concerted actions from all stakeholders in the food system are needed to contribute to creating a nature-positive world. It will require connecting the roles of being a professional, a farmer, a consumer, a neighbour, and also as a (grand)parent, as future generations are at risk. The need for such widespread actions can leave people feeling overwhelmed and unclear about where to start and what to do. Oddly, it can lead to no action at all. How can we avoid this and ensure that there is clear leadership for coordinating these combined interventions, to leverage their synergies effectively?

Social-environmental changes are greatly facilitated by coalitions of leaders united by common interests, ideas or values

Single organisations or leaders seldom have the necessary resources on their own. Coalitions have larger networks, share knowledge, resources, data and expertise. They are also able to activate individuals who can or do play leadership roles in their communities. Evidence suggests that social tipping points can be triggered when most social and public opinion leaders recognise the moral implications of the biodiversity and climate crises, and exert pressure within their peer groups to use nature-positive products and limit ones that are not[21]. Where uneven burdens of transition exist, coalitions may also be better equipped to provide collective resources to help share the transition risk. In essence, coalitions can enable the sharing of networks, resources, expertise, and information, while simultaneously projecting an image of power through unity and numbers. What then are the most important coalitions of actors needed to address the interventions we have outlined before? In short: this will require the usual social-environmental suspects in government, business and civil society to work together and to bring in the more diverse voices, such as those embedded in grassroots organisations.

Below, we provide four concrete priority actions where each of these stakeholders should lead the collective transitions towards nature-positive food systems. Such leadership will require them to play the primary role by forming coalitions with other important stakeholders and carrying out joint activities towards nature-positive futures.

European Commission and Member States

The Commission and its Member States play an important role in providing an enabling regulatory environment towards a nature-positive future. The European Commission has shown leadership with the 'Green Deal' and can build on this with ongoing communication about climate and biodiversity priorities and actions. Priority actions include:

1 **Implementing existing Commission strategies, which already set clear targets for an environmentally safe and socially just operating space** (Table 1). A regulatory fast-track towards nature-positive food systems can begin through prioritising existing Commission proposals that target: reduced use of pesticides and artificial fertilisers and enhanced agroecological practices (Farm to Fork Strategy); strengthened restoration (Biodiversity Strategy and Nature Restoration Law); the enhanced use of organic and waste-based fertilisers, as a step towards circular economy[58]; avoidance of deforestation in other regions of the world (Biodiversity Strategy and the proposed Deforestation Regulation); turning harmful agricultural subsidies into payments for ecosystem services (Common Agriculture Policy); and enforcement of environmental accounting, true cost accounting and open disclosure (EU Taxonomy for sustainable activities).
2 **Leading by example by implementing nature-positive procurement at all public levels**, as this will cascade into market opportunities for nature-positive agriculture. Strengthening Green Public Procurement, currently a voluntary mechanism for the EU's public authorities, has great potential in this regard.
3 **Playing a lead coordinating role in setting up networks of nature-positive initiatives and communities.** This priority is a major gap in the current Farm to Fork and Biodiversity Strategy for 2030. Such societal organisation and mobilisation is critical to effective policy implementation. This will require that the Commission and its Member States engage with processes that formalise the process of reaching out to local governments and nature-positive initiatives. These networks should seek to diversify both 'horizontally' (e.g. across public departments, economic sectors, communities of professionals, different places) and 'vertically' (local to national, regional and global).
4 **Increasing investments in education regarding planetary and human health and their interactions.** This is a deeper intervention that shapes norms and values underpinning nature-positive behaviours and practices, and is considered essential for triggering transformative change.

Sub-national authorities (e.g. local and regional authorities)

Despite global and national regulations, a lot of the transitions regarding nature-positive futures require implementation at the level of local authorities. Local and regional governments fulfil a central bridging role between local and global contexts. With the encouragement and support of the European Commission, for example via regional funding instruments, Member States need to incentivise (via legal and financial instruments) regional and local authorities to carry out the following roles effectively:

1. **Organising processes of landscape governance.** This requires local authorities to run equitable participatory processes that consider the needs and contestations of place-based communities while creating a biodiverse and climate-resilient landscape, and to form a bridge with provincial and national governments for broader context. Part of this is the balancing of private property with public goods.
2. **Creating a nature-positive food environment through spatial planning and working with food chain actors and schools.** Especially in cities, this is viewed as a deep intervention to build appreciation of the value of food and nature, which is fundamentally intertwined with culture, diversity and health.
3. **Stimulating co-learning between citizens, professionals and government officials.** One way to do this is through boosting and linking local nature-positive food initiatives horizontally and vertically to share knowledge in both decision making processes and in organised public events (e.g. dialogues). This is a challenge that can be taken up at lower levels of government where they can be tailored to local needs and aspirations.
4. **Strengthening implementation of nature-positive public procurement.** As in EU and Member State spheres, local governments should lead by example as should public places in cities, hospitals, schools and public canteens.

Key actors in finance and trade

(e.g. private actors such as commercial banks, pension funds, investment firms and insurance companies and public actors like regulators and central banks).

Actors in finance and trade have a key influence in triggering change by rebalancing demand for private goods so that they fall within the limits of nature's capacity. Adopting policies and regulations to avert this has the potential to change the choice of architecture underpinning day-to-day decisions, which can cascade through society to shift norms and values.

1 **Mobilising coalitions that can provide courageous collective and systemic leadership for change, beyond individual organisations and single solutions.** Financial giants and multi-national corporations have the ability to influence and align values, and empower food chain actors – across different places and cultures. This requires a shared vision based on systems thinking, understanding the barriers to transformations, as well as the enablers to manage transition risks and shift mindsets. Visions, strategies and actions should level the playing field by working with policymakers, regulators and broader industry groups to remove activities that harm nature, and advocate policies that result in nature-positive investments.
2 **Accelerating environmental impact accounting as a core part of capital allocation decisions.** This includes open disclosure of Environment, Sustainability and Governance (ESG) data and criteria, as well as estimations of climate-and biodiversity-related financial risk exposures. There are numerous existing communities of practice and Task Forces at EU level that could be strengthened in this regard.
3 **Strengthening biodiversity considerations when investing in nature-based solutions.** This especially includes nature-based solutions in sustainable energy, waste and regenerative agriculture. All too often, these 'green' or 'blue' initiatives do not explicitly consider the effects on nature and biodiversity. It is important that these solutions, and thus the related investment procedures, develop safeguards to assess whether investments are not only climate-neutral, but also nature positive.
4 **Land investments and leases to support nature-positive land use.** Land investments can be an important trigger for nature-positive land use. Investors can give agroecological farmers priority when leasing out land, make 10% landscape features a prerequisite, and lease out their land to biodiversity-friendly farmers for a fair price.

Food industry key actors

(both suppliers and processors; e.g. multinational corporations, multinational cooperatives, small and medium-sized enterprises).

Despite the increasing attention being given to sustainability of the food industry – from policy makers, investors, consumers alike – this sector is lagging behind in nature-positive actions. There are many business opportunities to justify change towards nature-positive, and every day waiting to take action will lead to higher financial risks for the food industry. The following actions should be collaboratively led:

1. **Stimulating a demand for sustainable, healthy and diverse food**
   Major investments in the transition towards a planetary diet are essential and concurrently offer ample opportunities for innovation in food products. It is important to simultaneously broaden the diversity base of agricultural crops by investing in (local) supply of minor crops, in particular pulses.
2. **Implementing reliable and transparent labelling on food products** is essential for creating awareness about environmental footprints of food products and building trust amongst consumers. Such footprint labelling is also essential for monitoring and reporting (hopefully downward footprint trends) for key actors in the food industry. Sustainable sourcing should increase over time across the full chain, and drive the demand for nature-positive production.
3. **Reducing food loss and waste across the entire food chain** is another key action that should be led collectively by the food industry. An important step therein is rethinking food processing to create flexibility that allows the sourcing of diverse raw materials.
4. **Investing in technological agroecological innovations.** Current mainstream technology (machinery, breeding, crop protection) predominantly caters for expansive monocultures. The chemical industry can jointly decide to take destructive pesticides off the market and develop products and services that support agroecological innovation. There are already many innovations underway that could help upscale and advance agroecological principles: drones and robotics, but also for example new strategies for growing crop combinations. These technological developments represent an opportunity for the food industry to be in the frontline of managing diversity in the food system.

Farmers & consumers

Frequently a large part of the transition risks in transformative change are placed on individuals – farmers and consumers. Yet it is essential that enabling conditions for individuals are created by the stakeholders we mention above. Nature-positive food environments, local food initiatives, and formal and informal learning expose people to new cultures and knowledge. Giving people decision-making power, options and incentives to ease the transition to nature-positive choices will open new possibilities for nature-positive transformations. With these enabling environments in mind, farmers and consumers can become active participants in collective citizenship towards nature-positive futures. We specifically see the following actions as important:

1. **Be inspired and become involved** in the many 'seeds of transformation' that already pioneer nature-positive futures. Several of these 'seeds' are related to farmers that have already experimented with and adopted agroecological principles in their farm management, accelerated via co-learning in peer groups. Often the public has become engaged in these initiatives, via the recognition of the local origin of the food and their desire for the development of a nature-positive landscape.
2. **Taking the time to reconnect to how your food is produced, its impact on nature and to learn about different cultural viewpoints.** There is a wide range of ways to do this, such as information materials, videos, webinars, workshops, cooking events, film screenings, art projects and several local food initiatives. The media have a central role here as do, increasingly, (local) 'influencers' via social media, blogs and vlogs.
3. **Choosing nature-positive food options and switching to a planetary diet.** Consumers can use their purchasing power to influence corporate and government decisions, and activate and accelerate demand for nature-positive food products. This requires that consumers understand and acknowledge the true price and value of food.
4. **Participating with an open, entrepreneurial mindset.** There are many pathways to nature-positive food systems, not a one-size-fits-all model. Good farming skills will be more essential than ever, as well as appreciation for these skills from consumers, the risks taken and the ecosystem services supplied. This will require experimentation and open and respectful dialogues to explore the interactions and consequences of different approaches, and that ways forward are negotiated while acknowledging the burdens of past, present and future.

Research & Education key actors

(e.g. universities and other knowledge institutes).

1 **Developing research agendas to lead nature-positive innovations in farm, field, landscape, food chain and their associated technological advancements.** Research programmes should be geared towards solving the most urgent crises on the planet. There is still a knowledge gap in understanding agroecological processes and the interactions between farming, biodiversity and climate change. In addition, there is a huge need for evidence-based innovations that embed nature-positive approaches in the whole food chain, from technological innovations to manage complexity in the field and in food processing to co-developing new business models for farms and businesses that embrace multiple values of biodiversity. All technological innovations should abide by strong responsible and ethical research procedures.

2 **Investing in inter- and transdisciplinary research agendas, particularly those between the humanities and natural sciences.** Transformative change towards nature-positive futures needs all collaborative action. This starts with the acknowledgement and fostering of diverse conceptualisations of multiple values of nature by global and local stakeholders in the food system. By stimulating research delivering integrated solutions, cocreated with stakeholders, academic institutions can accelerate transformative change related to implementation of multiple values of nature in society.

3 **Supporting the implementation of nature-positive education programs into curricula.** Academia has a responsibility to make the new knowledge and insights that integrates biodiversity, climate, food, culture and systems thinking available for all. This requires additional efforts to help translate the knowledge for different levels of education (e.g. primary and secondary schools, tertiary levels, agricultural and other professional training).

4 **Stimulating dialogue and negotiating with diverse stakeholders and rightsholders.** This is a gap in the current EU Farm to Fork Strategy and Biodiversity Strategy for 2030, and one which a knowledge institute could contribute to, with mindful respect to weaving all forms of knowledge (e.g. scientific, experiential, tacit, indigenous and local knowledge). These dialogues should serve the purpose of opening up conversations to diverse points of view, seeking to bridge power differentials, increasing individual and group reflexivity, and making sense of different viewpoints and the values underpinning them.

Time is pressing for the implementation of these actions, as the window of opportunity for realising nature-positive futures is becoming narrower by the day. However, we can do this. We can do this when working together. Therefore, we metaphorically pass the 'baton of transformational change' to all these stakeholders in the hope that you will take the lead for implementing the actions that are urgently needed, with the clear message that we from WUR will support you in every step of this collaborative journey.

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Colophon

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The content of this Mansholt lecture came about through a wide science-policy consultation process. Existing 'seeds of innovation' in the biodiversity climate-food nexus were collected in a WUR-wide dialogue on 10th May 2022, which involved some 150 interdisciplinary experts. These seeds were collated into interventions for nature-positive futures, in an interdisciplinary workshop of WUR colleagues on 13th May 2022. They were further clustered into five entry points for nature-positive changes to the food system. The resulting entry points and interventions were discussed with several EU policy makers in another workshop in Brussels on 30th June 2022. We thank everyone involved in this process for their input.

Front cover
A picture from one of the 'seeds of innovation' towards a nature positive future that inspired the process of this lecture. The vegetable garden 'De Nieuwe Ronde' in Wageningen produces diverse, healthy and sustainable vegetables for ~700 families in the neighbourhood. This seed of innovation links to the entry points 'diversity on field and farm', 'biodiverse landscapes and seascapes', 'connecting communities' and 'sustainable food and diet'.

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