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RESEARCH

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Envisioning nature-positive futures for Europe: inspiring transformative change at the biodiversity nexus

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ABSTRACT

Transformative change is required to secure a liveable future for people and nature. The Nature Futures Framework (NFF) is a heuristic tool for supporting the creation of plural visions of nature-positive futures that build shared motivation for transformative change. Integrating nexus approaches with the NFF highlights the foundational role of biodiversity in supporting desirable outcomes across sectors (i.e. the biodiversity nexus). We bring these areas of biodiversity research together to ask: what could plural nature-positive futures for Europe in 2050 look like that explicitly leverage synergies in the biodiversity nexus? To address this, we co-created nature futures for Europe with 26 participants representing diverse sectors and regions, resulting in three visions underpinned by different value perspectives: *Dòigh Nàdair*: The way of nature (Nature as Culture), *NaturAll* (Nature for Nature) and *Return to Nature* (Nature for Society). Subsequent analyses and a follow-up webinar enriched the visions, identifying opportunities for more synergistic nexus interactions. Our findings highlight how plural visioning processes can generate distinct visions with positive nexus synergies enabled by unique indirect drivers (e.g. biodiversity-food synergies enabled by re-ruralisation and spiritual human-nature connections in '*Dòigh Nàdair*', technological advancements in '*Return to Nature*' and mimicking natural ecological processes in '*NaturAll*'). Yet, the visions also share common features (e.g. restored ecosystems and participatory governance) underpinned by overlapping value perspectives. We demonstrate how explicit consideration of the biodiversity nexus in visioning processes can reveal opportunities to align biodiversity goals with broader sectoral priorities, thereby helping sustain ambitious biodiversity outcomes amid diverse and competing agendas.

KEY POLICY HIGHLIGHTS

- Distinct and overlapping values for nature manifest as plural visions of nature-positive futures for Europe
- Positive synergies between biodiversity and other sectors are enabled by diverse indirect drivers
- Future applications of the Nature Futures Framework can benefit from a nexus perspective

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1. Introduction

Biodiversity plays a crucial role in sustaining life on Earth. However, anthropogenic influences on the environment are degrading ecosystems, resulting in a loss of biodiversity and nature's contributions to people, and in some instances species extinctions (McCallum 2015; Jaureguiberry et al. 2023). Biodiversity loss has significant impacts, including disrupting regulatory ecosystem processes and threatening nature's direct contributions to human

wellbeing (Cardinale et al. 2012; Díaz et al. 2018). The potential crossing of biodiversity tipping points further increases the risk of non-linear and systemic impacts on the functioning of the Earth system (Lenton et al. 2023). Despite widespread recognition of the urgency of the biodiversity crisis, biodiversity loss continues to accelerate, motivating growing calls for 'transformative change' (IPBES 2021). This drive toward transformative change, i.e. 'a fundamental, system-wide reorganization across technological,

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economic and social factors, including paradigms, goals and values' (IPBES 2024b) is supported by increasing global ambitions for biodiversity conservation under the Kunming-Montreal Global Biodiversity Framework, along with national and sub-national targets and commitments. Additionally, bottom-up actions aim to steward systemic change that improves human-nature relationships (Bennett et al. 2016).

Calls for transformative change bring to light important questions about the scope, scale and speed of change required to halt and reverse biodiversity loss and achieve nature-positive futures. Foresight methods are increasingly used to address these complex and uncertain dynamics, employing a wide range of methods and tools to explore the 'what' and 'how' of transformative change by engaging with future possibilities (Muiderman et al. 2020). Scenarios are a key approach for exploring drivers of change (Vervoort and Gupta 2018) in terms of both risk reduction through the development of 'probable' futures and uncertainty navigation through 'plausible' futures (Muiderman et al. 2020). However, these methods are also increasingly critiqued for neglecting justice considerations, policy impacts (Rubiano Rivadeneira and Carton 2022) and the perspectives of Indigenous peoples and local communities (Cheok et al. 2025). This critique applies particularly to scenarios developed through participatory means, though it may also apply to scenarios used to inform climate and land use change models. This has led to a growing focus on co-creating positive futures (Bennett et al. 2016; Pereira et al. 2019).

The recent IPBES transformative change assessment highlights the importance of 'shared positive visions' for guiding transformative change (IPBES 2024b), and the transformative change literature underscores the value of envisioning positive futures to motivate and build shared commitment for transformative change (Moore and Milkoreit 2020). Dominant conceptualisations of transformative change characterize it as emerging when marginal 'seeds' or niche innovations effectively scale and disrupt established systems, altering their identity and feedback loops in often irreversible ways (Geels 2002; Bennett et al. 2016). This disruption addresses practices that perpetuate biodiversity loss and its interactions with other sectors (e.g. 'predict-and-control' water management or intensive agriculture) while also identifying, nurturing, and mainstreaming practices that hold promise for a more sustainable future (e.g. adaptive, nature-based solutions in water management, agrivoltaics or agroecological agricultural practices). Participatory, co-creation processes are increasingly used to explore the desirable endpoints of these systemic changes, employing creative and transdisciplinary methods to make visions of a sustainable future more imaginative

and tangible (Hebinck et al. 2018; Pereira et al. 2018; Raudsepp-Hearne et al. 2020). Co-created visions can also reshape human-nature relations (IPBES 2024b), offering hopeful narratives and inspiring strategic actions (McPhearson et al. 2016; Lazurko et al. 2023). This paper builds on this call, using 'nature-positive' to broadly frame truly transformative futures for people and nature, recognising that this term is vague and can be taken up differently in various public and private contexts (e.g. Booth et al. 2024; Luxton et al. 2024). Such visions can paint a comprehensive picture of the future state of a local context, region, or the globe, and thus not only includes the state of biodiversity and factors directly influencing it (i.e. direct drivers, such as land use change, pollution and resource exploitation), but also the underlying causes that alter these direct drivers (i.e. indirect drivers, such as socio-cultural, institutional, economic, demographic and technological factors). These indirect drivers indicate possibilities for deeper change at the level of paradigms and values (IPBES 2024b). We use these definitions of indirect and direct drivers throughout this paper, aligning with (IPBES 2014).

Importantly, transformative change is messier and more contested than dominant conceptualisations might imply, as it also emerges from the plural perspectives and value judgments of people with a stake in transformation (Leach et al. 2010; Stirling 2014). Ignoring the plural and political dimensions of transformative change has myriad risks, including that actions taken in the name of transformation further justify business-as-usual thinking, do not reflect the diversity of needs and aspirations for change, or shift the burden of change to more vulnerable groups (Blythe et al. 2018). Plurality – understood as the inclusion of diverse perspectives – is an important principle when engaging with transformative change to enhance inclusivity in the process and novelty in the outcomes (Delina and Sovacool 2018; Leventon et al. 2021). This plurality can be achieved through various means, such as integrating different knowledge systems or varying ideas of human-nature relations (Visseren-Hamakers et al. 2021; Raymond et al. 2023). The Nature Futures Framework (NFF) addresses these risks by providing a heuristic tool that facilitates the co-creation of plural, place-based visions of nature-positive futures drawing from diverse value perspectives centred on human-nature relations (Pereira et al., 2020; Kim et al., 2023). Developed through an iterative, co-creation approach by the IPBES Task Force on Scenarios and Models, the NFF is based on the premise that 'values play an important role in supporting transformative change visions' (IPBES 2024b, p. 35).

The research community is responding to the need for plural visions of nature-positive futures by using the NFF as a tool for structuring place-based

visioning processes. The NFF aims to guide the development of inclusive and transformative scenarios towards nature- and people-positive futures underpinned by diverse nature values (Section 2.1) and is being used at local and regional scales in Europe. Examples include an evaluation of the performance of nature recovery options across NFF value perspectives in an urban boundary landscape in England (Dunn-Capper et al. 2023), the development of desirable futures for a national park in the Netherlands using a combination of the NFF and futures methods (Kuiper et al. 2022), and an exploration of integrated scenarios for the functioning of ecological infrastructure in Switzerland (Mayer et al. 2023). Some studies are also applying the NFF at the scale of continental Europe. For example, Quintero-Urbe et al. (2022) use the NFF to evaluate the value perspectives reflected in pre-existing rewilding and nature's contributions to people participatory scenarios in Europe, Dou et al. (2023) use the NFF to envision variations of spatial implementation of EU and global sustainability targets, and Fornarini et al. (2023) develop narratives of the future of nature protection in Europe across various themes such as protected areas, forestry and freshwater ecosystems.

While applications of the NFF are growing, no visioning processes – within or beyond Europe – has considered the importance of mainstreaming biodiversity action across sectors as a crucial enabler of transformative change. This gap is underlined by failures of current policies to reverse biodiversity loss to date being partially attributed to the lack of integrated policies and practices that mainstream biodiversity across policy departments and sectors (Rounsevell et al. 2020). The mainstreaming of biodiversity was analysed in the IPBES nexus assessment, which emphasises that numerous highly synergistic response options are already available to actors in multiple sectors for sustainably managing biodiversity in ways that provide benefits across other sectors (IPBES 2024a). The IPBES nexus assessment defines 'nexus approaches' as 'understanding the interlinkages and interdependencies between sectors and systems in a holistic manner to develop integrated and adaptive decisions that aim to maximise synergies and minimise trade-offs' and focuses on interlinkages among biodiversity, water, food and health (IPBES 2024a). We extend the nexus in this paper to consider how biodiversity interacts with water, food, health, energy and transport (which we define as 'the biodiversity nexus'), expanding on existing nexus literature that predominately focuses on a subset of sectors such as water-energy-food (Conway et al. 2015; Johnson and Karlberg 2017; Kurian 2017). If taken seriously, the biodiversity nexus points to the need for change that not only directly addresses biodiversity conservation (e.g. establishment of protected

areas), but for extensive, transformative changes across domains and scales of linked human and natural systems.

This paper addresses the gap in plural visions of nature-positive futures that identify and leverage synergies between biodiversity and other sectors to deliver the transformative change required to address the current biodiversity crises. We focus on the European scale, asking *what could plural nature-positive futures for Europe in 2050 look like that explicitly leverage synergies in the biodiversity nexus?* The aim is to generate findings that can inspire and inform multi- or cross-scale scenario studies and EU policies, offering overarching vision archetypes that can accommodate a diversity of local or regional visions. To extend our contribution beyond Europe, we also respond to IPBES's calls for experimenting with and reporting on innovative methodological approaches for operationalising the NFF (IPBES 2023) by asking *what unique contributions our methods can offer to future applications of the NFF?* To address these questions, we designed and facilitated a participatory co-creation process with 26 participants operating at the European scale as part of the Biodiversity Nexus: Transformative Change for Sustainability (BIONEXT) project. Our process aims to develop plural visions of nature-positive futures underpinned by the different value perspectives of the NFF that explicitly consider the biodiversity nexus in fostering synergistic and transformative action between biodiversity and other sectors, including the indirect drivers of change (i.e. underlying causes) that enable them.

2. Methods

2.1. The Nature Futures Framework

The NFF places human and nature relationships at the centre of the co-creation process by harvesting diverse participants' worldviews in developing new visions that can inspire transformative actions (IPBES 2022a). The framework in Figure 1 presents three main value perspectives on nature that are widely understood in conservation research and practice (Pereira et al. 2020). The Nature for Nature perspective focuses on the intrinsic value of nature, as in sparing space for nature for it to thrive without human exploitation. The Nature for Society perspective emphasizes instrumental values of nature as in diverse benefits people receive from nature. The Nature as Culture/One with Nature perspective presents relational and cultural values that show diversity and richness in how humans interact, co-create and co-exist with nature. These value perspectives are intricately intertwined with synergies and conflicts that are specific to the location and context. Nature

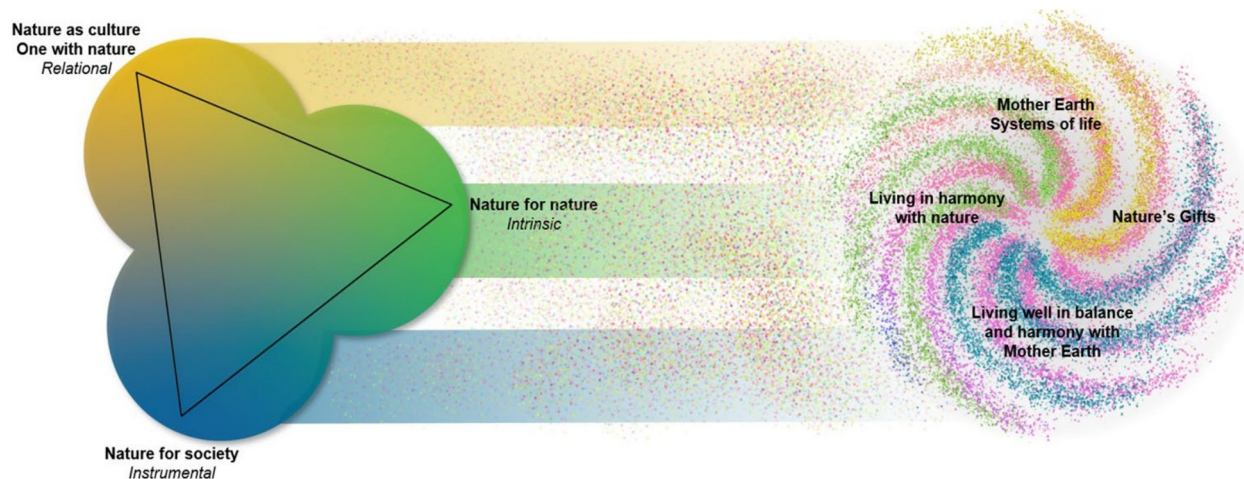


Figure 1. The Nature Futures Framework, a tool developed by the IPBES Task Force on Scenarios and Models to aid in developing scenarios and models that address the need for more desirable futures for people and nature. This visioning process focused on the left side of the figure, though the right side was shown in the co-creation process and brought in implicitly through participant contributions (IPBES 2022a).

futures scenario modelling aims to identify interventions that have multiple co-benefits and fewer trade-offs for nature and people (Kim et al. 2023). To ensure that these diverse worldviews and values of nature are considered in developing future visions, the NFF can be used as a heuristic for convening and opening dialogues with a broad range of societal actors in co-creating the futures we want to move towards (Durán et al. 2023). In this study the NFF is used to create plural visions that are distinct by using the three value orientations explicated by the NFF as a starting point and tracing how these values orientations developed over the process.

2.2. Vision co-creation, analysis, iteration and validation

The methodology for vision co-creation, analysis, iteration and validation summarized in Figure 2 was adopted to respond to the question: *what could plural nature-positive futures for Europe in 2050 look like that explicitly leverage synergies in the biodiversity nexus?* Key co-creation exercises that engaged researchers and participants are the vision co-creation workshop and

vision iteration and validation webinar (yellow). Researchers synthesised and analysed the outputs of these activities to aid in stakeholder iteration and validation (blue), and artists were engaged to help with communication and utilisation (green). In addition, participants in the co-creation process were included in the development of this paper (as knowledge co-creators and listed co-authors). This shared oversight over the methodology mitigated the risks of circular analysis and bias among the researchers constructing and analysing the process and ensured that the interpretation of workshop findings and more generalisable insights reflect their original intentions.

Importantly, the purpose of the visioning process was to counter dominant scientific narratives about the biodiversity crisis by developing inspiring visions that represent transformative change relative to the status quo, particularly focusing on plurality and leveraging synergistic solutions. This is a unique and important contribution to a larger research process that focuses on imagination and inspiration, and in which we prioritised reflecting stakeholder expertise and views without explicitly fact checking the underlying assumptions and seeking scientific

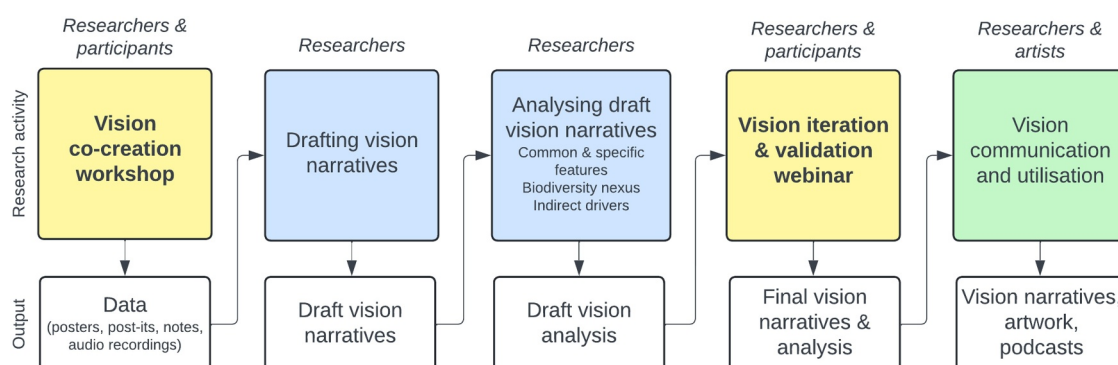


Figure 2. Summary of methodology for vision co-creation, analysis, iteration and validation.

evidence about feasibility in the present. The validation of the coherence and feasibility of the visions comes in later project stages (not reported in this paper), when the visions are used to inspire transformative action pathways, which are then modelled to reveal whether the visions are feasible and achieved.

2.2.1. Vision co-creation workshop

The first co-creation workshop held on 4–5 May 2023 in Santorini, Greece, led participants through a structured process designed to co-create plural visions of nature-positive futures for Europe in 2050. At this stage, the biodiversity nexus was considered primarily through participant recruitment: the 26 participants in the workshop represented all sectors considered in the BIONEXT project to constitute the biodiversity nexus (i.e. biodiversity, water, food, health, energy and transport), organisational types (i.e. research organisation, government, civil society/non-governmental organisation, business and minority groups), and regions in Europe (i.e. western Europe, southern Europe, central/eastern Europe). Participants were selected through snowball sampling, starting from institutions and/or individuals known to the project team. Significant considerations were made for a balance of age, gender and other characteristics, though it was noted that the focus on the European scale and English language in the workshops resulted in a bias of participation from a more elite demographic, including those who were more highly educated and non-migrant populations of Europe. The vision development activities are summarised in Table 1.

During the workshop, we guided the co-creation of visions using broad themes that combined various types of direct and indirect drivers of biodiversity loss (state of environment and natural resources, governance, voice and equity, etc.). These themes were chosen for their intuitiveness to stakeholders, helping them articulate a broad picture of how society could function in the future. While the vision narratives were drafted using these themes, the subsequent analysis focused on a different, more specific set of nexus elements and indirect drivers relating to transformative change (see Section 2.2.3). The outcome of the workshop was analysed (Section 2.2.2) into a set of plural nature-positive visions for Europe in 2050.

2.2.2. Drafting vision narratives

Following the workshop, the data in the form of posters, post-its, notetaker notes and audio recordings were collated for each vision. Three researchers analysed the data for one of the three visions in parallel and inputted participant contributions relevant to the different vision themes into a standard template. The contributions were summarised as descriptive bullet points and disagreements and contradictions between vision elements in the same vision were highlighted. Following this, a brief analysis of similarities and differences across the visions was conducted by a researcher who was not included in the initial analysis. The results of the analysis of similarities and differences were discussed, including resolving disagreements and contradictions, before the three researchers proceeded with drafting vision

Table 1. Vision development activities during the vision co-creation workshop.

Session	Purpose	Activity
Day 1, Session 1	Familiarise participants with the three value perspectives on the NFF triangle	Facilitators presented the NFF and then participants were asked to think of an experience related to nature and to locate and discuss that experience by standing within an NFF triangle taped to the floor. This allowed participants to familiarise themselves with the NFF and position themselves relative to other value perspectives.
Day 1, Session 2	Brainstorm key elements of desirable nature futures for Europe	Participants were asked to brainstorm responses to the question: what themes are important to include in a desirable future for people and nature in 2050? A facilitator elicited and clustered key themes on a wall and worked with participants to give headings to each cluster.
Day 1, Session 3	Locate key themes from Session 2 on the NFF triangle to form three vision groups with three different value perspectives	Participants considered where each theme from Session 2 fit in relation to the three value perspectives on a large version of NFF triangle on the wall. Themes were moved into a commensurate location anywhere in the triangle. Themes that were essential to all value perspectives or for which the underlying value perspective was uncertain were put on separate posters to ensure they were considered in the visioning process for all three value perspectives. Three final clusters that included an approximately equal number of themes determined the value perspectives underlying three visioning groups (see clouds in Figure 7).
Day 2, Session 4	Develop three narratives of desirable nature futures for Europe, underpinned by value perspectives from Session 3	Participants developed visions in pre-defined breakout groups with representation of the participant selection criteria. Participants were guided through a visioning meditation followed by collaborative completion of four posters designed to make the vision more detailed according to the following categories: core principles; environment and natural resources (including biodiversity nexus interactions); governance; economy, jobs and education; demographics, health and wellbeing; voice and equity.
Day 2, Session 5	Creatively present three narratives of desirable nature futures for Europe	Each group named their vision and prepared a presentation of their vision in the format of a 'news story'.

narratives (i.e. descriptive paragraphs elaborating the vision of a desirable future) with narrative subsections according to the themes used to develop the narratives in Session 5 of the workshop (i.e. core principles; environment and natural resources – including biodiversity nexus interactions; governance; economy, jobs and education; demographics, health and wellbeing; voice and equity).

The vision narratives were subject to two levels of quality review. First, the three researchers who drafted the narratives evaluated the consistency of the analytical approach, level of detail and language across the two other visions. Second, another researcher independent of the initial analysis reviewed the narratives. The narratives were then refined based on feedback.

2.2.3. Analysing draft vision narratives

The three draft vision narratives were analysed to identify common and specific features, explore interlinkages within the biodiversity nexus and examine the role of indirect drivers across the three visions. This analysis ensured that the visions were *plural* (i.e. had enough specific features), considered the *biodiversity nexus* (i.e. explicitly leveraged synergies) and *transformative* (i.e. addressed indirect drivers of biodiversity loss). In addressing indirect drivers, attention was given to the deeper underlying causes of these drivers, particularly at the level of societal paradigms and values (IPBES 2024b).

2.2.3.1. Common and specific features. An analysis of common and specific features helps elaborate the shared goals that frame what is inside the NFF triangle and the unique features that make the visions distinct (IPBES 2023). The analysis started by comparing the state of five elements of the biodiversity nexus (i.e. biodiversity, water, food, health, energy and transport) and the five generic domains of indirect drivers (demographic, economic, politics and institutions, socio-cultural, and technological) across the three visions. This initial analysis then informed a summary of common and specific features according to the themes used to develop the vision narratives (i.e. core principles, environment and natural resources, governance, etc.). It also helped to further detail the specific features.

2.2.3.2. Biodiversity nexus. The three vision narratives were analysed for interlinkages within the biodiversity nexus (i.e. system interactions that linked biodiversity with other sectors). First, sentences that describe any nexus element/sector in the biodiversity nexus were highlighted and summarised in bullet points. Synergies – i.e. interlinkages between sectors

that contribute to positive outcomes in multiple domains or sectors concurrently – were identified in the narratives by highlighting statements that explicitly or implicitly link biodiversity to the other nexus elements (i.e. interlinkages from another sector to biodiversity, or biodiversity to another sector). These interlinkages were then contrasted to the current state by summarising the findings of a recent review on current understanding of the biodiversity nexus in Europe (Kim et al. 2024).

2.2.3.3. Indirect drivers. The vision narratives were analysed to understand how they addressed the indirect drivers of biodiversity loss, i.e. those underlying causes that influence direct drivers, as indicators of transformative change – as transformative change requires fundamental change in these indirect drivers (Visseren-Hamakers et al. 2021; Pascual et al. 2022). This approach aligns with the IPBES Transformative Change Assessment, which expanded and deepened the concept of what constitutes transformative change (IPBES 2024b). The indirect drivers examined – socio-cultural, economic, politics and institutions, demographic and technological – were selected based on the IPBES Global Assessment (IPBES 2019), which offers a comprehensive driver categorisation for this analysis. By comparing the visions with the current state of these indirect drivers, the analysis identified which were more explicitly foregrounded in each vision. These highlighted drivers were then further examined to assess their role in enabling the fundamental changes required to achieve positive synergies within the biodiversity nexus.

2.2.4. Vision iteration and validation webinar

A visioning webinar was held in February 2024 to validate and further elaborate the visions developed during the co-creation workshop. A significant focus of the webinar was to explicitly leverage synergies in the biodiversity nexus, as this was only done primarily indirectly during the co-creation workshop through participant recruitment (Section 2.2.1). All participants who attended the vision co-creation workshop were invited with 11 of the 26 original participants attending. These participants represented all sectoral expertise from the workshop except transport (biodiversity, water, food, health and energy), all organisational types from the workshop, and all regions of Europe from the workshop, though only one participant was from northern Europe. Participants were sent the draft vision narratives beforehand. The activities of the webinar are summarised in Table 2. The outcomes of the webinar were analysed to inform another iteration of the visions, resulting in plural visions of nature-positive

Table 2. Visioning webinar activities.

Session	Purpose	Activity
1	Share the vision analysis from Workshop 1 and validate aspects of the visions that were identified as problematic or unclear	Plenary presentation of the three vision narratives followed by Mentimeter questions and answers (i.e. online poll) with targeted questions for each vision.
2	Discuss and elaborate the analysis of elements and interlinkages of the biodiversity nexus and compare to the current state	Breakout group discussion on sub-sections of the biodiversity nexus (i.e. biodiversity-energy-transport, biodiversity-water-food, biodiversity-health). Participants collaborated on a Mural board to consider how they could enrich the state of nexus elements or better highlight synergies between elements in each vision, and to validate the characterisation of the current state.
3	Highlight the distinct aspects of the three visions by asking questions that allow participants to relate visions to one another	Plenary format, with facilitators reading out a question from Mentimeter and providing context from the current state (if relevant) and background from each vision. Participants ranked visions relative to one another according to the questions.

futures for Europe in 2050, with a focus on additions that explicitly leverage synergies in the biodiversity nexus.

2.2.5. Vision communication and utilisation

The three final vision narratives were translated into communication products and for future co-creative exercises in BIONEXT project. The artist Lina Kusaite attended the vision co-creation webinar and worked with researchers through a series of iterative meetings to develop art pieces that reflect participants' contributions and stimulate new ideas and interpretations. In addition, the vision narratives were summarized as podcasts. These outputs aimed to stimulate the co-creation of transformative pathways that show the actions and strategies in the different nexus elements and systems required to reach each of the visions.

2.3. Reflecting on final value perspectives

The visioning process aimed to produce visions underpinned by plural values, which was done by orienting the three visions within different locations on the NFF triangle (see Session 3 of vision co-creation workshop). This was a core contribution for how we operationalised plurality in a shared futures visioning process. A reflection exercise with researchers and participants at the end of the co-creation process considered how each of the three visions evolved toward a particular value orientation. Participants reflected on the three visions during the vision iteration and validation webinar, where participants were asked 'Where would you place [vision name] on the NFF?' via Mentimeter. To respond, they rated the degree to which the vision reflected each of three value perspectives on the NFF (Nature as Culture, Nature for Society, Nature for Nature) on a scale from 1 to 5. Researchers reflected on the value orientation the three visions after the narratives were finalised by responding to the same questions in survey format. The findings were averaged across participant and researcher contributions.

3. Results

3.1. Three visions of nature-positive futures for Europe

The three vision narratives that emerged from the vision co-creation process are summarised below and presented in full in [Supplementary Material 1](#). The visions are underpinned by different values for nature within the NFF triangle. While these locations started closer to the corners of the three value perspectives, they also include elements between value perspectives ([Figure 7](#)).

3.1.1. Vision 1: Dòigh Nàdair: the way of nature (nature as culture value perspective)

In 2050, European society has a more pluralistic, balanced and reciprocal relationship with nature. People are guided by core principles of care and contemplation, and mainstream culture has a deeper spiritual and cultural connection with the natural world. Diverse and culturally embedded landscapes support flourishing ecosystems across Europe where human and natural processes are intertwined. Sustainable, regenerative and circular natural resource management nurtures a balanced relationship with the environment. Agricultural systems are community-based and rooted in agroecological and organic principles, and diets are local and seasonal with the little animal protein that is consumed supplied by pastoralists and small-scale fishers. Energy systems are renewable and configured to local needs and resources. Water is recognised as a commons and a human right, balanced with legal rights for water bodies. Governance systems are simple and localised, with strong connections to local landscapes and ecosystems. At higher levels, climate change and biodiversity considerations are mainstreamed within environmental, social and economic policies. The European Union embraces diverse worldviews and reorients toward being a good listener on the global stage, adopting an open borders policy. The economy in Europe is based on a degrowth and sharing model,

rooted in stewardship and care. There is high equality of professions with universal basic income and more time for nature and community stewardship. Education systems are collaborative and embrace diverse forms of knowledge, preparing people for active citizenship. The population is stable but older and more diverse, with more people living in rural areas than is currently the case. Europeans have robust rights to healthcare, including mental health, and have rediscovered the roots of natural and ancestral healing traditions to complement western scientific medicine. In 2050, Europe has achieved a more just and democratic society that prioritises active citizenship, stewardship and human rights. An artist interpretation of this vision is found in [Figure 3](#).

3.1.2. Vision 2: NaturAll (nature for nature value perspective)

The importance of respecting nature for itself and giving space to natural ecological processes is highly valued among European society in 2050. Society is ecologically literate and adapts its activities to the dynamics of nature. Most people live in compact, self-sufficient cities and have lifestyles with low environmental impact. This is enabled by a sufficiency approach to energy demand, an



Figure 3. Artist interpretation of Vision 1: Dòigh Nàdair - the way of nature (nature as culture value perspective). Artist: Lina Kusaite.

energy system that is renewable and an active and or electrified mobility system. A preventative health approach improves lifestyles and wellbeing, reducing pressure on the environment of medical care. Water management adapts to and builds upon natural processes, such as through the removal of dams and restoration of channelized rivers to give space to nature. In agriculture, a high (genetic) diversity of native species is prioritised, and nutrient cycles are balanced through integrated livestock systems. Diets are predominantly plant-based, seasonal and local. The governance system in place is multi-level and decentralized with most legislative power with the European Union and regional communities. The regional communities collaborate on the basis of solidarity and are (financially) supported by the EU. Moreover, there is a global platform for dialogue and collaboration which helps the EU negotiate zero-conversion trade policies. Within the EU, nature has been granted rights, which are implemented through democratic representation and courts. This ensures the rights and responsibilities that humans and nature have towards each other. Through degrowth and equitable distribution, the economic system has stabilised and is more local. Key indicators for prosperity are the state of the environment and wellbeing. People work fewer hours and focus their work on community and nature. Education is also more focused on ecological literacy and practical skills and partially conducted in informal community settings and in nature. The size of the population has stabilised after regulating migration into Europe. An artist interpretation of this vision can be found in [Figure 4](#).

3.1.3. Vision 3: return to nature (nature for society value perspective)

In 2050, European society has achieved a more balanced future for nature and people. Europe focuses on meeting the needs of nature and people with technological solutions, reduced consumption, and more highly valued biodiversity and water. Urban areas are community-based and transformed with nature-based solutions and green infrastructures. Biodiversity flourishes in rural areas with nature accessible where it exists. Rewilding takes place in forests, wetlands, mountains and rivers, which achieve good ecological status. There is an expansion of sustainable farming via circular economy, science and technology, and novel food sources to meet local and regional needs with reduced consumption. Water availability is improved with efficient storage, cities are greened with reused water resources, and coastal areas are protected by restored wetlands. EU policy and governance contribute to preventing wars, with



Figure 4. Artist interpretation of Vision 2: NaturAll (nature for nature value). Artist: Lina Kusaite.

extractive industries strictly regulated and higher independence from trade with mega countries. Sixty per cent of energy sources are renewable with improved technology, production and storage including smart grids in rural areas, biowaste and sewage contributing to energy production and nature conservation, and an overall reduction in energy use. More bikes are used than cars in cities. The EU manages pandemics better, with reduced disease risks, by securing space for nature and a decentralised health system reflecting diverse perspectives and practices. There are technology breakthroughs and skills development, and lifelong education adapts to the changing job landscape. The population has stabilised and equity has improved, with prosperous rural areas and spatial division between nature and human activities. An artist interpretation of this vision can be found in Figure 5.

3.2. Common and specific features in the three visions

Table 3 summarises the common and specific features across the three visions. This analysis reveals how the visions share common features that frame the outcomes of nature futures, such as reduced environmental impact, improved human wellbeing,

and a transformed food system. By using the NFF, there are also distinct features reflecting different value perspectives, such as a greater focus on technological shifts in 'Return to nature' versus socio-cultural shifts in 'Dòigh Nàdair: The way of nature'. The themes of the direct and indirect drivers in the table emerged from the workshop process, wherein the direct drivers were clustered together to reflect nexus interactions and indirect drivers were clustered into sensible themes for stakeholders to have a free-flowing discussion. The themes were meant to be as comprehensive as possible to ensure no topics were explicitly excluded.

3.3. Transforming toward positive synergies in the biodiversity nexus

This section presents the analysis of the visions for key indirect drivers of biodiversity loss. Changes in these indirect drivers are seen as potential enablers of the transformative changes required to achieve the positive synergies within the biodiversity nexus (Pascual et al. 2022). This is followed by a more granular analysis of pairwise positive synergies between biodiversity and other nexus elements (i.e. water, food, health, energy and transport), drawing from examples of which type of indirect drivers (i.e. socio-cultural, economic, political and institutional,



Figure 5. Artist interpretation of Vision 3: Return to nature (nature for society value perspective). Artist: Lina Kusaite.

Table 3. Summary of key elements of the three visions of nature futures for Europe.

Themes	<i>'Dòigh Nàdair: The way of nature'</i> <i>Nature as Culture value perspective</i>	NaturAll <i>Nature for Nature value perspective</i>	Return to nature <i>Nature for Society value perspective</i>
<i>Primary value</i>	Nature as Culture	Nature for Nature	Nature for Society
<i>Core principles & values</i>	Common: balanced relationship with nature and reduced environmental impact; biodiversity valued more and human wellbeing improved		
	• Pluralistic, balanced, and reciprocal relationship with nature • Care, contemplation, connection and respect • Deep spiritual and cultural connection to the natural world	• Value and recognise natural processes • Human activity adapts to natural processes • Ecological literacy and respect for nature • Solidarity between communities	• More balanced, practical, autonomous and local • Sparing space for, and restoring, nature • Meeting human needs while adapting to nature • Minimising ecological impact of Europe
<i>State of biodiversity (outcomes)</i>	Common: restoring ecosystems and conserving biodiversity via diverse landscapes and/or improved ecological connectivity		
	• Thriving, diverse and culturally embedded landscapes • Nature reserves actively managed with community ownership and equal access	• Highly diverse and well-connected landscapes • Majority of land allocated for nature exclusively • In those areas: stable population of keystone species and very high biodiversity intactness	• Biodiversity flourishing in rural areas • Nature-based solutions and green infrastructure in cities • Rewilding in forest, wetlands, mountains and rivers • Achieving good ecological status
<i>State of environment and natural resources (direct drivers)</i>	Common: commitment to transforming the food system for sustainability with changes in farming, diet and reduced waste; enhanced water quality and management; transition to renewable and sustainable energy sources with minimized impact on nature and biodiversity		
	• Sustainable, regenerative and circular natural resource management • Community-based and agroecological agricultural practices • Local and seasonal diets with animal protein consumed less and supplied by pastoralists and small-scale fisheries • Renewable and localised energy and transport systems configured to local needs and resources • Water recognised as a human right, balanced with legal rights for water bodies	• Human activity builds on natural processes in agriculture (e.g. by prioritising native species) and protecting water and wetlands ecosystems • Minimised negative influence through energy sufficiency and renewable energy and reduction of chemical use and other pollution • Transport is electrified and regulated through progressive pollution taxes • Natural processes facilitated by removal of dams and locks, and settlements relocated from flood plains	• Sustainable farming via circular economy, science and technology, novel food sources to meet local and regional needs, and reduced consumption. • 60% renewables with improvements in technology, production and storage, e.g. smart grids for rural areas, biowaste and sewage contributing to energy production and nature conservation, and reduction in energy use • Improved water availability with efficient storage, greening the cities by reusing water, and protecting more coastal areas
<i>Governance (indirect drivers)</i>	Common: localised, participatory, inclusive and well-networked governance system; EU as a strong coordinator for solidarity and sustainability; governance and strategies mainstreamed to mitigate climate change		
	• Simple localised system, with strong networks connected to local landscape • Mainstreaming of climate and biodiversity across sectors and social policies at higher levels • EU embraces diverse values and worldviews, becomes a good listener with open borders	• Multilevel governance system mirroring natural processes • Most legislative power with the EU and with regional communities; solidarity between regions facilitated by EU • Rights for nature through representation and courts • Global platform for dialogue and collaboration	• Decentralised, polycentric, participatory and less technocratic • Legislative power in regional and national governance • EU plays a strong role in maintaining peace and reducing environmental impact • Reduced trade with major powers • Active integration of EU environmental policies
<i>Economy, jobs, and education (indirect drivers)</i>	Common: transition to more sustainable and community-oriented economies towards an equitable society; improved work-life balance as a result of a shift in the measure of success beyond economic growth; education for environmental, societal and technological challenges		
	• Economy rooted in stewardship and care, universal basic income within degrowth/sharing economy • High equality of professions, with more time for nature and community stewardship • Education prepares people for active citizenship and embraces diverse forms of knowledge	• Local and degrowth economy with equitable distribution of wealth. Prosperity indicated by wellbeing and environment • Fewer working hours, most jobs community and nature oriented • Education is more community-based and focuses on practical skills, ecological literacy and stewardship	• Decentralised and circular economy towards green and steady growth • Success measured on happiness and wellbeing • Reduced workdays with flexible job transition • Lifelong education, training skills development, harmonised minimum wage across Europe
<i>Demographics, health, wellbeing (indirect drivers)</i>	Common: stable European population; nature improves overall wellbeing		
	• Stable but older and more diverse population, with more people living in rural areas • Robust rights to healthcare; natural medicines and ancestral healing traditions complement western scientific medicine	• Stable population due to regulated migration • Majority lives in compact self-sufficient cities • Lifelong mental and physical health promoted through lifestyles and healthy food • Healthcare focuses on preventative approaches, and the natural rhythm of life is respected in older age	• Stable population with low birth rate, more people in cities, migration in Europe • Nature improves human wellbeing with reduced pandemic risks by securing space for nature • Pollution impact reduced on nature and people

(Continued)

Table 3. (Continued).

Themes	<i>‘Dòigh Nàdair: The way of nature’ Nature as Culture value perspective</i>	<i>NaturAll Nature for Nature value perspective</i>	<i>Return to nature Nature for Society value perspective</i>
<i>Voice and equity (indirect drivers)</i>	Common: more inclusive society with equity improved in wage, education and healthcare; shared concerns for social justice, equity • A more just and democratic society with active citizenship, stewardship and human rights	• Communities have rights and responsibilities over nature and nature has rights and voice • Social justice agenda includes nature • Conservation through co-design with plural perspectives considered	• Citizens and countries with a stronger voice • Equity improved on wage, education and health

demographic and technological) appear to most significantly facilitate the transformative change required to enable them.

3.3.1. Indirect drivers enabling positive synergies in the biodiversity nexus

The type of indirect drivers that appear more significant in the visions in enabling transformative change toward positive synergies in the biodiversity nexus are summarised in Table 4. All visions elaborate indirect drivers that signify a deviation from the current state, as defined by (Elbakidze et al. 2018; IPBES 2018; Shaw et al. 2020; Stoddard et al. 2021), but each vision has a different rationale for which indirect drivers underpin transformation processes. In ‘Dòigh Nàdair: The way of nature’, transformative change is driven by socio-cultural changes in people’s connection to nature as well as a political change toward active citizenship. Alternatively, in ‘NaturAll’ transformative change is driven by changing and institutionalising the inherent value of natural processes (e.g. legal protection of nature). Finally, in ‘Return to Nature’, transformative change is driven by incentivising and regulating pollutive industries and by emerging technologies.

3.3.2. Pairwise synergies in the biodiversity nexus, as enabled by indirect drivers

The explicit pairwise synergies between biodiversity and other nexus elements in each vision are visualised for the Food-Biodiversity interlinkage, summarised for other synergies, and described in full in Supplementary Material 2. These descriptions include both 1) the nature of the positive synergies in each vision and 2) examples of the specific indirect drivers facilitating transformative change to enable each pairwise synergy. The findings show how most interlinkages from other nexus elements to biodiversity in the current state are negative, reflecting how persistent unsustainability in other sectors drives biodiversity loss, as defined by a recent review of the current state of the biodiversity nexus in Europe by Kim et al. (2024). However, even in the current state interlinkages from

biodiversity to other nexus elements are mostly positive, reinforcing the foundational role of biodiversity in many aspects of human life. In contrast, the three visions include more synergistic interactions from and to biodiversity. Positive synergies from other nexus elements to biodiversity highlight how more nature-friendly action generates a reciprocal relationship to biodiversity, facilitating a more balanced relationship between humans and nature across all three visions.

3.3.3. Food and biodiversity

The state of the interlinkage between biodiversity and food in the current state and the three visions is depicted in Figure 6. In the current state, expansion of agricultural land, agricultural intensification, monocropping, erosion of genetic diversity, rise of invasive species, and influx of nutrient and chemical inputs drive biodiversity loss and limit space for nature (Kim et al. 2024). Conversely, biodiversity underpins ecosystem processes that support food production. In ‘Dòigh Nàdair: The way of nature’, a more spiritual and reciprocal connection to nature and demographic re-ruralisation enables a food system that embraces local and seasonal diets and adopts agroecological, organic and community-based agricultural practices that enhance biodiversity. In ‘NaturAll’, more compact cities and agricultural land areas free up land for nature, and a society that values natural ecological processes enables the food system to value genetic diversity and use of native plants. In ‘Return to Nature’, scientific and technological advancements and financial incentives enable sustainable and diversified production of novel protein sources that free up land for nature and improve biodiversity.

3.3.4. Water and biodiversity

In the current state, water infrastructure causes ecological fragmentation and alters flows in ways that contribute to biodiversity loss, yet biodiversity underpins ecosystem processes that support the water cycle. In ‘Dòigh Nàdair: The way of nature’, a rights-based perspective balances the rights of water bodies with the human right to water to enable an integrated

water management approach as a commons that reduces pressure on biodiversity. In 'NaturAll', societal adaptation to natural processes improves that state of aquatic ecosystems and wetlands (e.g. by controlled human withdrawal from floodplains and removing dams to give space to nature), which in turn improves biodiversity. In 'Return to Nature', expanded protection of coastal areas, technological innovations on storage and reuse, pollution control, and nature-based solutions improve water quality and availability which improves biodiversity.

3.3.5. Health and biodiversity

The current state of the interlinkage between health and biodiversity is mixed. On one hand, pharmaceuticals and high energy use in the health sector impact the environment and ecosystem functions in ways that can negatively impact biodiversity. Yet, biodiversity underlies many ecosystem services that are crucial for human health. In 'Dòigh Nàdair: The way of nature', changes in socio-cultural norms enable a shift toward the use of natural medicines and access to nature as a complement to western medicine, enhancing wellbeing and biodiversity. In 'NaturAll', socio-cultural acceptance of natural processes leads to lower chemical medication use that reduces pressure on the environment. In 'Return to Nature', the state of health improves through people's increased connection to nature and technological advancements in the pharmaceutical industry reducing pollution impact on nature.

3.3.6. Energy and biodiversity

In the current state, energy infrastructure negatively impacts terrestrial and marine habitats and renewable energy production can increase competition for land. Furthermore, peat extraction for

energy production, fossil fuel burning and fuel-wood all reduce habitat quality. Yet, ecosystems can also provide a fuel source such as through sustainable harvesting of biomass. In 'Dòigh Nàdair: The way of nature', changes in demographics, namely a re-ruralisation, and increased citizen involvement in infrastructure development enable widespread use of agrivoltaics (i.e. mixed solar-PV and agricultural production) that free up land for nature. In 'NaturAll', the socio-cultural shift toward adapting to ecological processes leads to an energy sufficiency approach that reduces energy demand, thereby reducing the impacts of energy on biodiversity. In 'Return to Nature', government regulations, reduced consumption and technological developments mitigate the impact of renewable energy on nature.

3.3.7. Transport and biodiversity

In the current state, transport infrastructure harms nature as it causes species mortality, restricts species movement and reduces genetic diversity. Furthermore, marine and terrestrial transport systems spread invasive species, pathogens and disease vectors. In 'Dòigh Nàdair: The way of nature', demographic changes lead to more local production and consumption and therefore an overall reduction of transport and mobility that reduces pressure on the environment. In 'NaturAll', a different demographic shift (e.g. more compact cities) allows for more collective and active travel modes that have reduced environmental impact. In 'Return to Nature', there are limitations on private cars with increased use of active transport (e.g. bikes) in cities and more hydrogen and electricity-based transportation that improves biodiversity.

Table 4. Summary of current and future state of key indirect drivers enabling transformative change toward positive synergies in the biodiversity nexus per vision.

Categories of indirect drivers	Current state	Nature futures visions		
		Dòigh Nàdair: The way of nature <i>Nature as Culture</i>	NaturAll <i>Nature for Nature</i>	Return to Nature <i>Nature for Society</i>
Socio-cultural	Materialistic norms, global trends, extractive approach to nature, perceived duality between nature and society	Building a more spiritual and reciprocal connection with nature	Adapting to natural ecological processes	Reconnecting with nature and reducing consumption
Economic	Global economies, decision-making focused on GDP growth, productivity and individual gain, linear resource economy	Prioritising degrowth and sharing/local economies, wellbeing	Prioritising degrowth and ecological wellbeing	Prioritising a circular resource and green/stable economy
Politics and institutions	Centralised power and governance structures, limited participation, minimal representation of nature, high levels of privatisation	Building active citizenship and stewardship	Granting legal protection of nature	Regulating environmental impact and reducing resource dependency
Demographics	75% of population live in urban and (sprawled) suburban areas	Re-ruralising society	Densifying to compact urban areas	Prosperous rural areas
Technological	Prioritisation of labour productivity and financial efficiency	Localising and motivating citizen involvement in infrastructure	Mainstreaming a sufficiency approach (i.e. reducing demand)	Prioritising sustainability and research/innovation in energy, food and water systems

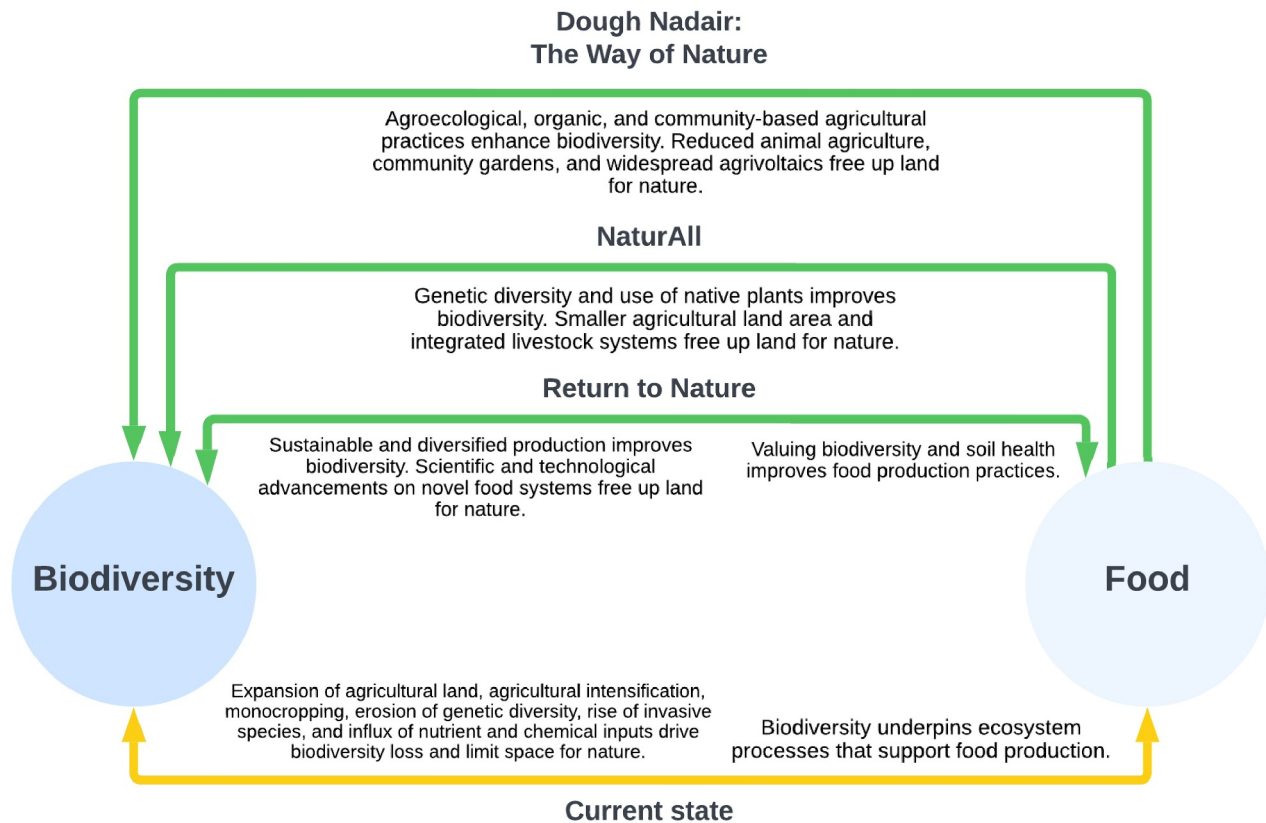


Figure 6. Interlinkage between food and biodiversity, including the current state and three future visions.

3.4. Reflection on value perspectives on the Nature Futures Framework

The starting positions of the visions on the NFF (cloud icons) and approximate end positions of the visions on the NFF (centroids of triangles) are depicted in Figure 7, based on evaluations from participants and researchers as described in Section 2.3. The locations of the centroids relative to the starting positions show how the perceived value perspective migrated closer to the centre of the triangle than their original positions and how each vision was perceived to include significant elements of the different value perspectives. Importantly, these locations are approximate and based on the perceptions of researchers and workshop participants.

4. Discussion

This paper asked *what could plural nature-positive futures for Europe in 2050 look like that explicitly leverage synergies in the biodiversity nexus? What unique contributions can our methods offer to future applications of the NFF?* The study developed three new visions for Europe that can inspire and inform other studies at local, regional and European scales: ‘Dòigh Nàdair: The way of nature’, ‘NaturAll’, and ‘Return to Nature’, each starting from three distinct value perspectives of the NFF. The analysis of common and specific features across the visions (Section 3.2) revealed how common

features reflect broad ambitions about which there was consensus among participants (e.g. to achieve a balanced relationship with nature), while the specific features often relate to the structures and processes of a landscape and society that enable them. For example, in ‘NaturAll’, a balanced relationship is enabled by a society that mimics natural ecological processes, while in ‘Dòigh Nàdair: The way of nature’, this balance is enabled by a spiritual connection with nature and in ‘Return to Nature’, it is met through government regulations and technological solutions. This entanglement of common and specific features was an emergent feature of the study that suggests that their categorisation is more nuanced and complex than described in the IPBES methodological guide (IPBES 2023). An additional emergent finding was the changes to the perceived location of the visions on the NFF over time, where the visions started toward the corners of the triangle but migrated toward the centre, potentially signifying more overlap across value perspectives. These learnings offer important insights for the future of nature and people in Europe, where the heterogeneity of landscape and culture may call for a heterogeneity of visions and pathways to achieve them.

4.1. Contribution to nature futures visioning in Europe

These plural visions of nature-positive futures for Europe are situated amid a range of studies applying

the NFF to generate narratives of positive futures for nature and people. We chose the European scale to allow for opportunities to inform multi- or cross-scale scenario studies (i.e. linking global to regional scales) and inform European-level policies. In particular, by focusing on nature-positive visions that leverage synergistic response options in the biodiversity nexus, we offer timely and unique inspiration for operationalising key findings from both the IPBES transformative change and nexus assessments in Europe (IPBES 2024a, 2024b). While developed independently, the visions here offer examples of how region-specific narratives can be situated alongside or nested within global narratives, such as those used to demonstrate the value of the NFF (Durán et al. 2023). For example, 'NaturAll' closely reflects the 'Arcology' illustrative narrative focused on Nature for Nature, reflected in their shared focus on compact cities and pristine nature areas. However, there were some differences, such as 'Arcology' being more technology driven, potentially reflecting different interpretation of region-specific considerations missing at the global scale. Our contribution also offers a complementary view to other studies producing European visions of nature-positive futures using different methodologies (Quintero-Urbe et al. 2022; Dou et al. 2023). The most similar study to ours was from the NaturaConnect project (Fornarini

et al. 2023), which developed visions organised according to the three distinct value perspectives on the NFF. However, the NaturaConnect visions were developed with a focus on future nature protection, while our visions focus on nexus-oriented approaches and cover a wide range of sectors, actions and themes (e.g. protected areas, forestry, freshwater ecosystems, etc.). The NaturaConnect visioning methodology also assumed a common baseline for indirect drivers across their three visions (e.g. economy, governance, culture, etc.), while our visions allowed the status of these indirect drivers to emerge from the visioning process. Such similarities and differences across narratives reflect the range of framings, contexts, and methodologies used to operationalize the NFF and enrich the imagined future state of Europe. These findings hint toward the potential opportunities and implications of linking our European-scale visions with those at even more local and place-based scales, where the heterogeneity of Europe and representativeness of stakeholders may be better reflected.

4.2. Methodological advances for applications of the Nature Futures Framework

This paper offers three important methodological advances for applications of the NFF, expanding the

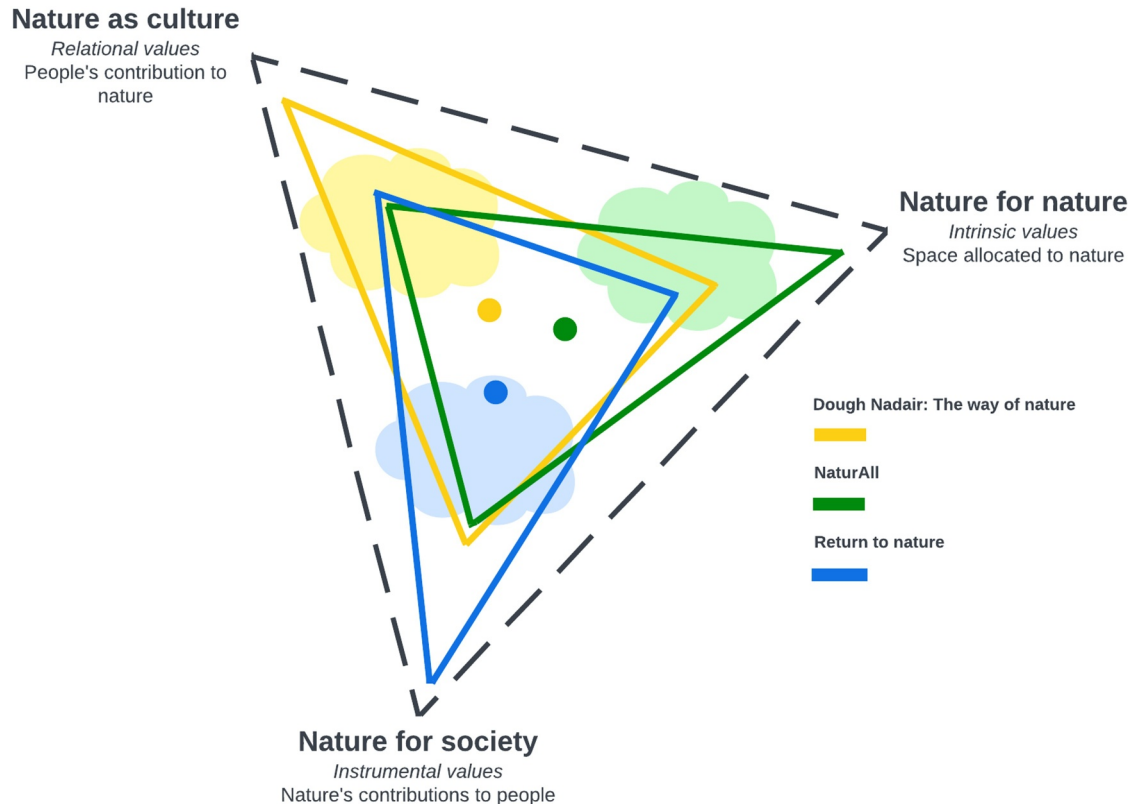


Figure 7. Starting and endpoint locations of visions on the NFF. The cloud icons correspond to the original starting points for vision development determined during the co-creation workshop. The points of the triangles are the mean of researcher and participant perceptions of the endpoint locations across researchers and participants for each vision. The circles are the centroid of the triangles.

impact of our research to the global research community by responding to the question, *what can our unique methodological contributions offer to future applications of the NFF?* First, this paper used a structured approach to bring explicit consideration of synergistic interactions in the biodiversity nexus into a positive visioning process, expanding nature futures visioning and the nexus approach to a wide range of sectors that interact with biodiversity (IPBES 2024a; Kim et al. 2024). To do so, the visions were first developed by orienting them to unique value perspectives during the workshop (i.e. the clouds in Figure 7), resulting in draft vision narratives that in some cases were missing explicit consideration of nexus interactions or had hidden trade-offs. During the webinar, these draft visions were elaborated with explicit consideration of the biodiversity nexus, resulting in visions that respond to calls for more holistic and systemic consideration of nexus interactions in mainstreaming biodiversity across policy sectors (Rounsevell et al. 2020; IPBES 2024a). In doing so, this paper has demonstrated how applying a nexus perspective in co-creative visioning can help synthesise opportunities for synergistic nexus interactions documented in the literature (e.g. Hanspach et al. 2017; Timko et al. 2018; Baldwin-Cantello et al. 2023; Kim et al. 2024) into coherent storylines to guide policy action. These storylines can influence policy by offering a counterpoint to conventional policymaking: rather than starting with sectoral policies and attempting to reconcile them, the visions offer an internally consistent narrative under which all sectors can simultaneously attempt to achieve their goals. This opportunity for translating visions to action is further explored in Section 4.4. However, this is just a starting point for bringing nexus interactions into visions: we focused on 2-way interactions between biodiversity and other sectors, but opportunities exist for more interrelated and coupled (e.g. 3-way) interlinkages that leverage even more synergistic response options (IPBES 2024a).

Second, this paper allowed the future state of indirect drivers to emerge through the vision co-creation process. In doing so, we explored how changing values can play a foundational role in addressing the biodiversity crisis (DePuy et al. 2021; Leventon et al. 2021; Raymond et al. 2023), particularly the need to move beyond narrow economic and political valuations of nature toward more expansive, pluralistic value sets in decision-making (IPBES 2022b). This process also uncovered multiple opportunities to shift the deeper roots of transformative change – i.e. fundamental, system-wide shifts in worldviews, structures and practices – discussed in the IPBES transformative change assessment (IPBES 2024b). Importantly, the analysis of indirect drivers revealed that those most influential in enabling transformative

change toward positive nexus synergies vary significantly across value perspectives. For example, in ‘Dòigh Nàdair: The way of nature’, key indirect drivers include socio-cultural shifts in human-nature relationships, demographic re-ruralisation, and a move toward localised economies, enabling synergies between biodiversity and food, health, energy and transport. In ‘NaturAll’, demographic changes toward more compact cities and a socio-cultural shift toward mimicking natural ecological processes drive synergies between biodiversity, food, water, health, energy and transport. In ‘Return to Nature’, technological innovation and reduced consumption support synergies between biodiversity, food, water, health and energy. These findings highlight that the diverse values for nature in the NFF may also influence values underpinning the state of many indirect drivers, including societal relationships with technology and the economy. They also underscore the importance of tailoring policy approaches to the distinct opportunities and enabling conditions presented by different indirect drivers across the European landscape.

Third, this paper showed that the dominant value perspectives underpinning the visions (from the perspective of stakeholders and researchers) evolved through a co-creative visioning process. While this finding was unanticipated at the beginning of the visioning process, allowing this plurality of values to evolve was important to ensuring inclusivity in the process and novelty in the outcomes (Delina and Sovacool 2018; Leventon et al. 2021). By tracing the perceived location on the NFF through the visioning process we suggest that the visions may have migrated from distinct toward a more overlapping and entangled mix of value perspectives. This supports and enriches existing literature emerging from IPBES that emphasises the plurality of values and the need for inclusivity to inspire and inform transformative change (Visseren-Hamakers et al. 2021; Raymond et al. 2023) despite the challenges associated with identifying, disentangling and evaluating distinct nature values (Pascual et al. 2017, 2023). To maintain plurality in our participatory process and avoid unnecessary merging of the visions, we included an exercise to make the visions more distinct during the webinar. In doing so, the process encouraged participants to consider how European contexts can achieve similar outcome indicators (e.g. improved biodiversity or uptake of renewable energy) while looking significantly different on the landscape due to different underpinning value perspectives (e.g. proportion of land allocated for nature or percentage of people living in urban areas). Allowing for a flexible process in which value perspectives could evolve may have contributed to an enriched understanding. Further, by validating the vision narratives

with participants and involving several participants as co-authors in this paper, we were able to ensure that while the values underpinning the visions may have evolved over the process, their communication and interpretation stayed consistent with their original intent, thereby facilitating a joint learning process between researchers and participants.

4.3. Study reflection and limitations

Significant efforts were made to ensure that the 26 participants in the study represented a diversity of representations of regions, organisational types and sectoral expertise. However, all stakeholder processes have resource constraints to include a certain number of participants representing a subset of a population, which can never be fully representative. In this case, the focus on the European scale resulted in a bias toward those operating in institutions at the European level who were relatively highly educated with above-average knowledge about the issues under discussion. As a result, the visioning process focused on a subset of actors with personal and professional interest in biodiversity and was not oriented to the public: this meant there was minimal representation of more marginalised groups, such as Indigenous Peoples, diverse socio-economic backgrounds, refugees, and people without such professional expertise. Further, our focus on the European scale and English language presented both opportunities and challenges in attempting to reflect the heterogeneity and diversity of people and landscapes across the continent.

Researchers and participants observed that the outcome of co-creation processes may be influenced by the social dynamics within the visioning group. For example, participants in the 'Return to Nature' group tended to evaluate the vision contributions based on the current reality, which in some cases resulted in vision elements that were undesirable to other group members, such as lower ambitions for renewable energy or persistent gender inequality despite efforts to close the gap. Researchers reflected on a persistent challenge in which participants found it difficult to uproot from the limits of 'now' and envision a desirable future (Bendor 2018; Pereira et al. 2019).

The choice to divide participants according to the diversity of the group aligns with best practices in knowledge co-creation, as it is meant to allow for richer discussion and better outcomes (Leventon et al. 2016). However, in our case it meant that participants did not necessarily fully align with their given value perspective, potentially contributing to inconsistencies in the visions. Still, participants appeared to benefit from stretching their own values and perspective. Thus, the choice of how to split

participants into visioning groups should be aligned with the explicit goal of the exercise – i.e. groups with aligned value perspectives can allow for consensus and more divergent vision narratives, whereas groups with more diverse value perspectives can stimulate dialogue and produce visions that may reflect the aspirations of a wider swathe of society. Moreover, using the NFF as a starting point for three visions with distinct value orientations can be perceived as a tool to stimulate plurality while also being a limitation. On the one hand it created a language to distinguish values and helped ensure differences among the three visions. On the other hand, it may have restricted the visions to stay somewhat aligned to a particular value orientation and limited the opportunity to explore or include other value orientations. Nevertheless, plurality emerged in other dimensions beyond values, such as diverse types of knowledge being brought in by participants or diverse perspectives of relating to nature that were discussed in all three groups. Finally, factors such as the amount of time and energy offered by participants, who is in the room, which methods are used for facilitation, and the choices and interventions of facilitators may influence the outcomes and results in direct and indirect ways (Lazurko et al. 2023), pointing to the need for multiple concurrent processes that together generate enriched pictures of the future of nature and people in Europe and beyond.

4.4. Future research and application

The contribution of this paper has the potential to unfold several areas for future research and practice. More methodological experimentation is required to combine the plural values of the NFF with the systemic insights of a nexus approach. Further research is also required to understand the implications of plural visions that maintain an entangled mix of common and specific features and overlapping value perspectives. Is it possible for Europe to move toward all three visions at once, and which combination of futures are current policies and practices creating? In particular, targets under global frameworks like the Kunming-Montreal Global Biodiversity Framework, the EU's Biodiversity Strategy to 2030, and national and sub-national targets and commitments could benefit from the broader range of options facilitated by a deeper consideration of the diversity of visions and pathways to achieve them.

Additionally, critiques of the NFF point to its focus on human-nature values, which doesn't explicitly include consideration of other indirect drivers. However, the approach described here makes other indirect drivers such as socio-cultural, economic and technological change explicit as well, which were also distinct across value perspectives and

had unique contributions to positive synergies in the biodiversity nexus. Further research is required to understand the role of indirect drivers in enabling positive synergies in the nexus, particularly when translated to pathways. In addition, further research is needed to understand the rationale for *why* certain indirect drivers were common across value perspectives while others were distinct. Furthermore, achieving these visions in Europe would have numerous implications in other regions beyond those described in these visions (e.g. migration or the role of the EU in international processes), including in ways that may put greater pressure on nature elsewhere (i.e. offshoring environmental impacts). These issues were addressed ad-hoc by certain visioning groups (e.g. the NaturAll vision includes zero-conversion trade policies), but further research would be required to fully elaborate how the visions for Europe described in this paper may be nested within nature futures at the global scale.

The purpose of the visions was to offer inspirational counterpoints to dominant scientific narratives about the biodiversity crisis by developing inspiring visions that represent transformative change toward a nature-positive and synergistic Europe. However, while such visions can spark motivation, their transformative potential remains limited unless they are translated into concrete, actionable steps. To produce more action-oriented knowledge and test the feasibility of the assumptions underpinning the visions, they are being integrated into a future workplan. This includes a second co-creation workshop, where participants – including a diverse range of European-scale actors such as policymakers – will co-develop transformative pathways to realise the visions. This approach aims to ensure relevance and uptake in both public policy and private sector strategies. These pathways will also be evaluated using a nexus modelling framework that combines several modelling tools: an agent-based model (CRAFTY-EU; Brown et al. 2019), an integrated assessment model (IAP2; Harrison et al. 2019), and a system dynamics model (Juniper; Ioannou et al. 2024). After modelling, the outputs will be compared with the visions to assess whether the pathways successfully achieve the envisioned outcomes. This process will stimulate mutual learning for both modellers and workshop participants and inform subsequent steps in iterating – and potentially raising the ambition of – the transformative pathways.

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Research ethics

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