A diverse, healthy and just food future for Europe in 2100

A co-creative journey

WAGENINGEN
UNIVERSITY & RESEARCH

wur.eu

Contents

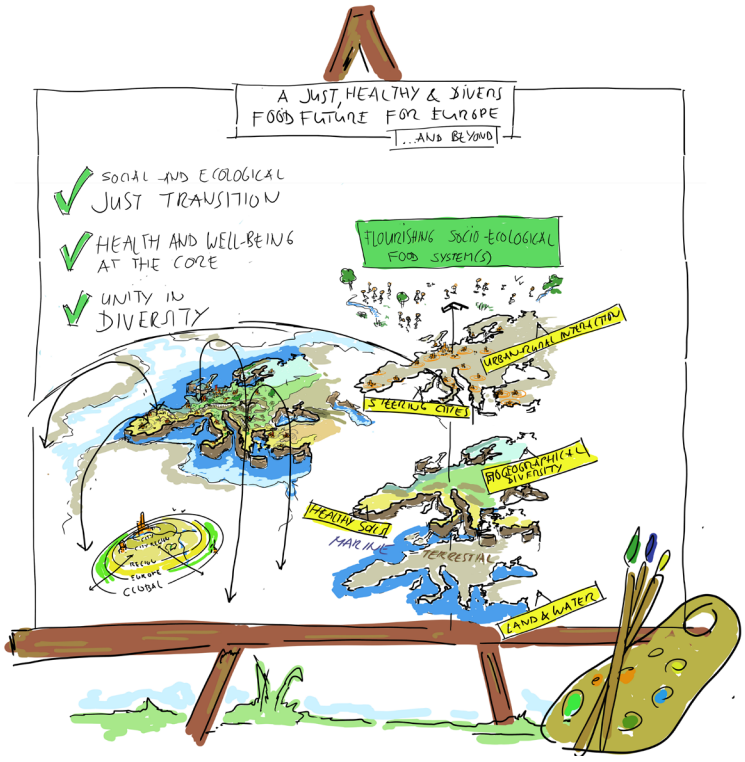


Figure 1: A co-creative journey towards a just, healthy & diverse food system for Europe and beyond (De Rooij, 2023)

A snapshot of Europe: food for thought

The intricate tapestry of Europe's food system reveals a market-driven landscape where dietary preferences diverge, and organizational patterns vary. These distinctions, while reflecting cultural diversity, also underscore the underlying complexities of the regions' culinary ecosystem. However, a profound challenge emerges beneath the surface that demands urgent attention for diet-related illnesses before consumers' control.

At the heart of Europe's food challenges lies a twofold connection: the intrinsic relationship between climate and biodiversity loss, and the direct impact on both the region and its inhabitants. The global phenomenon of climate change and the escalating loss of biodiversity have profound. The implications for Europe's food system. These challenges not only endanger the ecological equilibrium but also pose a direct threat to human well-being. The web of life that sustains our diets is under strain, as shifting climate patterns disrupt the delicate harmony of ecosystems. Delving deeper, we uncover the dilemmas that permeate the existing food systems, leading to adverse consequences that transcend individual choices. Structural obstacles embedded within these systems contribute to diet-related illness, often beyond the control of consumers, resulting in compromised health and overall quality of life (Eng et al., 2020). Addressing these calls for immediate and cohesive action, the formulation and implementation of policies that enable global access to nutritious choices while concurrently minimizing the environmental impact of food production (Lindgren et al., 2018).

Central to this transformation is acknowledging the hidden costs within the current trajectory of our food system. Shifting towards sustainable, nature-positive, and inclusive models hinges on recognizing and mitigating these concealed expenses (Gaupp et al., 2021). The inefficiencies plaguing the system's distribution, processing, and services further exacerbate the challenge. The pursuit of nutrition and sustainability goals is compromised by these systemic shortcomings. A crucial realization is that sustainable shifts necessitate not only altered consumer behaviour but also deliberate spatial planning and management strategies (Woodhill et al., 2022). In essence, reformation of food systems is an intricate endeavour, demanding a persistent confrontation of hidden challenges, the advocacy of equitable access to quality nourishment, and the orchestration of purposeful transformations (Marsden & Sonnino, 2012).

Europe stands at a crossroads, where its food challenges are not just problems but pathways to a healthier planet and its thriving people. The journey towards change is arduous, but the promise of a harmonious coexistence with nature and an enhanced quality of life advances us forward into a sustainable future.

1. The starting point

"We cannot solve our problems

with the same thinking we used when we created them"

Albert Einstein

Europe faces a whole set of fundamental challenges, that will set society for decisive choices in the upcoming decades. The effects of climate change and biodiversity loss are putting the resilience of Europe and the rest of our planet to test. Planetary boundaries are reached and often exceeded, while competition for land and water is putting pressure on the health of natural systems. This affects the health and wellbeing of all inhabitants in Europe and beyond.

The future is catching us up much faster than we think. Extremes are getting more extreme, not only in terms of weather and climate but also in terms of the urban-rural divide, land intensification versus land abandonment and -not to forget- social and ecological injustices. In the complexities of this European landscape, food systems are both key drivers of and affected by climate change and biodiversity loss (IPBES, 2019; Meinzen-Dick, 2021), in Europe and abroad. Food is also seldom at the table if we talk in terms of planning, policy and strategy. Current coping strategies cannot keep up and are mainly based on holding on to and suboptimizing current systems, while fundamental challenges require fundamental change. Change is urgently needed. The interconnectivity of these challenges and crises shouts for an integrated approach and transformative change. Transformative change driven by positive energy, transformative change towards the future we want.

In 2023, Wageningen University & Research challenged its academic community to develop a vision on how Europe's food system could look like in 2100. A holistic view that goes beyond the current status quo and paradigms, with a focus on Europe but also including the global perspective and relations. A vision that inspires and generates an impetus to engage further thinking and transformative actions, not only in the scientific community but in society at large.

If we imagine a just and diverse European food system based on social and ecological justice, planetary and human health, what would such a system look like? That was the initial question that an interdisciplinary group of researchers raised. How can we build such a vision upon the same principles and beliefs it is based upon?

These two questions became the starting point of a co-creative journey. We challenged the next generation, but also ourselves and our colleagues to really look into the future, with a fresh and holistic view. We did this with the solemn belief that striving for a just, healthy and secure food future for people, also means striving for a healthy and thriving planet. The connection can be found in embracing diversity: social diversity and biodiversity. If we are decisive, we can still do a good turn, but the window is narrowing fast.

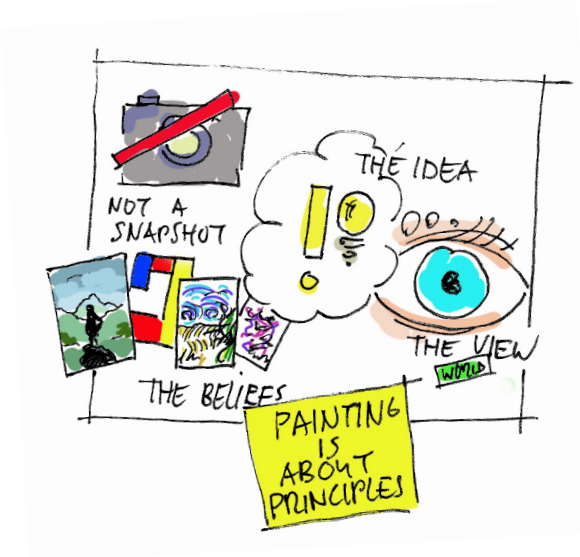
In 2023 the Mansholt lecture presented a nature-based future for Europe (Van Hattum, 2023). As a follow up we present a dive into Europe's food future that enriches and deepens that perspective. In this brochure we will navigate you through our journey and along the main elements of the vision that was developed. It is an invitation to build further with us on a better, diverse, healthy and just future for Europe in 2100. It is a call to action. The future already started, let's make it ours.

2. Our methodology

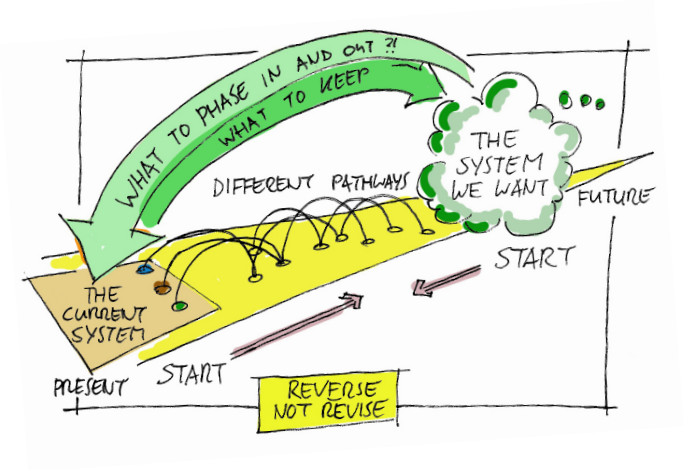
Rethinking our food system and making true transformation happen is a socio-political and socio-ecological challenge, that requires a non-linear, long-term process (Leeuwis, 2021). A process that starts with developing a desirable, open-ended and holistic vision of a collective future and continues with outlining the pathways and actions towards that future. It requires new approaches and collaborations. Transitions are dynamic and ongoing, and visioning the future is a relevant guidance and steering mechanism in the chaos that surrounds transitions. We shifted the focus towards a process oriented and relational perspective. It puts the emphasis on the dynamics: things always are in process and change, while the relational aspect underlines the essence of linkages. Process-relational approaches are seen helpful towards more integrative and trans- and interdisciplinary research (Arthur, 2015; Garcia, 2020) and are an added value in design-thinking.

Our approach is built upon three elements:

- envisioning -painting a collective future
- back casting -mapping out an actionable future
- co-creation

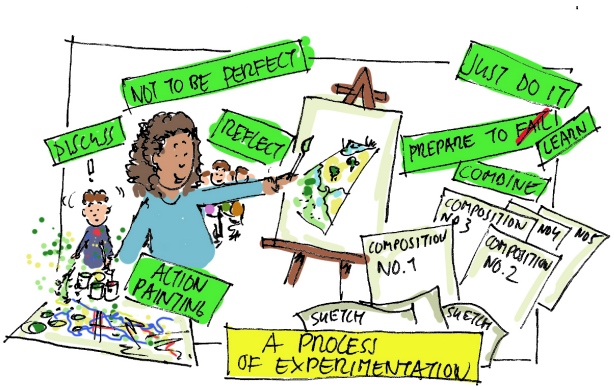


What should our food system be about?



Envisioning

Backcasting



Co-creating

Figure 2: Illustrations of three methodologies: envisioning, backcasting and co-creating. (De Rooij, 2023)

Envisioning: painting a collective future

If you can imagine it, you can make it happen. We made the analogy with the art of painting. Painting is a process that is based on the idea that comes with beliefs and principles. A process that requires experimentation. Experimentation that comes with choices. Choices in style, elements, types and composition. It is not just about the result, but about the outcomes of that results and what brings that about. Tolstoy Like Tolstoy states: "Art…is a means of union among people, joining them together in the same feelings, and indispensable for the life and progress toward well-being of individuals and of humanity."

Visions of desired futures are needed and essential to guide sustainable transformation in various societal sectors (Tapiola, 2023). The multifaceted nature of Europe's food system and its intertwinedness with other domains and sectors, but most of all society-at-large, deserves a wider view and broad dialogue. A dialogue that is not only interdisciplinary, but also intergenerational. We started this co-creative dialogue in our own community but aim at starting a dialogue in society-at-large. The vision serves as a starting point to capture beliefs and directions. As Hölscher stresses: "Visions are not meant to be static, but rather give an open-ended desirable state allowing improvement through revisiting, reflecting or even reframing them". It is not only about how it will look like. It especially on finding out what it should be about and build common grounds to work about.

A value-based future
The dialogue was not just about how our food systems could or should look like, but especially what our food system should be about. Choices and directions are inherently political and involve different views and visions, requiring 'systemic ethics' (Bui, 2019; Wigboldus, 2020). The initial step is bringing these different views and visions together. These views and visions are inherently multi-scalar and multi-aspectual. In example, views on global cooperation also implies effects or directions at a more regional scale and vice versa.

A place-based and pluralist future
Context matters, also in food systems. The food system comes never alone. Each region has its own characteristics and challenges in terms of society and the environment. This deserves a place based approach, valuing specific conditions and culture and taking local needs to the forefront of systemic change. Europe's biogeographical regions are a starter to look into Europe's geographical and cultural diversity and how that links to a future diverse food system.

Following the Mansholt lecture 2023 'Imagining a nature-based future for Europe in 2120' the visioning process takes into consideration Europe's biogeographical regions and their challenges alike, amalgamated into 5 ecoregional clusters and the overarching global perspective. Europe has eleven biogeographical regions and seven regional seas. Biogeographical regions are useful geographical reference units delineated by their shared challenges and inherent characteristics. They were originally defined for describing habitat types and species which live under similar conditions in different countries. However, these regions also link nature and culture; mapping these regions also encompass the relationship between human nature and culture. They represent areas that share similar natural ecosystems and human cultural characteristics.

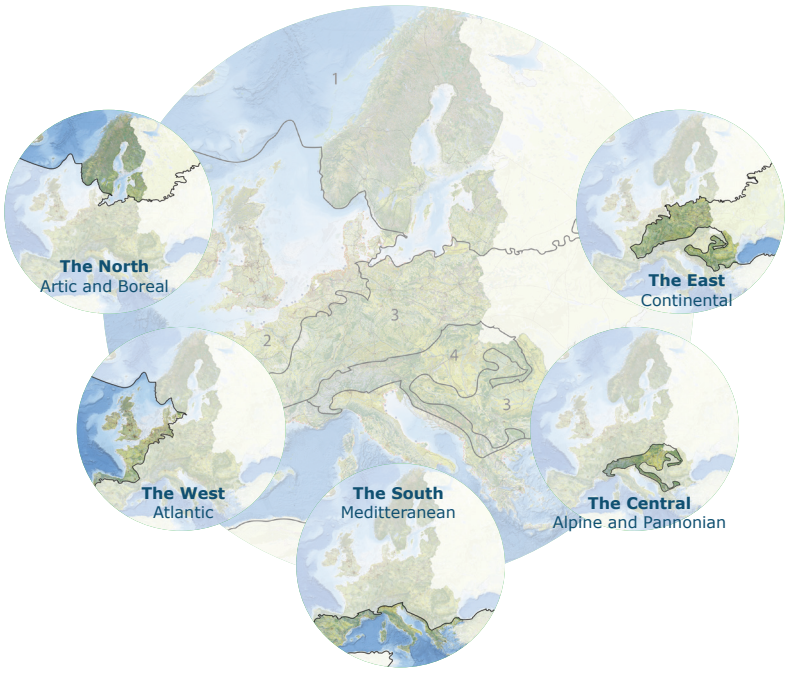
The five ecoregional clusters are:

- **The North**
  Arctic and Boreal biogeographical regions, including the Baltic Sea
- **The West**
  Atlantic biogeographical region, including the North Sea and the Atlantic Ocean
- **The East**
  Continental biogeographical region, including the Black Sea
- **The Central**
  Alpine and Pannonian biogeographical regions (no sea included)
- **The South**
  Mediterranean biogeographical region, including the Mediterranean Sea

This outline fits into contemporary bioregionalism. In a recent study, bioregioning is described as a new wave of bioregional discourse. Wearne describes bioregioning as "a subtle dancing with the system -referencing Meadows, 2001", which is best pursued by the process of open, brave and contextually nuanced discussions and experiments". According to Wearne, it enacts a dialogic approach -creating a shared space for people to work together-, enables questions of scale but most of all, allows people to move between broad ideas that can be translated in and across different contexts. Current practices in bioregioning appear to adopt relational perspective and facilitate diversity from contextualized exchanges (Wearne, 2023).

Considering a place-based and pluralist future also comes with a different view on the food system. Current discussions often focus on the distinction between local food systems versus a global food system. A multi-scalar perspective could bring in a more diverse view and heterogeneity. Intertwined systems could build in more resilience and draw more on values, local knowledge, relationship to biodiversity that the embody and cultural aspects; drawing on people's complex and plural values. A shift in design of systems and policies is urgently needed to create new modes of governance that reflect these values and unlock new strategies and facilitate greater diversity in food systems to allow plurality of values (Jehlieka, 2020; Riechers, 2021, Leventon, 2021).

In a multi-aspectual perspective, unsustainability in one place (or entity) cannot be compensated for by having more sustainability somewhere else (Wigboldus, 2020). In this light of the above the concepts of pericoupling and telecoupling are highly relevant. Understanding the regional differences, challenges and opportunities, connecting it to a European perspective and strategy and reflecting on the potential impact and required interactions at a global scale. Pericoupling has all to do with the interactions between adjacent systems (Hermans, 2023). We realize that already a systemic understanding of a region with all its complexity and interlinkages is difficult, let alone pericoupling or even telecoupling (the remote effects across the globe). Nonetheless, these relationships are essential to value strategies and measures to the best extent.



Painting a collective future

If you can imagine it, you can make it happen. The act of painting really challenges you to make it imaginable and actionable. It is not only about how it will look like.

Place-based

Context matters, also in food systems. The food system comes never alone.

Biogeographical regions

Each region has its own characteristics and challenges in terms of society and the environment. This desirves a place-based approach, valuing specific conditions and culture and taking local needs to the forefront of systemic change.

Figure 3: Europe's biogeographical regions as a base to dive into Europe's food future. (van Hattum et al., 2023)

The North

The Northern region is known for its expansive wilderness, that encompass endless forests, mires, wetlands and lakes, as well as various types of permafrost. Its climate features long, cold winters and brief summers. The North is recognised for its thriving economy and distinctive culture. Key industries like forestry, fisheries, and resource extraction (oil, gas, and iron ore) contribute significantly to its prosperity, aligning it with the typical Nordic economic and social model. Despite large uninhabited areas, urbanization rates are high, with around 60% of people concentrated in city regions along the coast and in the hilly, fertile lowland in the South, known as Boreo-nemoral. These urban areas differ greatly from the rural regions in terms of population size, composition and development. The proximity of the cold waters of the Atlantic and the Baltic mean that fisheries and fish farms play an important role alongside navigation. The region's distinctive landscape also stems from its intricate river patterns and extensive peatlands. As the climate undergoes changes and temperatures continue to rise, various circumstances are also changing. Rising temperatures, particularly in this region, lead to reduced snow and ice cover, shifting permafrost boundaries, and related issues such as increased greenhouse gas emissions, desiccation of peatlands and ecosystem stress. However, these climatic changes also present opportunities. For instance, tourism is already experiencing growth in the region. Furthermore, the new climate extends the growing season, which benefits increased land use, agriculture, and forestry. As a result, migration to this ecoregion is expected to increase. The key lies in finding the right balance to ensure a sustainable and prosperous, healthy and resilient future environment for the region.

The challenge

The Boreal holds tremendous potential as climate shifts create opportunities for more diverse forestry practices, agriculture, urbanisation and tourism. However, the manner in which these opportunities are pursued is crucial. Rising temperatures lead to reduced snow and ice cover posts challenge to water management, including hydropower development, in the strategies that have been outlined. The relationship among increasing urbanisation, nature and food are also a challenging topic in the future of Boreal region.

The West

The Atlantic region, stretching from northern Portugal to the western parts of Norway, is one of Europe's most densely populated regions and features diverse coastlines, ranging from low-lying coasts with shallow waters, lagoons, peat meadows and large areas close to or below sea level reclaimed land, to rocky coasts with fjords, rias, peninsulas and islands. This region has numerous rivers that serve as crucial gateways for international trade and fisheries, with some of the largest and busiest European ports. The regional climate is mild and humid, with dominant tidal movements and western winds. The Atlantic region and its riverine and Deltaic areas are some of the most important bird habitats but are also encouraging for developing intensive agriculture. Climate change leads to rising sea levels and impacting the region with a stark alternation between periods of heavy precipitation and extremes in river discharge, and extreme weather events happening, including prolonged warm spells and heatwaves. These changes not only increase coastal and riverine flood risks but also affect salinization, freshwater availability, urban heat stress and occurrences of wildfire. Nevertheless, the shifting climate zones present opportunities for extended growing seasons and multiple crop cycles. However, the region already contends with intensive use of land and water, which poses challenges to biodiversity, as well as social and economic resilience.

The challenge

As a foundation for a resilient nature-based strategy, the main rivers in the Atlantic region act as essential elements. They play a pivotal role in water management, ensuring safety during extreme discharges and retaining water during droughts. Natural areas are essential for water retention and filtration in the freshwater strategy, involving peat regeneration and land use re-evaluation. As droughts become more prevalent, adopting a climate smart forest strategy and regenerating soils will provide solutions. This approach mitigates the risk of wildfires, enhances water availability and retention, combats water salinization, cools down urban spaces and fosters sustainable material and food production.

The marine perspective is also vital for the Atlantic region, especially in the low-lying areas, where a nature-based, future proof coastal defense strategy integrates safety measures with habitats expansion and enhancement. A comprehensive marine strategy covering ecosystems, food systems, energy transition and navigation complements terrestrial strategies, ensuring that marine areas are an integral part to the regional development.

The East

The Continental region, one of the largest ecoregional clusters, is a central land mass that connects to most other regions. Moving from north to south, the landscape shifts from flat, to hilly terrain, even elevating in altitude to become mountainous. A similar north-to-south gradation can be observed in soil types and conditions, ranging from true podzols to grey and brown forest soils and highly fertile soils like the chernozems. This region encompasses the middle courses of many of Europe's most important rivers and experiences a climate characterized by strong contrasts, with warm summers and cold winters. Rainfall is most abundant during summer, contributing to its highly productive natural, agricultural and forest ecosystems. The predominant land uses are agriculture (over 52% arable land) and forestry (27%). The most densely populated areas lie in the north-western part of the region, with the eastern and southern parts being less densely inhabited. Despite this, urbanisation, new infrastructure, economic activities and industrial zones are expanding significantly, particularly in the east. Vast parts, especially in the east, are modified to benefit agriculture through drainage, river diversion and irrigation. However, such intensified land use in agricultural practices, mining, and industrial complexes have led to heavy pollution, water issues, soil erosion, fragmentation, and land degradation.
The region is increasingly confronted with challenges including non-vital forests and reduced agricultural yields, coupled with heightened climate risks like (flash) floods and droughts in agriculture, forest fires, landslides, and urban heatwaves. The primary goal of our planning is to reduce the environmental impacts of agriculture and the forest industry.

The challenge
The nature-based strategy for the Continental ecoregional cluster centres around sustainable vitality. At the heart of this vision lie thriving soils, forests, and nature, marking a shift from unsustainable practices to regenerative and circular alternatives. Adaptive forest strategies will transform the extensive forests into diverse, healthy and resilient ecosystems. Both reforestation and afforestation will contribute, with the latter extending into urban spaces. Enriching forest diversity and implementing an integrated wildfire strategy—comprising fire breaks, grazing, and heightened biodiversity—will further bolster resilience. In agriculture, new practices will conserve and regenerate valuable soils. Circular systems, combined with a comprehensive water strategy and nature inclusiveness, will serve as the foundation for a new economy and business model in the Continental region.

Fertile land in-and-around urban areas will be developed for food forests, high-value crops and low-and-high-tech urban farming. shortening the farm-to-fork distance and bridging the food-society gap. This approach adds to both the food system as to urban climate, making the Continental ecoregion a hotspot for circularity in Europe, fostering production within planetary boundaries and fostering diversity-based resilience.

The Continental ecoregion faces a significant challenge in achieving sustainable land use. It will remain an essential area for both forestry and agriculture, which will continue to play crucial roles. However, the key to addressing this challenge lies in adopting sustainable practices and enhancing resilience through nature-based approaches.

The South

The Mediterranean region is characterized by hilly and mountainous landscapes, inland plateaus, islands and long intensively used and exploited coastlines with a combination of rocky terrain, sandy beaches and coves. With low humus content, soils in nearly half of the region face elevated erosion risk. Overgrazing, deforestation, wildfires, and surface disturbances worsen these problems, contributing to rural challenges including heightened aridification, desertification, land abandonment, and depopulation. Known for its production of olives, fruit and nuts, the region relies heavily on intensive agriculture, particularly for vegetables, olives and citrus orchards require necessitating substantial irrigation. Livestock farming is also on the rise in some parts of the region, leading to potential conflicts, especially during periods of extreme droughts and heatwaves, affecting not only agriculture and industries but also nature.

The Mediterranean region and the Mediterranean Sea are facing significant challenges from climate change. They are experiencing severe effects such as extreme drought, soaring temperatures, and intense weather events, which require long-term solutions. The spring of 2023 serves as an example of these challenges, as it was one of the hottest and driest seasons on record, leading to water shortages, the drying up of lakes, and an extremely high risk of wildfires. The area is becoming increasingly arid and desert-like, leading to a scarcity of water resources. Additionally, during the same spring, heavy flooding occurred in the region due to intense rainfall. These multiple climate risks, often interconnected with land use practices, have become a daily reality in the Mediterranean region.

While rural areas undergo depopulation, urban centres, especially those along the coast, are expanding. The region already accounts for over 35% of tourist visits in Europe, which places significant environmental pressure on land and water resources, adding to the competition for water. Rising sea levels present challenges to coastal areas, cities, and heritage sites. Urbanization also poses threats to the natural qualities and richness of the Mediterranean Sea, which remains one of the most species-rich in the world.

The challenge

The first steps towards an initial strategy focus on connectivity, which involves connecting nature and reimagining the Mediterranean as more than a border with Africa but as a link to it. Structural choices based on nature-based strategies can still turn the tide. Initiatives to revive and regenerate the inland rural areas, nature and soils are crucial. Relying solely on technical fixes for climate change is unsustainable; fostering healthy soils and resilient vegetation is key to a robust food system and economy while reducing risks and dependence on scarce resources. Local circularities and the reuse of resources, including water, along with indigenous species and traditions, can provide inspiration. Integrated green strategies focused on revegetation and reforestation should prioritize risk reduction, including fire risk reduction, flood risk management and erosion prevention. An interesting idea is proposed to extend underwater forests in the Mediterranean, such as kelp forests, which can enhance marine ecosystem. Concerning urban zones in the region, the importance of green, water-sensitive cities is evident, particularly due to escalating temperatures. Lessons from traditional practices, like compact building, wind utilization, and resilient functional green spaces, offer valuable inspiration for coping with these changing conditions.

The Mediterranean region finds itself at a critical juncture, a tipping point to a new reality, facing numerous challenges induced by climate change. The key dilemma lies in overcoming existing crises and making structural decisions and implementing measures that will revitalize and regenerate the area. These choices are centred around the restoration of a new balance, with a focus on soil, water and nature. Connectivity around the Mediterranean, whether natural, social or international, is a fundamental principle, highlighting the importance of solidarity.

The Central

The Alpine region encompasses the central mountainous areas of Europe, including the Alps, the Pyrenees and the Carpathians. The Scandinavian Mountains are considered to be 'Alpine' biographic region, but in this study, they are considered as part of the Northern region. This diverse region boasts a wide range of ecosystems and habitat types, significantly influenced by altitudinal gradients and geology Approximately 90% of the area is still natural or semi-natural area, with forests being the dominant land cover. However, climate change is expected to heavily impact this region and its natural processes, not only within its borders but also in adjacent regions. The effects will not only be seen in the region itself, but also in the adjacent regions. The Alpine region plays a crucial role in Europe as a watershed the source for many of the great European rivers.

Changing climatic conditions are causing glaciers to melt at an increasing pace, while replenishment during winters is decreasing. These changes are resulting in significant changes into the discharge characteristics of rivers, streams, and groundwater systems. Furthermore, the vulnerable ecosystems, characterized by low productivity, slow response rates and their isolated geographical positions, will be greatly affected by climate change, accelerating shifts in biodiversity and species distribution. Lowland species are expected to move upwards in altitude and upland, montane species may face extinction as populations become cut off and isolated as their habitats shrink and disappear. The region's traditional balance between natural and cultural landscapes and land-use practice is under pressure. Fragmentation, changing land use changes and intensified agriculture and tourism, have adverse effects on biodiversity and resilience. The heavy reliance of the tourist and recreational sectors on ice and snow make these economic sectors vulnerable as their predictability decreases. To adapt to these likely irreversible climatic conditions, new forms of multi-functionality must be introduced.

The challenges

The Alpine region, encompassing the Alps, the Pyrenees or the Carpathians, should assume a central role in Europe's climate strategy due to their significance as vital watersheds and drivers of the continent's water strategy. It is essential to implement water storage and discharge measures, coupled with an energy strategy (hydropower) and ecosystem restoration. A new balance in multifunctionality and natural systems is crucial, including strategies for retaining and infiltrating water, reducing uncontrolled runoff and mitigating risks of land degradation and landslides. Nature-based strategies, that combine water and biodiversity challenges, revitalisation and rewilding, will work towards achieving this new balance.

The Alpine region serves as an important source area for many adjacent regions, as water is vital for life. The primary goal is to solve water-related challenges at the source.

A systemic perspective

In 2019, the Rockefeller Foundation organized an international food system vision prize, concluding that "Food visions can be catalytic. Creating food systems not only solve multiple existing problems, but more importantly give us hope for a future that we want" (Rockefeller Foundation, 2021)". Already in 2017 Gladek stressed that "to develop an outlook of how the food system would perform in a sustainable state, we can start with taking all of its current negative impacts and describe what the system would look like if they were to be eliminated or reversed, but the ultimate picture that emerges should be a holistic vision of a system that addresses human and ecological needs simultaneously, characterized by its adherence to the principles seth forth in systemic sustainability frameworks" (Gladek, 2017). A holistic vision of a system depends on a systemic perspective and a systemic approach.

The food system framework or food system approach serves as an interdisciplinary, conceptual guidance to grasp the complexity of food systems, its different elements and relations: "A food systems approach is a way of thinking and doing that considers the food system in its totality, taking into account all the elements, their relationships and related effects" (FAO, 2016).

Food systems encompass a chain of activities that again are highly interlinked, the aggregate of food-related activities and the environments (political, socio-economic and natural) within these activities occur" (Van Berkum, 2018). It is difficult to decide on a precise demarcation of food systems, as Van Berkum states. Envisioning a future in which the food system is an integrated part of society and acts as a leverage, demarcation should not be the objective at all. Embracing systemic relations and feedback loops is central to a systemic approach. Identifying potential trade-offs and synergies in choices and transitions, with the food system and beyond. Starting with an all-encompassing view on the future and desired outcomes, before unravelling and setting forth towards actions and activities.

One thing is for sure: the food system never comes alone.

Backcasting: mapping out an actionable future

The act of painting really challenges you to make it imaginable and actionable. In our approach envisioning is directly connected with back casting. The outlined shared normative future vision, build on desired outcomes and values, serves as a starting point to look backwards from that future to the present to strategize and plan what is needed to make this future happen (Quist, 2006; Bezold, 2009). Visions of desired futures are needed and essential to guide sustainable transformation in various societal sectors (Tapiola, 2023), Unlike Tapiola (Tapiola, 2023), we are convinced a shared vision is needed. Instead of outlining several visions it is key to outline a shared open-ended vision, based on common understanding, beliefs and values and always open for adjustments and enrichment. In backcasting from this future perspective towards the current situation, multiple pathways should

be provoked that all build towards that desired future. Bringing about different pathways, underlines the multifaceted and multi-aspectual nature of systems and transformative change.

The essence of back casting is developing pathways that connect the preferred future to the present by identifying milestones and outlining actions that lead to those milestones. There are few specifics yet in literature on how to develop these (Bengston, 2020), but is requires an open set of minds, transformative thinking and a critical-reflexive approach. The present seems always at the table, also in terms of references and frameworks. Besides actions and milestones, the identification of signposts or signals of change proves to be very helpful in flip-thinking the desired change. Signposts are 'recognizable potential events that signals significant change' (Strong, 2008). This significant change can be conditional or essential to unlock certain directions and actions. These signals of change directly link to agency capacities - the abilities of multiple actors to search, change and mobilise their directions and context-specific conditions and to engage and implement transition pathways, as an individual but also collectively.

Co-creation

Key in the process of envisioning and back casting is co-creation. Co-creation is a methodology that capitalizes on collective and collaborative creativity. Together with design thinking it focuses on approaching issues from a new and broader perspective. Co-creation builds new partnerships and delegates power based on common understanding, trust and aims at an open attitude and view to issues and challenges. Co-creation as such, can be seen as a social learning process, in which share convictions about problems and solutions are the results of a dialogue between actors, in which multiple actors with highly diverse backgrounds actively engage in mutually dependent relationships to co-develop and co-create beneficial outcomes (Lelieveldt, Dekker, Voelker, & Torenvlied, 2009; Voorberg, 2017).

The process towards this initial vision should be seen as a starting point for further co-creation. In just under half a year, we managed to start two parallel and intertwined processes. First, we gave space to dialogues within a broad interdisciplinary group of our own scientific community and within the next generation of multinational and interdisciplinary students. Second, we started a first dialogue between them. Enriching and inspiring. New ways of engagement and working constructive and critical at the same time. Every participant is considered and valued equal in terms of expertise, both the students and the scientists. We are the food system. A new food system that is us.

Figure 4:
Co-creative workshop for *Food 2100* with young professionals and students (De Rooij & van Moûrik 2023)

3. A dream to desire: Europe's food future

Imagining Europe's food future is more than making a map. It is not just a projection of a desired single outcome. It is not a fixed destination. It is a snapshot of the choices that we made and the key principles that we want to put into effect. Each of our choices leads to effects and requires choices and actions in related fields. If we truly start from a food system perspective, each choice urges for alignment in actions within the different actors and domains. Frankly, it should be a desired outcome from society within.
A shared narrative and connected and transparent pathways showing the relations and dependencies are crucial to really make transformative change happen and build together towards a more just, healthy and resilient food system.

As such, the map of Europe's food future 2100 is not a still but is on the move. Each move shows how the spatial outcomes depends on the choices made. Choices made in key principles as in the way these principles are put into effect matter. The map illustrates desirable futures and calls for fundamental choices.

The next generation has strong beliefs that a food system transformation is needed and is possible. Let's not wait for disruption but make change happen This requires fundamental changes and strong principles. Strong principles that build to food security outcomes, environmental outcomes and socio-economic outcomes at the same time. Outcomes that come with benefits not only on a local, regional, national or European scale, but also take into account the international perspective.

In the co-creation three main principles were set:

Principle 1 Human health is planetary health
Principle 2 Biodiversity equates sociodiversity
Principle 3 Social justice in local and global alliances

Human health is planetary health
The first principle directly links human health to planetary health. Human population growth and the way humanity interacts with the planet and its resources increases pressures. Crossing planetary boundaries also come with consequences for human health and wellbeing.

Underlining this direct relationship, building new narratives that includes flip-thinking to opportunities that both add to human health -in terms of nutrition, safety and mental wellbeing- and regenerating planetary health at the same time, should not only build awareness but also create new coalitions and actions. Within a food system perspective these awareness and actions should include the whole chain, from production to consumer and the full health perspective, from prevention and lifestyle to insurance and healthcare systems. Making the direct link between health, wellbeing and our food system is a crucial step, next to livelihood and security, to bring the environment into the personal sphere of life.

"One bag of potatoes is finally cheaper than a bag of crisps"

Biodiversity equates sociodiversity
Diversity is one of the most important elements to be resilient. In a resilient and prosperous future biodiversity and sociodiversity equates. Cherishing these two types of diversity and their interaction, requires new types of governance and engagement. Diversity comes with a diverse set of approaches, narratives, actions and incentives, that should be tailored. Bioregioning will be helpful to find the most appropriate scales in doing so -linking a biodiverse environment and a socio-cultural and socio-economically diverse society- and facilitating dialogue and co-creation.

"Healthy soils and a good water system gives a good life to people all over the world."

Social justice in local and global alliances
Cherishing sociodiversity and unlocking different types of engagement tailored in the transitions needed builds towards social justice at local, regional and global scale. Social justice is much more that leaving no one behind, everybody should be able to be active part in the transitions and in shaping these transitions. Local and global alliances will open constructive operationalisation of the different aspects of justice -recognitional, distributive, procedural and restorative- towards a diverse, healthy and just food future for and with all.

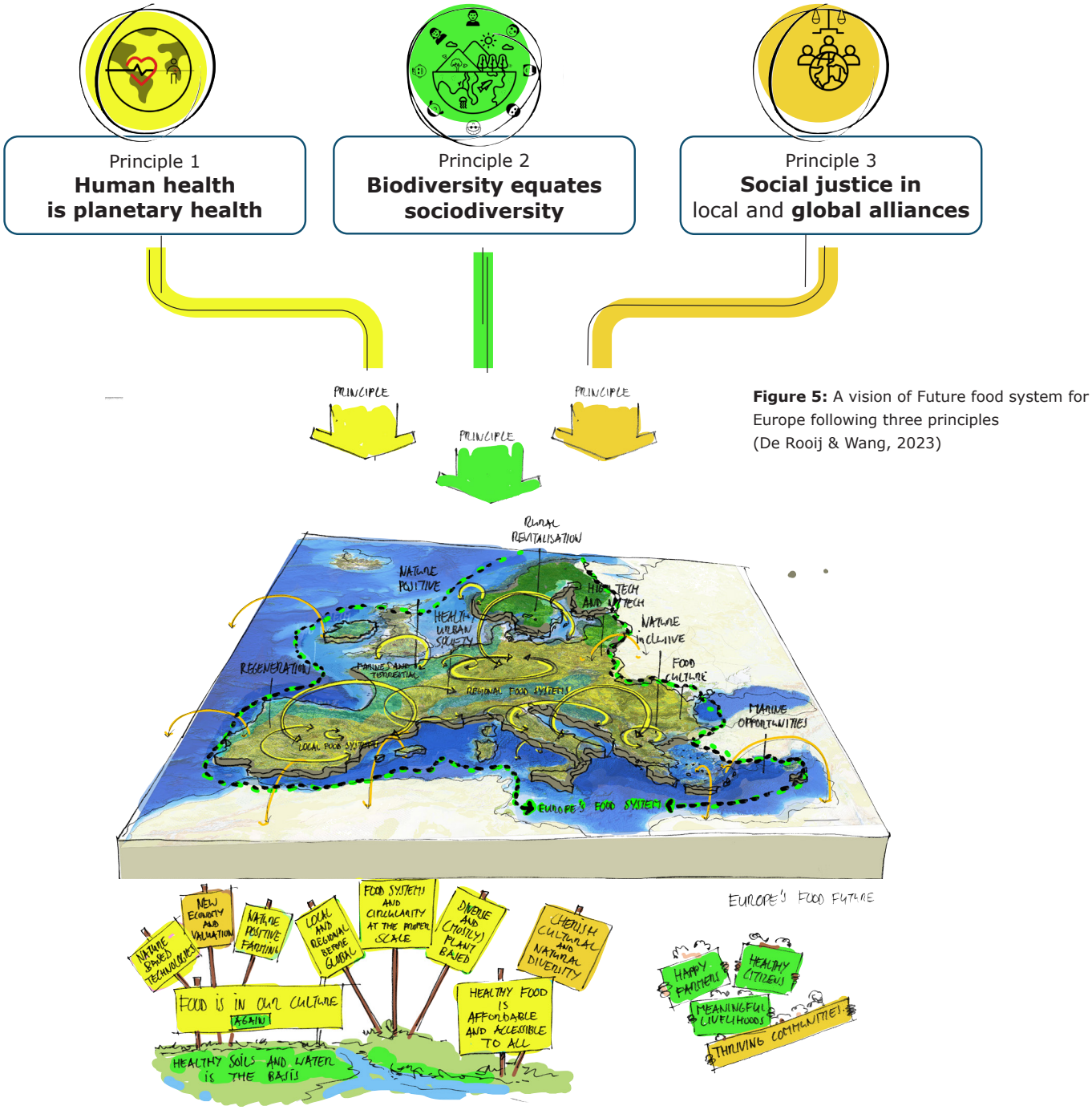


Figure 5: A vision of Future food system for Europe following three principles (De Rooij & Wang, 2023)

In 2100, the major headline in the news states that *"the world celebrates 15 years of food sovereignty through cross-country transformations."* The way Europe has taken the crossroad towards a diverse, healthy and just food future in the early 20's of the 21st century has defined a fundamental change. Thriving communities, healthy citizens, happy farmers and meaningful livelihoods derive from putting food again in our culture, rediscovering our roots in nature and our environment and valuing and cherishing cultural and natural diversity. Food sovereignty as the right of people to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems.

There is no one food system, but a set of intertwined regional and local food systems that interact beyond administrative boundaries. Countries have engaged in joint transformations, based on a shared understanding and appropriate scale of bioregional and cultural areas. Europe's food system as a whole is based on what is possible and needed within planetary boundaries and societal needs. Rather than feeding the world with food that comes at a price, Europe is feeding the world with knowledge and support, based on the beliefs and opportunities that comes with the new principles.

4. A dream to desire: the regional food future

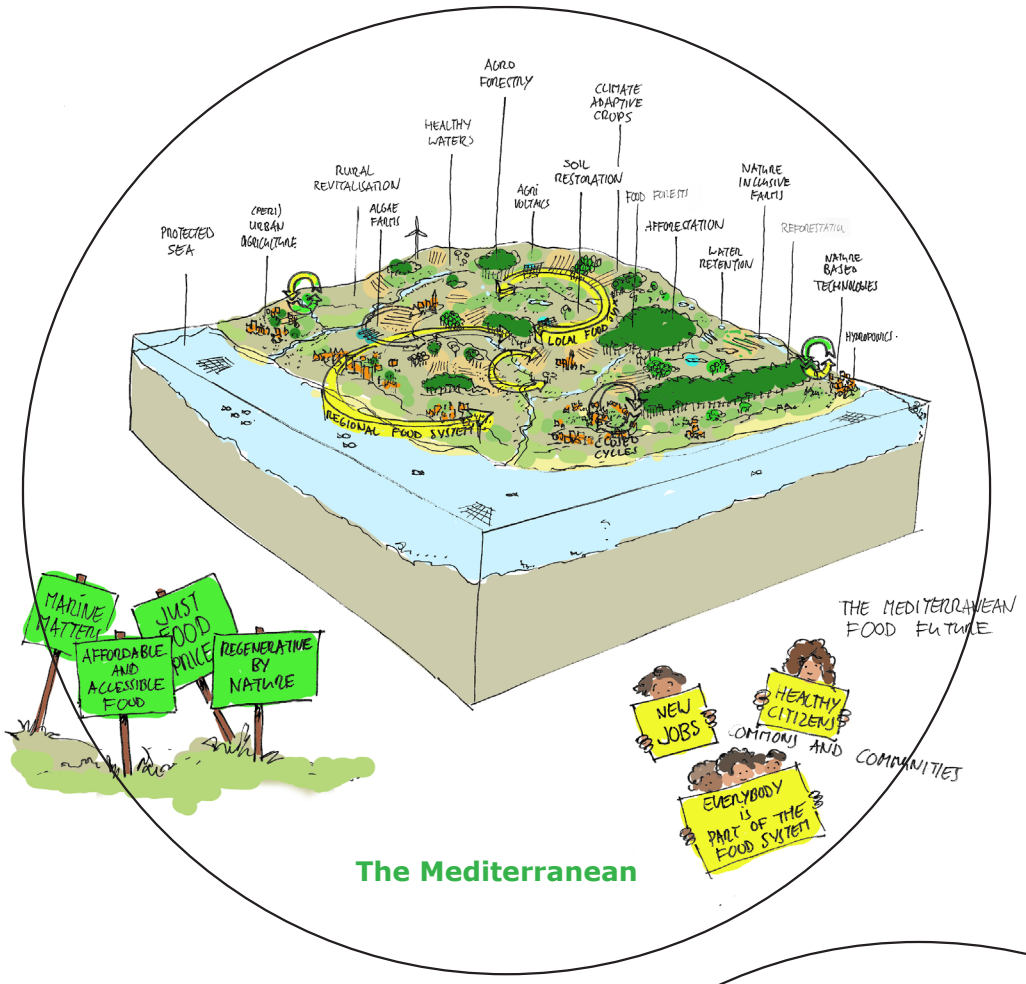
In our approach we outlined the importance of a regional approach based on the bioregions. Given the time available in this initial co-creation process the choices was made to make a deep dive into two various regions of Europe.

Mediterranean

Starting with the most challenged bioregion of Europe, the Mediterranean, the solemn belief that rethinking the food system and our interaction with the natural system is key. Regeneration and revitalisation based on a balance between high tech technological advancements and nature based or even nature positive solutions will revive the region. Different regional and local food systems are established, in conjunction with rural revitalisation and urban-rural linkages in combination with tailored circular systems. In these local and healthy food system the fact that a bag of potatoes is finally cheaper than a pack of crisps also symbolizes a transformed and valued landscape. Subsidies are rerouted and technological strides pave the way for more diverse, sustainable energy sources while ensuring efficient, low-waste agriculture. Global justice came with ensuring fair wages for farmers and making farming an appealing profession again, also in these areas again. This shift leads to an abundance of affordable and healthy food, accessible to all. Cities pioneer innovative provisioning methods, valuing knowledge over trade in produce. Education becomes a beacon, teaching sustainable diets and popularizing flexitarianism, nurturing healthy soils and fostering a robust water system. This reimagined future doesn't just promise nourishment; it cultivates a thriving ecosystem where food, sustainability, and health harmoniously intersect.

Continental

A vivid portrait is painted of the Continental. The rural landscapes of Europe have been reshaped into thriving, diverse gastronomic hubs. Like in the Mediterranean also the revitalization of rural areas and the celebration of diversity is key. The heart of the thrives in the Continental rural expanses envisioned a future where these areas flourish into lively ecosystems. Natural ecosystems and agribusiness ecosystems. Access to knowledge, targeted food education and widespread citizen engagement through citizens assemblies fuel advancements in agricultural technology, revolutionizing also farming here again into an efficient and appreciated profession. The shift has been made from feed to food; which values the valuable soils and agricultural value much more. This also supported the dietary shift to more plant-based; although some livestock remains for closing regional cycles. Although scale is still an important issue, the regional scale seems most appropriate. The regional food systems focus on regional food patterns at first and diversification. What the planet offers more within its boundaries, can be supportive in global trade. Nature inclusiveness and nature positivity is the norm. This transformation extends beyond fields, advocating for inclusivity and diversity. It promotes free mobility, embraces diverse cultures, and celebrates the richness of food. Not only did it streamline farming but also paints a societal canvas where diversity and inclusivity constitutes fundamental values.



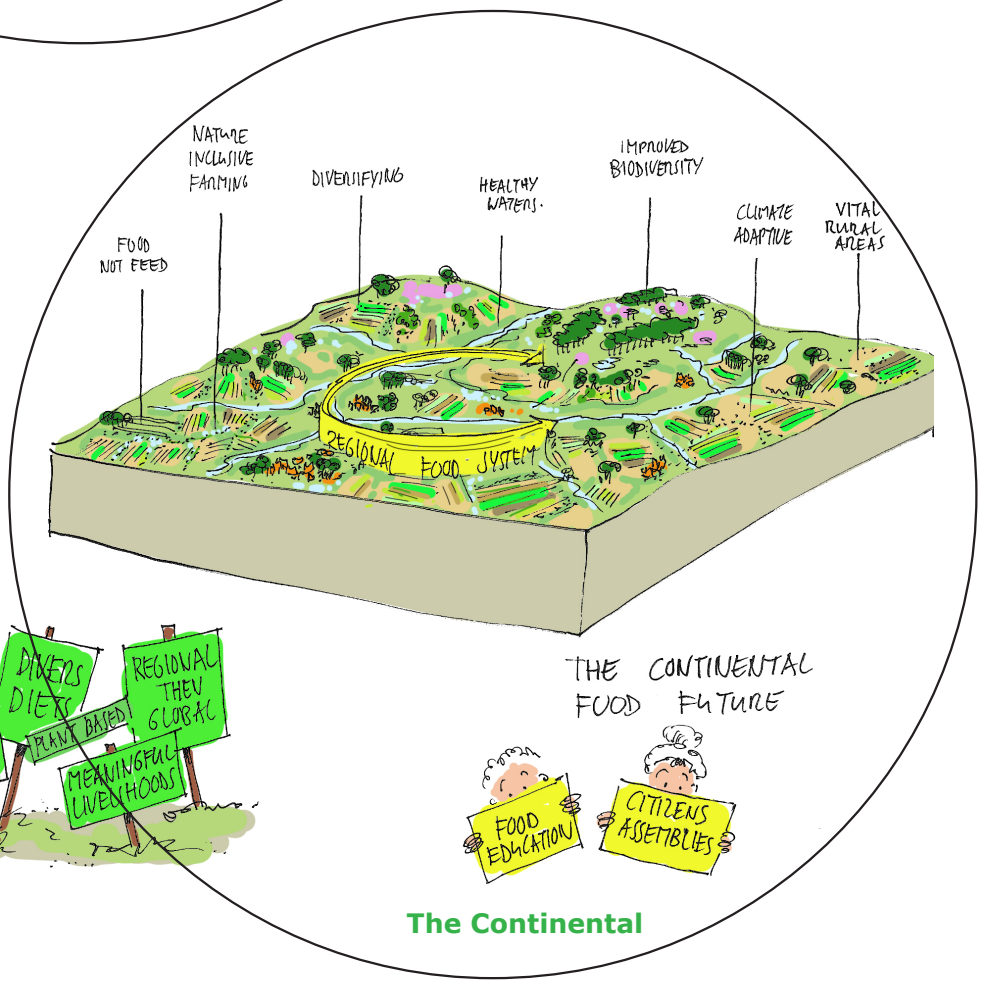


Figure 6: The regional food future for Mediterranean and Continental areas based on the workshop results (De Rooij, 2023)

5. Choose for change, choose to change

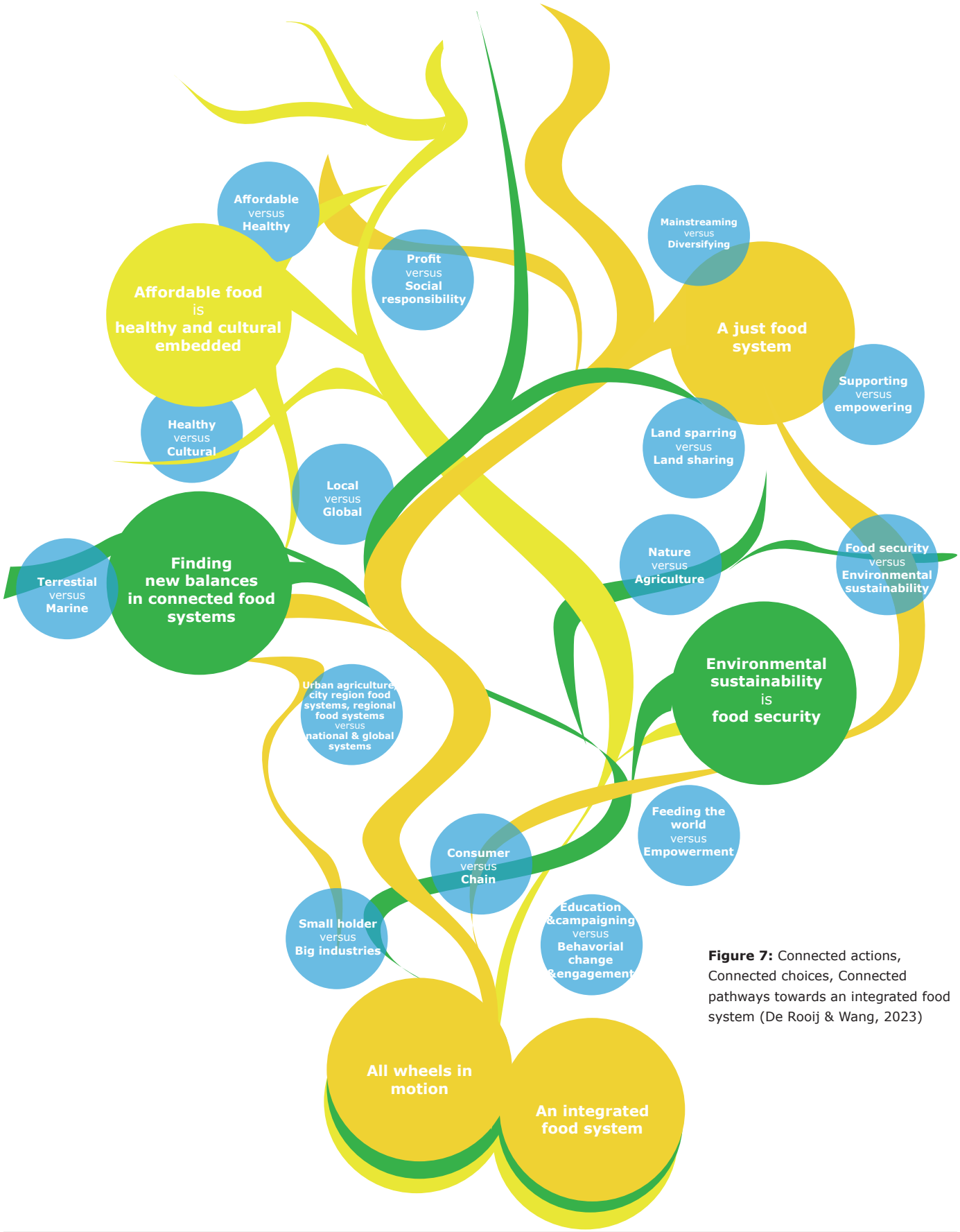


Figure 7: Connected actions, Connected choices, Connected pathways towards an integrated food system (De Rooij & Wang, 2023)

The outlined vision of Europe's food future and its regions outlines connected choices, connected actions and connected pathways. The back casting exercise carried out by the different working groups, revealed that different pathways support different actions and change. There is a path dependency and practical actions are depending on decisive choices, societal and institutional readiness.

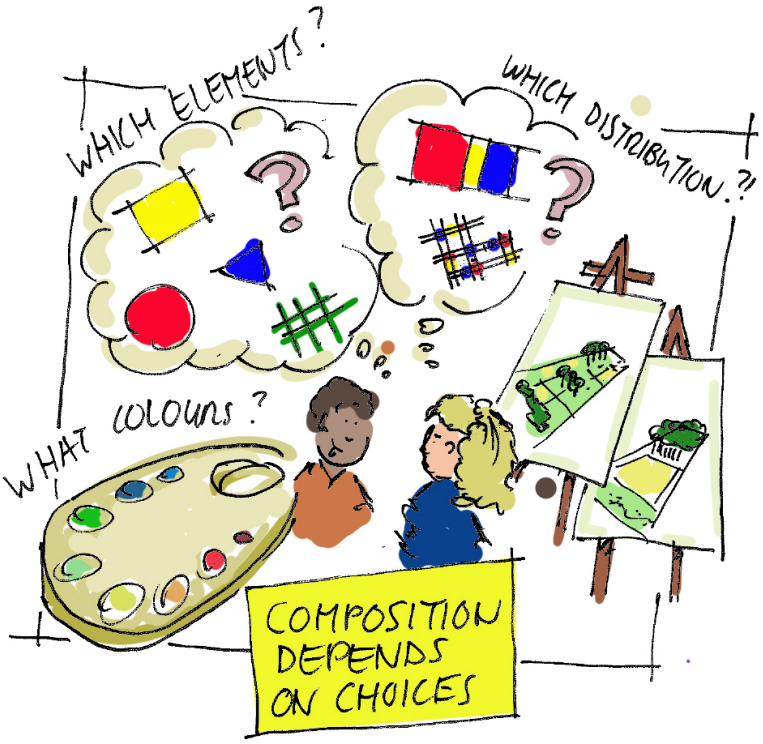
Demarcating pathways connected to the three main principles can lead us along these decisive choices and how these choices will open opportunities for different actions across the pathways. In addition, actor-based pathways can be added. In the science-driven pathway, education and technology promotes an agricultural shift, minimizing waste, promoting climate-adaptive crops, and expanding fisheries and aquaculture. This highlights the importance of a positive association between human and planetary health. Simultaneously, the Policies and Governance pathway revises trade agreements to foster knowledge sharing, multi-level governance, and regulations ensuring universal food income, thereby upholding the necessity of social justice in global and local alliances. Lastly, the Consumption & Production pathway amplifies local agriculture participation and strengthens farmer-consumer bonds. Consumers actively engage, learning to cultivate and value food deeply. Food industries prioritize healthy, planetary-boundary-friendly products, fostering consumer awareness of food's environmental impacts.

As said before, bringing about different pathways, underlines the multifaceted and multi-aspectual nature of systems and transformative change. It is not about defining fixed pathways, it is all about understanding the linkages and dependencies and being adaptive to it. Setting the direction, open for signals of change and targeting on decisive choices, tackling radical dilemma's together and moments that will open the future for the next steps with society at large.

Like, in the act of painting the actual composition depends on choices.

This paints a future where a well-informed majority consciously prefers and interacts in an environmentally-friendly and sustainable food system. A food system that formed one of the important leverages for a broader societal change: an integrated food system.

Good composition is like a suspension bridge
-each line adds strength and takes none away
Robert Henri



"Implement true pricing, incorporating social and environmental costs of a product"

"Redefine meaningful work as work for nature restoration and climate adaptation and pay those that do the work"

"Restore the sea system which will lead to another type of food system: aqua food system."

"Change consumer behavior by banning ads, education, and stimulate changes to a flexitarian diet"

"Ban pesticides, artificial fertilizers, and stop subsidies for the livestock industry"

"Investigate plant-based diets so that there is an availability of more flexible and fusion food patterns"

Figure 9: A co-creative journey bringing up all kinds of voices and urges to make the choices (De Rooij, 2023)

6. A call to action

The most important message is a clear call to action and shouts for:

- **Making meaningful choices**
- **Giving direction**
- **Rethinking the food-nature-society nexus**

- **Time to say goodbye**
- **Improving integrated governance**
- **Welcoming the new**

Meaningful choices and giving direction is the red threat throughout the story. The main choice and direction is centred around rethinking the food-nature-society nexus. The way food, nature and society interact and how the add to each other is crucial. Nature should be seen in the broadest sense, including all living and non-living elements and processes on our planet. In progressing the Nexus it is time to say goodbye to many habits, behaviours and viewpoints. To secure a healthy and secure future also current certainties and normalities should be replaced by new ones. The focus in the narrative of this transition should not be focused on the things we leave behind, but all the things that we get in return.

In doing so, there is a need to improve integrated governance across the new nexus. As Leventon puts forward: "making these changes means engaging with actors, structures and processes across the governance system, with the underlying system intent, the system design and structures so that diversity, inclusivity and plurality can be present in the mechanisms and policies we create" (Leventon, 2021).

Integrated governance means aligning outcomes and actions between the different stakeholders and beneficiaries. Different stakeholders across different communities and society-at-large. Besides science, policy, practitioners and citizens, more specifically also the different domains should be in sight. Think about spatial planning community, the financing community, the economic community and environmental community. The have to come together as within the transition as a whole different transitions are needed to really make change happen.

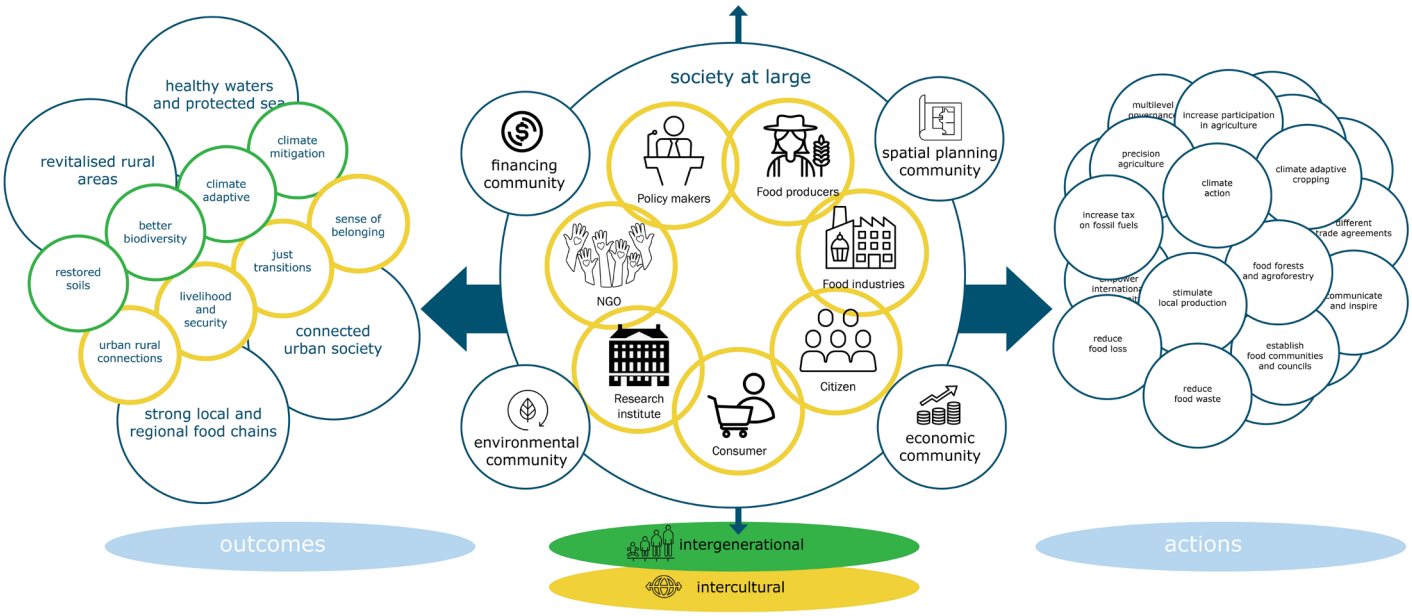


Figure 8: Associated actions, stakeholders and outcomes to realise the dream (De Rooij & Wang, 2023)

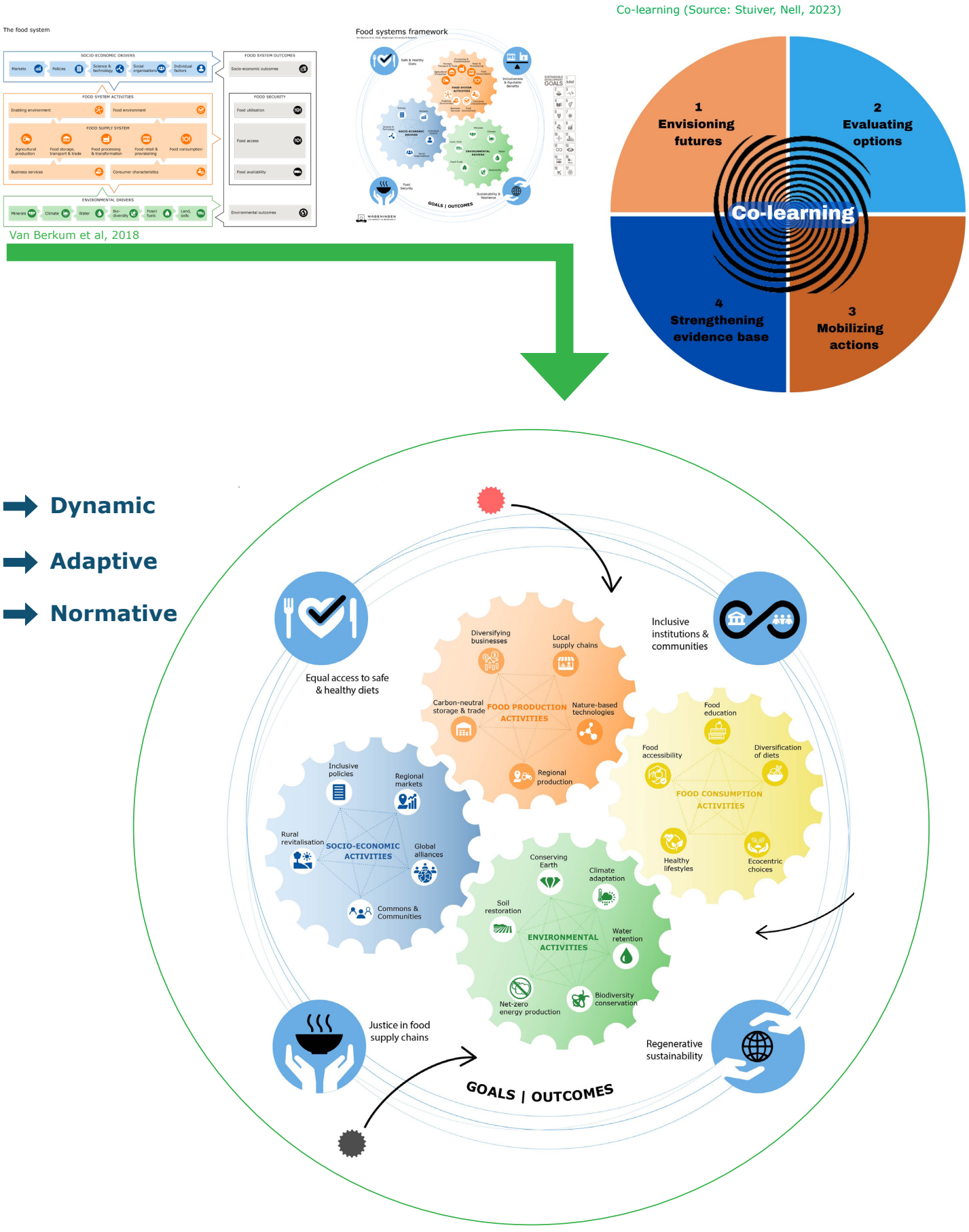


Figure 10: Towards a just and regenerative food system (in Europe)
(Stuiver, **de** Rooij, Wang, 2023, Adapted from Van Berkum et al, 2018)

7. Change the system? A new systems perspective

To make change happen, the ways we depict the system perspective needs adaptation. The existing food system framework at https://www.wur.nl/en/themes/from-hunger-to-food-security/food-systems.htm that outlines he food system and all of it elements, is a valuable tool to focus on the four domains of 1) Sufficient food for everyone, 2) Ensuring a healthy diet, 3) Equitable distribution of costs and revenues and 4) Sustainability.

However, based on the outcomes of our project we suggest making a more normative version of the food system framework, refocussing on the complexity of interactions and challenging boundaries of what the food systems entails. We therefore suggest a new visual depiction of the food system interactions.

As the system changes also it's elements change. New elements and activities are added, old ones change. We underpin the renewed importance of the natural and socio-economic domains of the food system, not just as a conditions or outcomes but with its own dynamics and directions. This deserves rephrasing two wheels (the socio-economic and environmental drivers) towards environmental and socio-economic activities. We also make a distinction between food production activities and food consumption activities to stress the importance of the changes in both domains and we have added clear activities in all the 4 wheels to put the system in motion

The new food system perspective becomes more adaptive, more dynamic and normative by nature. Changing the food system to achieve food system change towards a diverse, healthy and just food future for Europe in 2100. A future that is us. All activities matter, all matter. We are the food system.

References

Arthur, W. B. (2015). Complexity and the economy. Oxford University Press, Oxford, UK.

Dekker, K. R., Torenvlied, R., Volker, B., & Lelieveldt, H. (2009). Explaining the role of civic organizations in neighbourhood coproduction. In J. W. Duyvendak, F. Hendriks, & M. van Niekerk (Eds.), City in Sight (pp. 223 - 248), Amsterdam

EEA (2002), Europe's biodiversity -biogeographical regions and seas, https://www.eea.europa.eu/publications/report_2002_0524_154909

Eng, S., Donoghue, C., Khun, T., & Szmodis, W. (2020). Critical consciousness of food sdystems as a potential lifestyle intervention on health issues. American Journal of Lifestyle Medicine, 14(3), 258-263.

FAO (2016), Food for the Cities Programme - Building sustainable and resilient City Region Food Systems, Rome, 2016

Gaupp, F., Ruggeri Laderchi, C., Lotze-Campen, H., DeClerck, F., Bodirsky, B. L., Lowder, S., ... & Fan, S. (2021). Food system development pathways for healthy, nature-positive and inclusive food systems. Nature Food, 2(12), 928-934.

Gladek, E, Roemers, G., Muños, O., Kennedy, E., Fraser, M. , Hirsh, P. (2017), The global food system: an analysis, WWF/Metabolic

Hermans, T., van Oosten, C., Ingram, V., & van Tilborg, E. (2023). Telecoupled landscapes for nature inclusive transitions: Conceptual framing and methods (No. WCDI-23-232). Wageningen Centre for Development Innovation.

Hölscher, K., Frantzeskaki, N., Pedde, S., & Holman, I. (2020). Agency Capacities to Implement Transition Pathways Under High-End Scenarios. In K. Hölscher, & N. Frantzeskaki (Eds.), Transformative Climate Governance : A Capacities Perspective to Systematise, Evaluate and Guide Climate Action (pp. 381-416). (Transformative Climate Governance). Springer. https://doi.org/10.1007/978-3-030-49040-9_11

Jehlièka, P., Grîvìòð, M., Visser, O., and Balázs, B. (2020). Thinking food like an East European: a critical reflection on the framing of food systems. J. Rural Stud. 76, 286–295. doi: 10.1016/j.jrurstud.2020.04.015

Leeuwis, C., Boogaard, B.K. & Atta-Krah, K. How food systems change (or not): governance implications for system transformation processes. Food Sec. 13, 761–780 (2021). https://doi.org/10.1007/s12571-021-01178-4

Leventon, J., Duşe I.A., Horcea-Milcu, A., (2021), Leveraging Biodiversity Action From Plural Values: Transformations of Governance Systems, Frontiers in Ecology and Evolution Vol. 9, https://doi.org/10.3389/fevo.2021.609853

Lindgren, E., Harris, F., Dangour, A. D., Gasparatos, A., Hiramatsu, M., Javadi, F., ... & Haines, A. (2018). Sustainable food systems—a health perspective. Sustainability science, 13, 1505-1517.

Marsden, T., & Sonnino, R. (2012). Human health and wellbeing and the sustainability of urban–regional food systems. Current Opinion in Environmental Sustainability, 4(4), 427-430.

Mancilla García, M., Hertz, T., Schlüter, M., Preiser, R., & Woermann, M. (2020). Adopting process-relational perspectives to tackle the challenges of social-ecological systems research. Ecology and Society, 25(1), 29.

Pothukuchi, K., Kaufman, J.L. (2000), "The food system: A stranger to the planning field," Journal of the American Planning Association 66(2): 113–124.

Riechers, M., Pătru-Duşe, I. A., and Balázsi, Á (2021). Leverage points to foster human–nature connectedness in cultural landscapes. Ambio 2021, 1–11.

Rockefeller Foundation (2021) A Nourishing, Regenerative Tomorrow: What We Learned from 1,300 Future Food Systems Visions

Tapiola, T. , Varho V., Soini, K. (2023), Exploring visions and vision clusters of sustainable food packaging - The case of Finland, Futures, Volume 149, 103157, ISSN 0016-3287, https://doi.org/10.1016/j.futures.2023.103157.

Tolstoy, Leo N. What is Art? Translated by Almyer Maude. New York: MacMillan Publishing Company, 1960.

van Hattum, T., van Buuren, M., Rooij, B., Nel, J., Reinhard, S., Baptist, M., Jones-Walters, L., Piet, G., Budding, A., van Apeldoorn, D., de Boer, I., Nabuurs, G-J., Arets, E., Stremke, S., Sluijsmans, J., Dankers, R., van Kampen, A., Woolderink, H., Voeten, J., ... Reznek, D. (2023). Imagining a nature-based future for Europe in 2120 : nature-based solutions at the heart of a visionary approach for accelerating the transition to a climate resilient and nature-positive future. Wageningen University & Research. https://doi.org/10.18174/637123

van Berkum, S., Dengerink, J., & Ruben, R. (2018). The food systems approach: sustainable solutions for a sufficient supply of healthy food. (Wageningen Economic Research memorandum; No. 2018-064). Wageningen Economic Research. https://doi.org/10.18174/451505

Voorberg, W. (2017), Co-Creation and Co-Production as a Strategy for Public Service Innovation: A study to their appropriateness in a public sector context

Wearne, S., Hubbard, E., Jónás, K., & Wilke, M. (2023). A learning journey into contemporary bioregionalism. People and Nature, 00, 1–17. https://doi.org/10.1002/pan3.10548

Woodhill, J., Kishore, A., Njuki, J., Jones, K., & Hasnain, S. (2022). Food systems and rural wellbeing: challenges and opportunities. Food Security, 14(5), 1099-1121.

Colophon

Rooij, L.L. de, Wang, Y., Stuiver, M., Vernooij, V. (2023), A *diverse, healthy and just food future for Europe in 2100 - a co-creative journey*, Wageningen, Wageningen Environmental Research, DOI 10.18174/645571

This research is part of the project Imagine Food Systems 2100 (KB35-103-003) of the KB Program Food Security and Valuing Water and is subsidized by the Dutch Ministry of Agriculture, Nature and Food Quality Wageningen

Authors
Bertram de Rooij, Marian Stuiver, Yawei Wang, Vera Vernooij

based on the valuable cooperation between and contributions of:
Martine van Mourik, Simone Ritzer, Mirjam Troost, Monica Bonu, Lizzy Peerenboom, Dirk van Apeldoon, Katrine Pittore, Marieke de Haas, Eveline van Leeuwen, Roger Cremades, Thirze Hermans, Vincent Linderhof, Jeroen Sluijsmans, Marnix Poelman, Carina Castagna, Jeroen de Vries, Jeroen Candel, Yasmin Dijksterhuis, Giulio Mornati, Alvaro Hopkins, Heleen Prins, Maud Vegelin, Laure Teresa, Hua Wang, Anna Gall, Souravi Sha, Clare Buscher, Jana Firse, Yuri Suzuki, Pantaleimon Argiandis, Eline Baltussen, Yoonseon Do, Jona de Levita, Anna-Lisa Brattinga

Graphics and design:
Bertram de Rooij, Yawei Wang

Photos
Shutterstock: cover, p2, p12; others: by the authors.

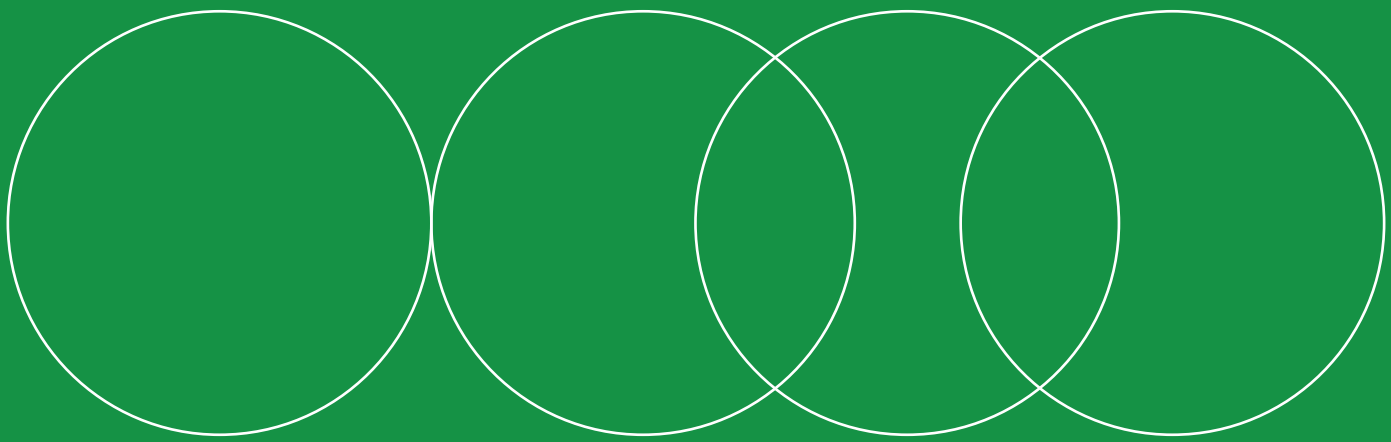
Wageningen University & Research, Wageningen, December 2023

Keywords: Food system, climate, adapation, just, transitions, nature based, biodiversity

The pdf file is free of charge and can be downloaded at https://doi.org/10.18174/645571 or at www.wur.nl.

Wageningen University & Research
P.O. Box 47, 6700 HB Wageningen
The Netherlands, T +31 (0)317 48 01 00

www.wur.nl.



Wageningen University & Research
P.O. Box 47
6700 AB Wageningen
The Netherlands
T +31 (0) 317 48 07 00
www.wur.eu

The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 6,800 employees (6,000 fte) and 12,900 students, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.