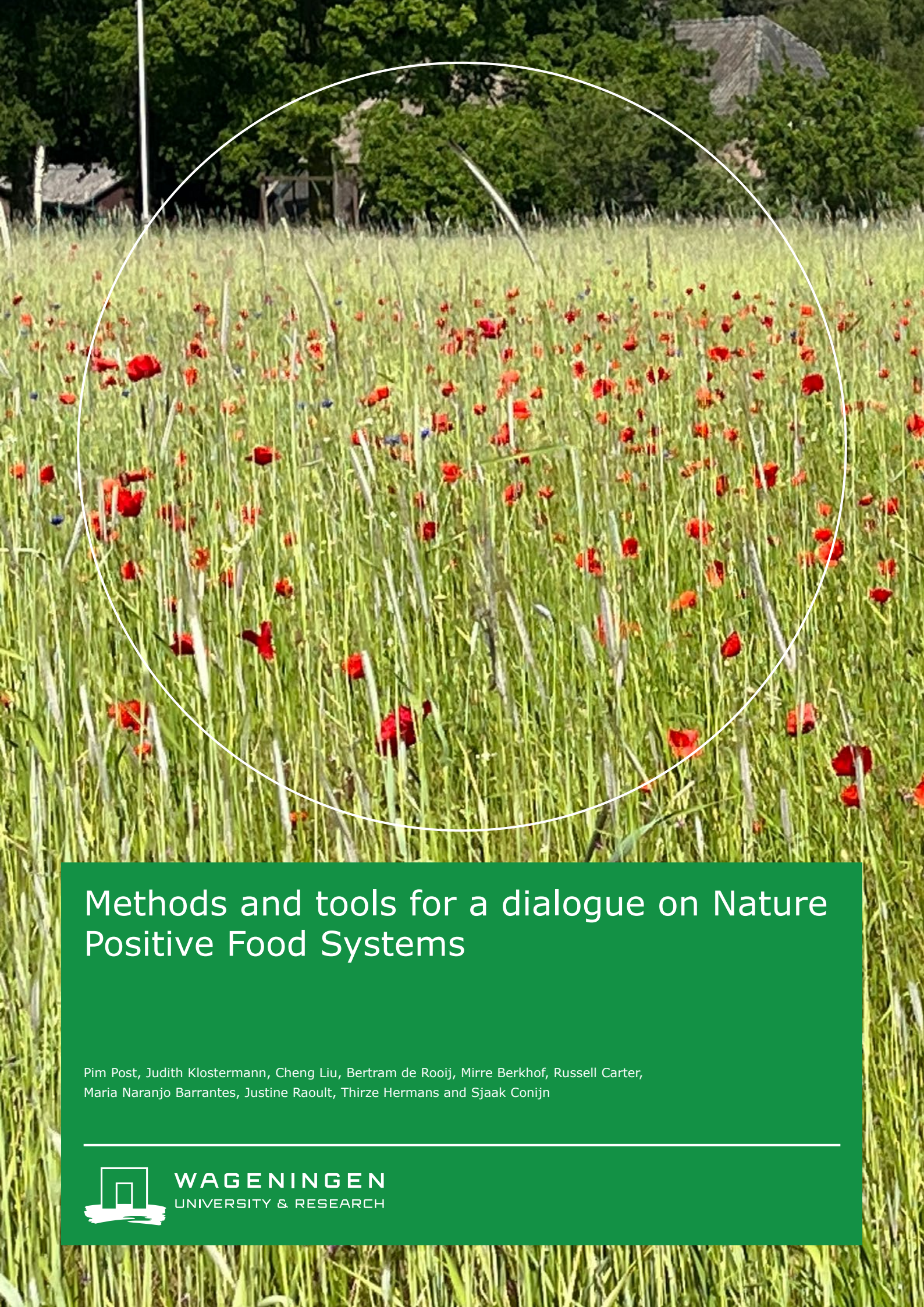

Methods and tools for a dialogue on Nature Positive Food Systems

Pim Post, Judith Klostermann, Cheng Liu, Bertram de Rooij, Mirre Berkhof, Russell Carter, Maria Naranjo Barrantes, Justine Raoult, Thirze Hermans and Sjaak Conijn

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Methods and tools for a dialogue on Nature Positive Food Systems

D3.1 of project Nature Positive Food Systems

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Dit rapport presenteert tools die de transitie naar een natuurpositief voedselsysteem kunnen begeleiden. Ze zijn ontwikkeld in het project Nature Positive Food Systems'. De tools omvatten i) een definitie van natuurpositieve voedselsystemen; ii) een set indicatoren die kan helpen om de voortgang naar natuurpositieve voedselsystemen in verschillende contexten te volgen; iii) een landschapscanvas om te helpen begrijpen wat een nature positief voedselsysteem betekent voor mensen in een specifiek voedselsysteem, wat er nodig is, wie er nodig zijn, hoe een transitie naar een nature positief voedselsysteem kan worden ondersteund en hoe succes eruitziet; iv) een tool om enablers en barrières in een specifiek voedselsysteem te evalueren om vervolgens stappen te zetten in de richting van een natuurpositiever voedselsysteem. De tools zijn getest in twee casestudies: één rond het Menengai-bosreservaat in Kenia en één rond etnoveterinaire geneeskunde in Gujarat, India. De casestudies hielpen om te reflecteren op de tools en ze te verbeteren. Een belangrijk inzicht uit het project is dat het concept van 'natuurpositieve voedselsystemen' dynamisch is en zou moeten evolueren terwijl een gedeeld begrip groeit. Er bestaan diverse perspectieven op de natuur en het erkennen hiervan en het vinden van een gemeenschappelijke basis is onderdeel van het proces. De ontwikkelde tools helpen om enablers en barrières te identificeren en doelen te formuleren om de transitie naar natuurpositieve voedselsystemen op gang te brengen.

This report presents a set of tools to guide the transition towards a nature-positive food system. They were developed in the project: 'Nature Positive Food Systems'. The tools include: i) a definition of nature-positive food systems; ii) a set of indicators that may help to track progress towards Nature Positive Food Systems in several contexts; iii) a landscape canvas tool to help understand what a nature positive food system means for people in a specific food system: what is needed, who is needed, how can a transition to a nature positive food system be supported and what does success look like; iv) a tool to evaluate enablers and barriers in a specific food system to move to a nature positive impact. The tools were tested in two case studies: one centred around the Menengai forest reserve in Kenya and one around ethnoveterinary medicine in Gujarat, India. The case studies helped to reflect on the tools and improve them. A key insight from the project is that the concept of 'Nature Positive Food Systems' is dynamic and should evolve while a shared understanding grows. Diverse perspectives on nature exist and acknowledging this and finding common ground is part of the process. The developed tools help to identify enablers and barriers and to formulate a comprehensive set of goals to transition towards Nature Positive Food Systems.

Keywords: nature, biodiversity, food system, canvas, indicator, Kenya, India

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name: Annemarie Groot

date: 28 January 2025

1 Introduction

1.1 Background

In this report, we describe a set of methods that aims to turn the present negative impact of the human food system on nature and biodiversity into a positive impact.

Global biodiversity is rapidly declining, thereby, threatening human existence and quality of life (IPBES, 2019; Leclère et al., 2020). In past decades, the rate of decline of biodiversity has been up to 6% per decade, depending upon the metric used (Leclère et al., 2020). This has contributed to severe decreases in the extent and condition of ecosystems and, thereby, threatens nature's capacity to provide food and feed, fibres, energy, medicines, genetic resources for agrobiodiversity, and various essential materials, such as timber (IPBES, 2019). Nature's deterioration also threatens key natural regulatory processes that contribute to air quality, freshwater quality, climate mitigation and adaptation, pollination, pest control and the impacts of natural hazards (IPBES, 2019).

Nature conservation is often dated back to the onset of the industrial revolution approximately two centuries ago (Haila, 2012). It could be argued that some forms of nature conservation existed long before that, for example, the reservation of wildlife resources only for royalty or aristocracy (Hooke, 2011), or even further back, the knowledge of indigenous people in conserving biodiversity and nature (Abas et al., 2022). The efforts always have two elements: self-interest in humans wanting to maintain natural resources, and a perception of the intrinsic value of nature, which can also incorporate religious and spiritual frames of thinking. The ways in which conservation ideas become actuated can also differ. They can originate from written analysis and/or a call-to-action, a government regulation, the establishment of a nature organisation, or from setting aside parts of land as 'nature parks'. In Europe, the 1992 European Union (EU) Birds- and Habitats Directive and its consequent regulations form a crucial 'landmark' for nature conservation. The Convention on Biological Diversity (CBD) (1992) was conceived with a similar aim at the global level. All these ideas, regulations, and physical efforts of the past centuries and decades, however, were not sufficient to stop the decline of biodiversity and nature. The CBD Aichi Targets have not been met. Recently, new goals and targets were set in the Kunming-Montreal Global Biodiversity Framework of the CBD (https://www.cbd.int/gbf).

Reversing the decline of nature requires an integrated strategy, in which not only conservation efforts are increased but also drastic shifts in production and consumption are taken up. Such a shift would mean an unprecedented ambition but would be necessary to reverse biodiversity losses by 2050, while avoiding conflict with affordable food production (Leclère et al., 2020). This nature positive ambition has been embraced by several organisations as a collective effort (Locke et al., n.d.).

Food systems are both key drivers for, and are affected by, biodiversity loss (IPBES, 2019; Meinzen-Dick et al., 2021). Biodiversity loss is for a large part driven by habitat degradation and fragmentation, to which agriculture has greatly contributed. One of the main impacts of food production is the conversion of wildlands into agricultural lands, see, for example, Figure 1. In addition, agricultural production is an important source of pollutants, including excess nutrients and pesticides. Furthermore, agriculture puts pressure on freshwater waterbodies for irrigation purposes and contributes to greenhouse gas emissions. In turn, food production is highly dependent on ecosystem services, such as natural pollination, pest control, soil health, water regulation, and climate regulation, which are all threatened by a decline in biodiversity (FAO, 2019).

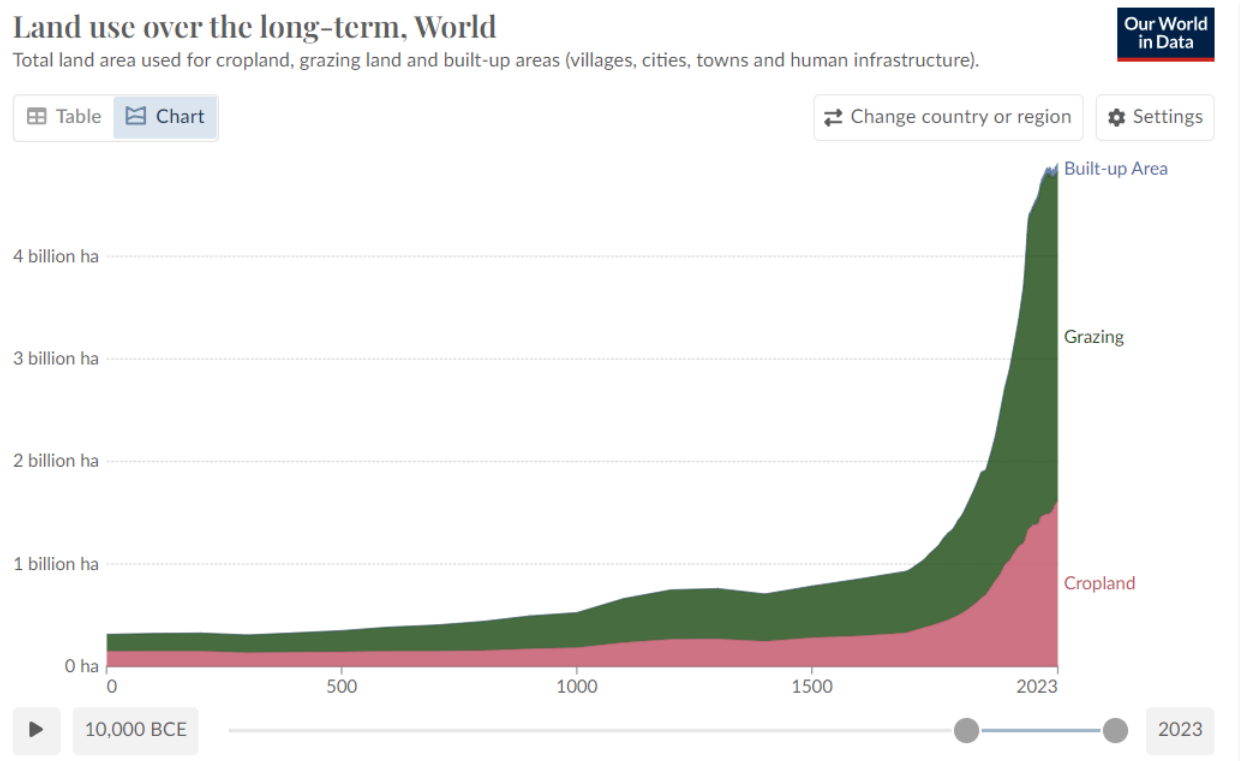


Figure 1 *Changes in land use during the past two millennia (Our World In Data. Land use over the long-term. https://ourworldindata.org/grapher/land-use-over-the-long-term). A steep curve of agricultural land use which began in the 18thCentury, became increasingly dominated by animal production.*

Many adverse effects of food systems on nature are avoidable. A reverse in biodiversity loss is considered possible (Leclère et al., 2020). This not only requires a high ambition but also a paradigm shift, from a focus on reducing harm to having a positive impact, and from seeing nature only as something instrumental to seeing it as something with intrinsic value (Mommer et al., 2022). Aiming for a positive impact on nature connects to a broader shift towards a more motivational and inspiring approach to sustainability (Gibbons, 2020). This is why the concept of Nature Positive Food Systems (NPFS) has been introduced: To explore how food systems can be developed that have a positive effect on nature (Mommer et al., 2022).

The concept of Nature Positive Food Systems is very young (Leclère et al., 2020; Mommer et al., 2022). Research, dialogue, and guidance are required for a transition towards nature-positive food systems. A project has been formulated by Wageningen Research to investigate ways towards such a nature-positive future. The project was called 'Nature Positive Food Systems' and it was part of the Knowledge Base (KB) programme of Wageningen Research (KB-35-101-003), funded by the Dutch Ministry of Agriculture, Food Security, Fisheries and Nature. In this report, we present the tools that were developed during the project that ran between January 2023 and December 2024.

1.2 Aim

The aim of the 'Nature Positive Food Systems' project was to develop practical tools to understand how food system activities and strategies interact with nature in both positive and negative ways. The tools developed from it were intended for use by stakeholders within the food system, such as stakeholders from agriculture, governments and/or private companies. The tools were also intended for use in investigation of the trade-offs, dilemmas and tensions that may arise when actors try to transform their part of the food system towards having a nature-positive effect. This report summarises the tools developed in this project.

1.3 Overall approach

The tools we developed and tested are (Figure 2):

- An extended, proposed definition of Nature Positive Food Systems as a foundation for developing a further shared understanding of this concept.
- A landscape canvas tool to help clarify understanding of what a nature positive food system means for people in a specific food system, what is required for it, who is needed to make it successful, how a transition to a nature positive food system can be supported and what success looks like.
- A set of indicators that can help to track progress towards a nature positive food system in several contexts.
- A tool to evaluate enablers and barriers within a specific food system to move to a nature positive impact.

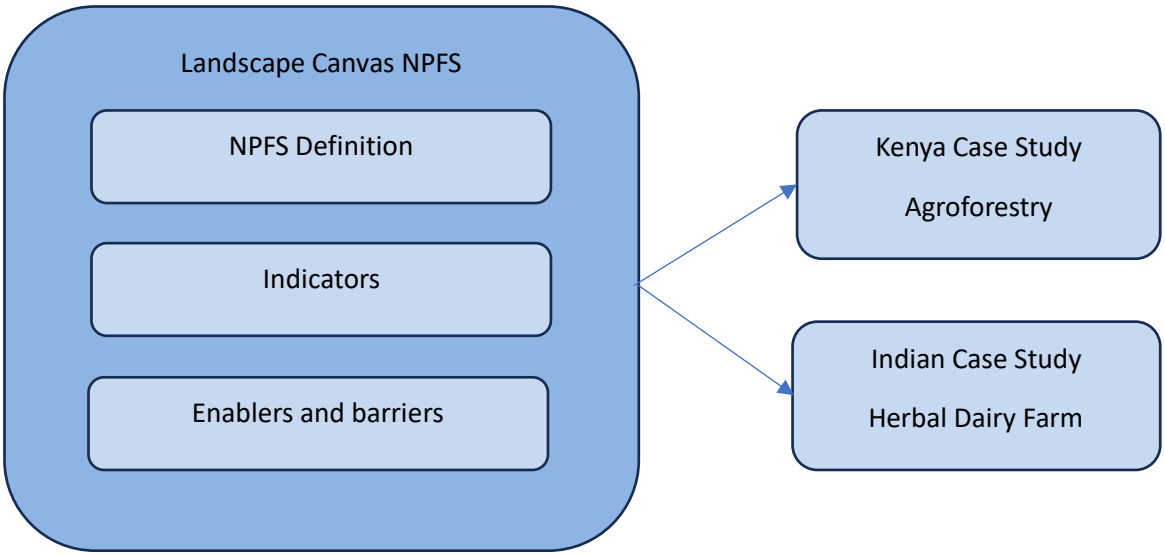


Figure 2 *Connection between the different tools and the case studies. The NPFS Definition, Indicators and Enablers and barriers can be applied in the context of a landscape canvas but also on their own.*

These tools are presented in the Chapters 2 to 5. The purpose of the tool, a quick overview, application in case studies and an evaluation are presented in each Chapter. In the final Chapter, we draw overall lessons and outline what is needed to further guide a transition towards Nature Positive Food Systems.

The case studies in which we tested the tools are described in Hermans et al. (2024) and le Roux-Pullen et al., 2024, and are briefly introduced here.

Menengai forest reserve in Kenya

The first case study centred around the Menengai forest reserve in Kenya. It involved the Menengai Community Forest Association (MCFA) - An umbrella body that aims to ensure sustainable management of the forest alongside various economic activities. While some of these activities do not support regenerative or restorative goals, nature positive practices, such as agroforestry, are popular and commonly used. Moreover, there is a high dependency of the community on the forest area and, therefore, a communal sense of importance of maintaining the forest. Balancing livelihood needs with the sustainability of the forest and surrounding agricultural land is, hence, the main challenge in the case study.

The Menengai Forest Reserve is a state forest covering 6,018.9 ha, which covers a forested area, approximately 10% of its area is plantation, and less than 10% of its area is bush and degraded area. The community living in the area is largely dependent upon the sale of agricultural food crops but also on the sale of unprocessed forest products and casual employment. Crops frequently grown include maize, beans,

potatoes and vegetables. Furthermore, the community depends on the forest in several ways, including the collection of firewood, livestock grazing, herbal medicines, vegetables, wild fruits, honey, as well as soil (improved into brick-making, as opposed to mud walls).

The vision of the MCFA is utilisation of non-timber forest resources without conflict with conservation. In addition, the MCFA explores new ways of land use, for instance, by enabling crop production to take place alongside tree planting. The basis of its collaboration is a participatory forest management plan.

Ethnoveterinary medicine in Gujarat, India

The second case study centred around ethnoveterinary medicine (EVM) in Gujarat, India, and the broader environmental and nature protection goals related to that. Local herb and medicinal plant formulations have been used for centuries in India to prevent and treat diseases in cattle, with good results (Rath and Joshi, 2020). Positive results include improved milk production and quality, healthier animals, less residues of antibiotics (and other drugs) in the milk and in the environment, and the potential to improve animal welfare.

In modern times, traditional knowledge has often been undervalued or forgotten. India has made great progress in rekindling understanding of and subsequently promoting the use of herbs on dairy farms, particular under smallholder dairy farmers (with one to five animals, but collectively contributing 62% to the country's total milk production). Yet, challenges remain, for example regarding the lack of validation and standardisation of EVM using western science parameters and a preference of the farmers and veterinarians for conventional antibiotics-based medicine practices.

The State of Gujarat produces approximately 7.5% of the country's milk and is home to a city that is known as the 'Milk Capital of India' - Anand. The Head Offices of many organisations involved in the dairy sector are located in Anand, including the National Dairy Development Board (NDDB), and the Head Office of Gujarat Cooperative Milk Marketing Federation Ltd (AMUL). The NDDB advocates a dairy development model that is known as 'Anand Pattern'. It is based on a cooperative model in which farmers collectively own and manage dairy processing and marketing.

Approximately 30% of India's milk is produced by crossbreeds of indigenous cattle and exotic breeds such as Holsteins and Jerseys. This initially helped to increase dairy production but seems to come at a cost of increased disease incidence. In addition, a large number of dairy farmers are dependent on buying in feed as they do not own land. Shortages of feed and fodder are major challenges for the livestock sector in India.

1.4 What to expect and not to expect from this report

This report presents methods and tools that were developed during 2023 and 2024 to define and further assess Nature Positive Food Systems under the WUR KB Nature Positive Food Systems project. The report evaluates how these tools were used in two case studies. Readers can use this report as an entrance point for other more detailed reports, a paper and deliverables:

- Definition brochure and background report: (Post et al., 2024b, 2024a).
- Case study descriptions of two case studies: available on request.
- Case study reports of two case studies, including results for each canvas element: (T. Hermans et al., 2024; le Roux-Pullen et al., 2024).
- Indicator report: (Conijn et al., 2025).
- White paper on Nature Positive Food Systems: (Naranjo Barrantes et al., *Forthcoming*).
- Scientific paper on indicator-based approach towards nature-positive food systems: (T. D. G. Hermans et al., *under review n.d.).*

Although there is sufficient knowledge to conclude that the food system is the main cause of global nature decline, the knowledge on how to reverse this is mostly lacking. Both nature and food systems are very complex and encompass the globe. Around eight billion people would have be required to adopt certain different behaviours to create and support Nature Positive Food Systems. So how could we start to work on Nature Positive Food Systems?

This study focused on developing tools for understanding and guiding a transition towards Nature Positive Food Systems, which is only a start. There are a lot of things the project could not do in the available time. We tested our tools in Low- and Middle-Income Countries, but not in High-Income countries. The two case studies focused on the production of food, but not on its processing, (over)consumption or the waste phase, which is also reflected in the developed methods and tools. Production is an essential part of food systems that links to many effects on biodiversity, while the relation with food consumption is more indirect.

Nevertheless, realising changes in phases beyond food production is also essential for a transition towards Nature Positive Food Systems. For example, a transition towards eating more plant protein.

In the case studies, we interviewed people from local communities and staff of local organisations, and we organised group discussions, but we did not collect any numbers and did not take any measurements. In addition, we did not address stakeholders at higher system levels, such as national governments, large food companies or the retail sector. Therefore, this document cannot report any final answers.

- We have not presented a consolidated definition of what a nature positive food system is. At this point, we have only offered a working definition for further discussion.
- We have not presented a final method to judge a (part of) a food system when it is considered to be a nature positive food system. Instead, we have presented a proposal for further development of a set of indicators into an instrument that can make such a judgement.
- As we cannot yet judge food systems, we also cannot offer clear examples of Nature Positive Food Systems. However, the interviews show the direction in which people within the field are thinking.
- We have not presented a list of actions that will bring us the Nature Positive Food Systems we aim for.

In this report, we take the first steps towards Nature Positive Food Systems with the aim of supporting shared understanding and the provision of development tools towards implementing Nature Positive Food Systems in practice. Our results show that such interaction motivates participants towards local action. We believe a shared understanding what Nature Positive Food Systems are is an essential step towards Nature Positive Food Systems, alongside more research and successful Government-led transformation processes that lead to changed diets, production and consumption, and land, sea and nature management.

2 Defining Nature Positive Food Systems

2.1 Purpose of a definition as a tool

The concept 'nature positive' was introduced only a few years ago and its application to food systems is even more recent. Several definitions of nature positive have been proposed (Zu Ermgassen et al., 2022). However, less definitions have been introduced with specific reference to food systems. Lack of specified understanding may hinder meaningful change (WBCSD, 2021). The main purpose of a definition is to have a starting point with scope for building a shared understanding. A shared understanding also means that the definition presented is not 'set in stone'. It presents Nature Positive Food Systems not as a state to be achieved but as a continuous process towards increased biodiversity and improved functioning of the ecosystem.

2.2 Working definition

Based on literature (from WEF, 2020, IUCN, 2020 and Mommer et al., 2022, among others), as well as internal discussions of the project team, the following working definition is proposed (Post et al., 2024b):

*"We refer to Nature Positive Food Systems as **food systems** that have **nature at the heart** of decision-making and that will lead to **increased biodiversity and improved ecosystem functioning** through **collective understanding and action."***

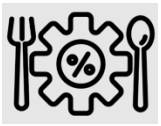
The definition was constructed from five building blocks, which are explained below.

Nature (in our definition described by 'biodiversity and ecosystem functioning'): The word 'nature' in the term 'nature positive' is operationalised as biodiversity and ecosystem function, which refers to the variability of living organisms from all sources and the processes and interactions of the living and non-living elements of ecosystems, such as soils, water, climate, and more, that collectively make up the living space of our planet. Implicitly, this variability includes humans, but that is not something to stress in this part of the definition.

By limiting the concept of 'nature' to biodiversity and ecosystem functioning, we have attempted to remain close to the purpose reflected in the concepts of nature positive and Nature Positive Food Systems (Locke et al., n.d.; Mommer et al., 2022), staying more restrictive than various other conceptions of nature (Post et al., 2024b). This frame highlights the impact of the human-driven food system on living and non-living elements of ecosystems, thereby, implying a human-nature divide. This divide is intentionally not emphasised in this definition, while also not stating that humans are part of nature. Connecting food systems and nature means that a balance is required between human needs and those of other living and non-living parts of ecosystems. The term 'biodiversity' refers to natural- and cultivated areas, because in both, a high level of biodiversity is desirable. The term 'functioning' is used to emphasise the dynamic aspect of nature, where an ecosystem should be able to function properly, because this likely creates more robustness also at the global level.

Positive (in our definition described by 'increase and improve'): Refers to the foundational objective of increasing biodiversity and regenerating ecosystem functioning towards securing the stability and habitability of the Earth's system within which we all live and share with other life forms. Other than this foundational objective, we did not explicitly define a desired level of biodiversity (supported by a sufficient percentage of natural areas/wilderness) because levels of such would differ per food system, for which measurable targets should be defined. Furthermore, the word 'positive' implies giving back more than is taken.

On a global level, a 2020 baseline has been proposed, as well as the objective of: 'full recovery by 2050' - which refers to restoring biodiversity and nature sufficiently to secure the stability and productivity of the Earth's system (Locke et al., n.d.; Obura et al., 2023). Although arbitrary, such concrete data and baselines, help to track progress. Global targets cannot easily be translated to individual food systems, but it should be possible to define local targets. A system approach is essential but raises several questions that are as yet unsolved: Should all effects on nature be positive, or only the overall effect? How can such an overall effect be measured? And, can a food system be classed as 'positive', if it has a positive effect on many aspects of nature, but a negative impact on parts of it?



Food system: The food system encompasses all activities from production to consumption, tied to socio-economic and environmental drivers (Van Berkum et al., 2018). A food system implies the necessity of a systems approach, in which spatial and temporal strategies are indispensable.

Food systems are demarcated by system boundaries. These do not necessarily follow geographic boundaries, which can make demarcation difficult, and yet system boundaries are essential for a focused analysis. In this way, the focus of food system analysis can vary from the food system activities within a community, to national level production, national level consumption, or consumption of a specific product within a continent. Outside or within such boundaries, socio-economic and environmental drivers can be identified as part of the analysis. And, in that sense, nature then already becomes implicitly embedded into the food system approach.

Nature at the heart: This element highlights the paramount importance of incorporating nature as a central consideration in decision-making processes, particularly in the pursuit of food security. It emphasises the need to align human interests with nature rather than seeking a compromise, ultimately aiming to improve the context of all life, including human life.

The phrase *"nature at the heart"* is explicitly included in the definition to reflect that Nature Positive Food Systems are not only about increasing and improving biodiversity and ecosystem functioning but are also about a paradigm shift from a human-centric design to one that integrates entire ecosystems into the core of the design philosophy (CSB, 2022; SBTN, 2021; WEF, 2020). A central consideration of nature and biodiversity is already applied in various contexts, such as the use of water and social guiding principles in landscape design (B. de Rooij et al., 2023), or in the practice of agroecology (Gliessman et al., 1998).

Collective understanding and action: The last building block emphasises the interconnectedness of a nature positive mindset among stakeholders. It promotes collective responsibility, dialogue, and action, thereby, addressing power dynamics and plurality in knowledge, values and cultures. Individual actions also lead to nature positive outcomes along the system, but collectiveness is foundational for true systemic change.

"Agents of change and a mix of interventions create enabling conditions that mobilise actor networks and trigger tipping points that accelerate transformative change. Importantly, there are many pathways to trigger such change, and these interact across people and places. Therefore, different mixes of interventions need to be activated and adjusted over time to ensure that the transition to nature-positive futures remains sustainable and ethical." (Mommer et al., 2022).

2.3 Application in case studies

Regarding a definition of Nature Positive Food Systems in the Kenya case study, participants described 'nature' as the environment around them and 'positive' as actions that do not harm the environment. They further explained 'nature' on two scales: Outside and inside the farm. The 'outside' refers to the forest itself, specifically the Menengai Reserve—often called, *"Mother Menengai"*— while the 'inside' includes elements within the farm, such as soil health, presence of wild animals, and crops. In discussions, specific practices came up such as organic farming, pesticide use, and alternative cooking styles. How such practices relate to Nature Positive Food Systems was not evaluated but partly reflects what participants perceive as Nature Positive Food Systems.

The relationship with nature in the Menengai Reserve was seen as a balanced exchange (giving and taking), especially when viewing the reserve as *"Mother Menengai"* or a living being. Examples of this include actions such as caring for trees through pruning (giving) balanced by making use of medicinal plants (taking), and tree planting (giving) balanced by collecting firewood (taking).

A key factor in defining Nature Positive Food Systems was finding a balance between regenerating nature and supporting livelihoods. It became clear that for Nature Positive Food Systems to thrive, communities need livelihoods that do not solely depend on the forest. This requires a balance between food systems that benefit both nature and people. In addition to the livelihood balance, the concept of accountability was emphasised. While the community has access to necessary resources, they are also responsible for undertaking restorative or regenerative activities to offset their resource use.

In the case study around ethnoveterinary medicine (EVM)in Gujarat, India, the working definition was presented in a focus group discussion and the participants were asked about their opinion. In general, the definition resonated with participants. They indicated that the concept of Nature Positive Food Systems is deeply intertwined with widely varying religious beliefs and traditions. The participants also recognised that food systems extend beyond food production and expressed that several factors influenced food systems, including seasonal availability, affordability, religious practices, and increasing consumer demand. They particularly acknowledged the connection between food consumption and human health. Participants could name several reasons why the current food system is not healthy and not nature positive.

2.4 Evaluation

The working definition proved useful, if not a key requirement, in developing other tools to guide transition towards Nature Positive Food Systems. It was a means to gain common ground within the project team that consisted of members from seven different Wageningen Research institutes with a variety of disciplines e.g. social, economic, livestock, plant and environmental sciences. The working definition helped to specify the concept and integrate the varying perspectives of different project team members.

The definition was presented in several internal and external events. As well as in regular meetings of the different departments that the project members were connected to, it was presented at the Net Positive Spring Parade (held at ARTIS, Amsterdam, The Netherlands on 17th April 2024), at TerraEnVision (organised in Valencia, Spain between 6th -13th July 2024), and at Food Revolution (which took place in Parma, Italy between 21st-23rd October 2024). The definition generally resonated well with the audiences at these events.

The main discussion points from these events are outlined here.

One question or confusion was related to the difference between the terms 'nature positive' and 'nature-inclusive'. The concept of 'nature inclusive' has been promoted in the Dutch context to integrate the sustainable use of natural resources in agricultural (or other) entrepreneurship (Runhaar, 2017; van Doorn et al., 2016) and is more familiar to Dutch stakeholders. The ambition to cherish nature is clearly present in both concepts. However, a participant at one of the events raised the point that the concepts can be quite

different. In theory, nature positive can be nature exclusive, for example, when agriculture is intensive in one spot to be able to rewild in another spot (the 'sparing-sharing' dilemma). This indicates that the context in which 'nature-inclusive' and 'nature positive' can be applied may differ. The 'nature-inclusive' concept is particularly applicable for individual practices, whereas 'nature positive' has a broader, system-level perspective.

Another question that was raised was: To what extent should collective understanding and action be part of the definition? This question reflects the idea that a nature positive food system is a target state to be achieved. Rather, we see Nature Positive Food Systems as a continuous process towards increased biodiversity and improved ecosystem functioning, and learning how to put nature at the heart of decision-making. For this process, collective understanding and action is essential, which is why it is part of the definition. Considering Nature Positive Food Systems as a process is challenging. Regular engagement in dialogue on Nature Positive Food Systems is fundamental to fuel the transition.

3 NPFS Landscape canvas

3.1 Purpose of the tool

The NPFS landscape canvas (Figure 3) serves as the framework for the research objectives, with each box representing an element that the research aims to address. Each element within it can be explored using various methodological tools (see Section 4 for elaboration of *"What is success?"* and Section 5 for *"What?"* on enablers and barriers), making it a versatile instrument applicable in a wide range of processes, dialogues, and sessions. This flexibility supports and guides discussions on Nature-Positive Food Systems, including potential indicators, actions, and outcomes. The canvas fosters a common understanding and provides in-depth insights into the diverse perspectives and perceptions associated with each element. Consequently, the canvas facilitates the further development and operationalisation of the NPFS concept and functions as an integral part of the ongoing process of learning in action.

The NPFS landscape canvas is inspired by the Business Model Canvas (Osterwalder, 2010) and other canvasses developed in the recent years (e.g. Circular Landscapes Canvas by van Rooij et al., 2022). In general, it can be considered as a tool for social learning processes which fits in new approaches in landscape governance (Van Oosten, 2021). Van Oosten defines landscape governance as: *"A place based, multilevel and multi-stakeholder process of negotiation and spatial decision-making for sustainable land use.".* It is important to bring in the landscape level, because: *"Landscapes provide a suitable context for social learning to happen."* (Van Oosten, 2021).

Social learning typically involves human interaction in groups, communities, networks and social systems and often involves an action component (von Schönfeld et al., 2020; Wildemeersch, 1995, 2007). In NPFS landscapes, it involves exploring together what a Nature-Positive Food System is or could look like. Moreover: *"Social learning has increasingly become a normative goal, shifting toward adaptive management and stakeholder engagement as a means to cope with complexity and the resultant uncertainty."* (Reed et al., 2010) and most of all: *"As active social participation in the practices of a community and to emphasise the dynamic interaction between people and the environment in the construction of meaning and identity."* (Muro & Jeffrey, 2008; Reed et al., 2010; Wenger, 1998)).

The term 'NPFS landscape canvas' has been carefully chosen. The term 'landscape' specifically carries the notion that Nature Positive Food Systems are very much spatially oriented. Adding the landscape component makes discussions more specific to a geographical area and less generic, without already predefining scale and boundaries. Overall, the term 'canvas' stimulates the imagination on what Nature Positive Food Systems could look like, what's needed for them and especially what they could mean in terms of impact, benefits, synergies and trade-offs.

3.2 Quick overview

The NPFS landscape canvas (Figure 3) consists of a simple graphical overview of guiding questions about Nature Positive Food Systems, ranging from the what, the why, the how and the who. These guiding questions are not only meant to be considered separately, but also in relation to each other. By placing them together in a canvas, with, of course, proper facilitation, will enrich discussions and insights.

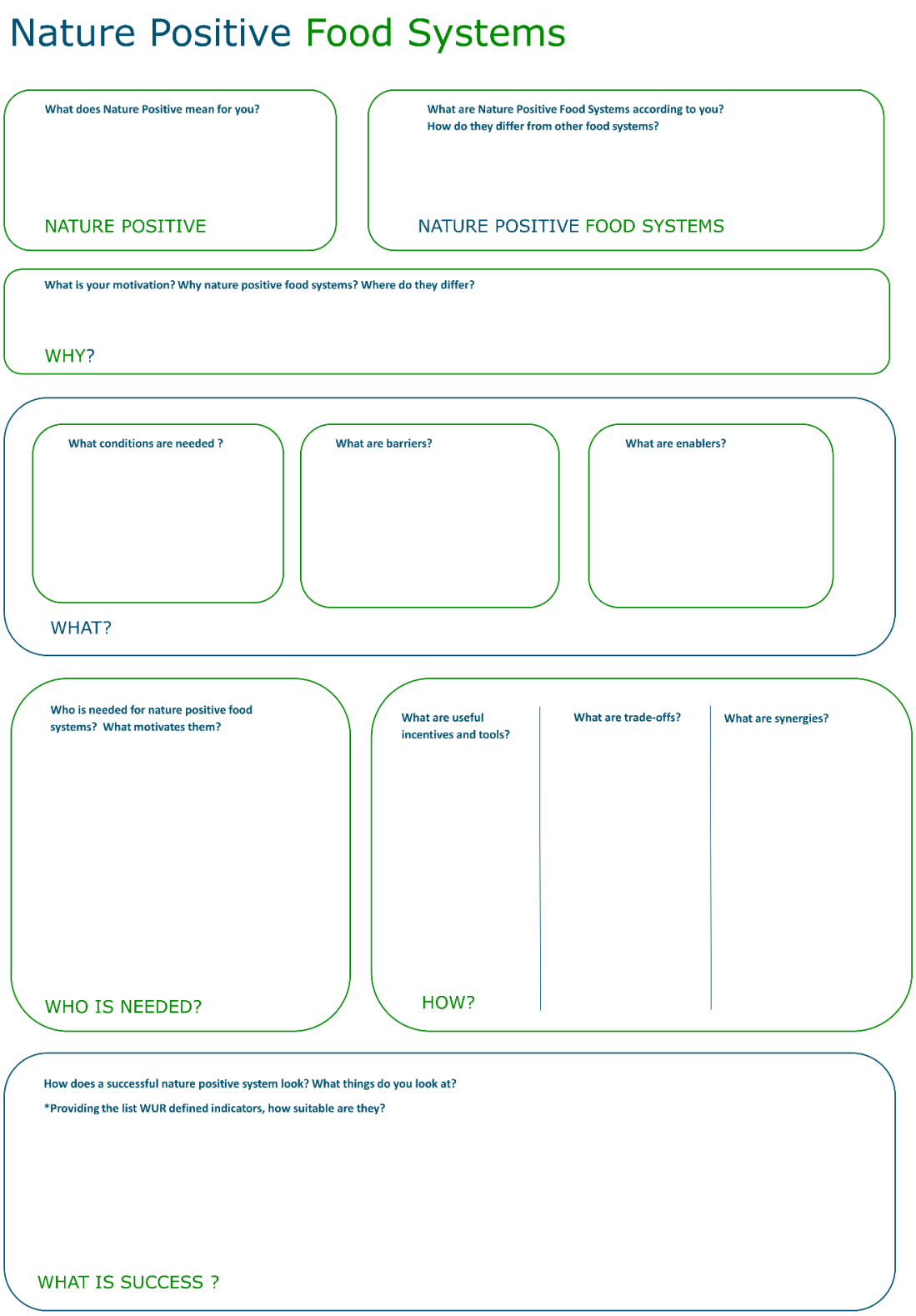


Figure 3 *Nature Positive Food Systems landscape canvas tool.*

The NPFS landscape canvas contains the following elements and associated questions:

Definition:
- Nature Positive: What does nature positive mean to you?
- Nature Positive Food System: What are Nature Positive Food Systems according to you? How do they differ from other food systems?
- Why: What is your motivation? Why would we need Nature Positive Food Systems? Where do they differ from other food systems?

Enablers and barriers:
- What: What conditions are needed to move towards Nature Positive Food Systems? What are barriers? What are enablers?
- Who is needed: Who is needed for achieving Nature Positive Food Systems? What motivates them?
- How: What are useful incentives and tools? What are trade-offs? What are synergies?

Indicators:
- How: What are useful incentives and tools? What are trade-offs? What are synergies?
- What is success?: What does a successful Nature Positive Food System consist of? What elements of Nature Positive Food Systems do you consider?

For these three topics, additional tools were developed (i.e. definition, enablers and barriers, indicators), which are also available in this report. A literature review was conducted for the definition (Section 2), a framework based on the food system framework was developed for the enablers and barriers (Section 4), and initial literature-based indicator lists were created for the indicators (Section 5).

Based on the experiences, insights and reflections from the case studies and the internal use, the NPFS landscape canvas can be adapted and improved.

3.3 Application in case studies

The NPFS landscape canvas tool was combined with the tools definition (Section 2), enablers and barriers (Section 4) and indicators (Section 5) to be applied in two case studies: Menengai in Kenya and ethnoveterinary medicine (EVM) in Gujarat, India.

Within the case studies, individual semi-structured interviews and focus group discussions were employed to address the various elements of the NPFS canvas. For instance, the literature-based definitions provided in Section 2 were used as a tool for participants to reflect on the suitability of the first two canvas elements within their specific contexts. Furthermore, regarding the element of: *'What is success?'*, the case study in Kenya organised a workshop to refine, add, and rank the proposed literature-based indicators. Meanwhile, the case study in India developed photographs to aid in the refinement and selection of contextually relevant indicators, as further elaborated in Section 5. Lastly, for the element: *'What?'*, the key enablers and barriers framework outlined in Section 4 was utilised to guide the semi-structured interview questions. This underscores the canvas as a framework, within which various context-adapted tools for discussion can be employed.

The Kenya case study used the NPFS landscape canvas to structure and guide data collection on Nature Positive Food Systems (Hermans et al., 2024). The canvas elements were explored through a combination of focus group discussions (FGDs) with user groups, semi-structured one-on-one interviews with organisational and Government representatives, and a workshop event, all conducted during a visit to Kenya. The interviews and FGDs addressed key topics, including the definition of Nature Positive Food Systems, the motivation behind adopting it (why), conditions, barriers, and enablers (what), stakeholders involved (who), and tools, trade-offs, and synergies (how). The final workshop explored the question: *'What is success?'* and introduced indicators for evaluating Nature Positive Food Systems. This session brought together participants from all stakeholder groups involved in the case study interviews.

The application of the landscape canvas helped to identify several enablers and barriers (Section 4.3), discuss indicators Section 5.3), and yielded several other outcomes (Hermans et al., 2024). One of the needs identified was enhanced capacity building in nature positive practices through living labs. Another vital need was to strengthen connections to Government extension services. User groups under the MCFA provide representation and a clear voice for the community. However, ensuring broader community connectivity and reassessing user group selection were found to be important. Additionally, exploring power and gender dynamics and improving accountability for natural resource use were considered essential. The discussion on the first canvas elements also showed that motivation for Nature Positive Food Systems is closely tied to health and livelihood security, making it a compelling narrative for promotion of Nature Positive Food Systems. Identifying practices that address short-term needs while enabling investment in nature-positive practices is key, potentially involving planning at various levels to achieve socio-economic and environmental goals.

In the case study around ethnoveterinary medicine (EVM) in Gujarat, India, interview questions were organised around the areas distinguished in the landscape canvas (le Roux-Pullen et al., 2024). The landscape canvas fostered conversations with stakeholders about food systems. Overall, this helped to identify what is needed to promote EVM in a way that helps achieve goals regarding Nature Positive Food Systems. The strategies identified included educational programs, improving infrastructure and logistics, and actively involving stakeholders in policymaking. In addition, to stimulate a transition towards Nature Positive Food Systems, creating supportive regulatory frameworks was considered to be essential.

3.4 Evaluation

The main value of the NPFS landscape canvas was its capacity to facilitate significant engagement of stakeholders throughout the research process. This is key for an open transdisciplinary approach that helps to frame, define, and understand the relatively new and emerging concept of Nature Positive Food Systems. The NPFS landscape canvas has been used in the internal discussions that outline our understanding of Nature Positive Food Systems, but also in the different case studies. The development of the tool itself helped in increasing the understanding, validation and potential further operationalisation of Nature Positive Food Systems. The application of the tool in the different case studies provided valuable insights about similarities, differences and contextualisation.

The NPFS landscape canvas helped to structure the conversation, engage stakeholders in all relevant aspects linked to Nature Positive Food Systems and provide insights into the different perceptions, directions and opportunities. It helped in validating and enriching our definition and the potential indicators with stakeholders. It also provided direct landing grounds for Nature Positive Food Systems into society and communities. Like many other transitions, a transition towards Nature Positive Food Systems is a shift in thinking rather than a direct solution. The tool shows that shifting our way of thinking can already begin today.

The NPFS landscape canvas covers several of eight elements that should be taken into account in social learning for sustainability, based on experiences in a variety of social learning communities (Silva-Jean & Kneipp, 2024):

- Information sharing by multiple stakeholders.
- Experimentation in learning together.
- Acknowledging the value of all contributions.
- Building common rules.
- Prospection of reality.
- Instrumentalising social learning.
- Resolving emergent conflicts.

The NPFS landscape canvas builds directly or indirectly on these elements. It builds knowledge with and by multiple stakeholders, including our own scientific community, rather than transferring, validating or asking commitment. Engagement in this initial phase is required for the follow up process and the transition towards nature positive futures. Emerging conflicts are seen as beneficial if treated well: with constructive conflict

management and multidisciplinary debates. Crucial to this is to create trust and an open atmosphere emphasising common grounds. This requires facilitation skills and also a proper position in the process: Managing expectations.

As mentioned by Da Silva, the NPFS landscape canvas is an instrument that could support the process of social learning and change, but there is still a lack of evidence as to how these instruments lead to changes in practice (Silva-Jean & Kneipp, 2024). As such, the initial NPFS landscape canvas that is primary focused on common understanding could be followed by a more action-oriented canvas that brings in the actual context and landscape and asks for practical solutions and actions to construct new Nature Positive Food Systems in real landscapes. These more practical canvases, like the Circular Landscapes canvas developed by WENR, ask for a design-approach and more specific translation, as such attractive visualisation and moving from concept to practice.

4 Finding key enablers and barriers

4.1 Purpose of the tool

Finding key enablers and barriers refers to the identification of those factors that hamper or foster the uptake of NPFS-practices, as a means to improve our understanding of what is needed for a transition towards Nature Positive Food Systems. Thereby, it links to the *"What"* box of the NPFS landscape canvas (Chapter 3). To facilitate such identification of the *"what",* a framework was developed for assessing food systems, providing insight into all the different elements involved in implementing Nature Positive Food Systems. The framework is based on the food system approach (Van Berkum et al., 2018): A practical interdisciplinary conceptual framework for research and policy aimed at sustainable solutions for the sufficient supply of healthy food (Figure 4).

4.2 Quick overview

The **Food System Framework** (Van Berkum et al., 2018) was designed to analyse and address sustainability challenges within global food systems. The framework identifies the complex interactions between food system components and the broader socio-economic and environmental context. It emphasises the importance of a holistic approach to improving food security, environmental health, and socio-economic equity.

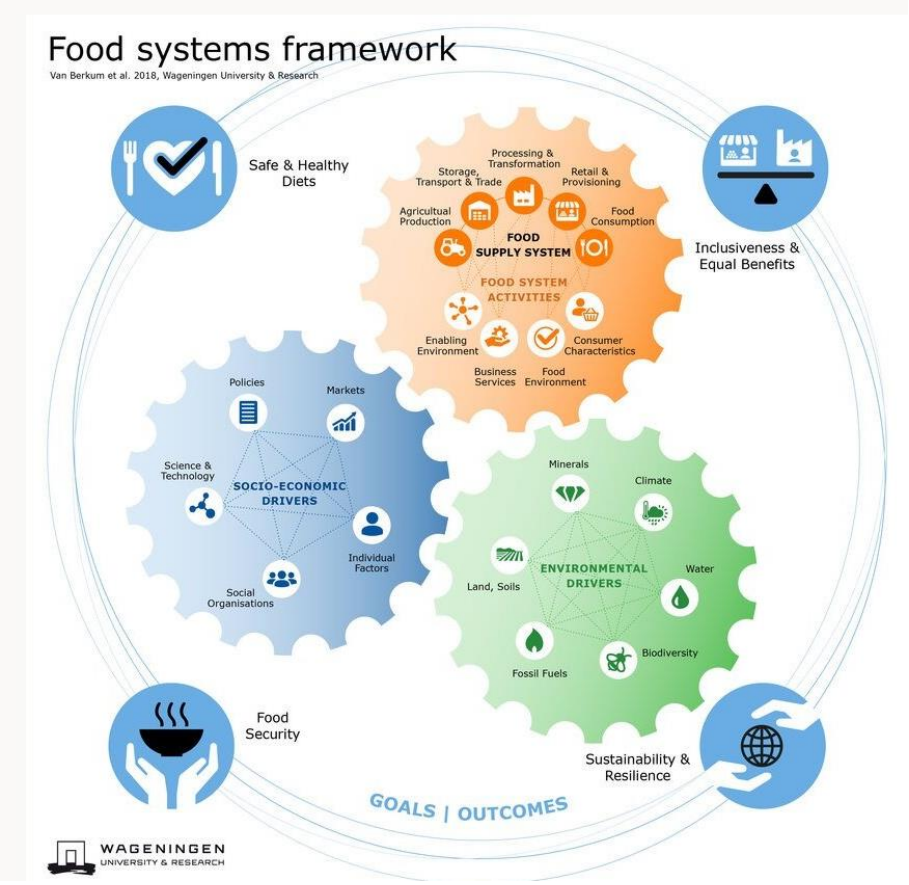


Figure 4 *Food systems framework (Van Berkum et al., 2018).*

The enablers and barriers framework has three main components: Food System Activities, Socio-Economic Drivers and Environmental Drivers:

- **Food System Activities**; enablers and barriers related to the activities within the value chain, service organisations, the enabling environment and factors that influence activities at the consumer level.
- **Socio-Economic Drivers**; enablers and barriers related to the socio-economic context in which the food system operates.
- **Environmental Drivers**; enablers and barriers related to the biophysical context in which the food system operates.

Specific questions can be asked for each component, for example, when applying the landscape canvas (Chapter 3). One of the sections of the landscape canvas focuses on: ***What conditions are needed to move towards nature-positive food systems. What are barriers? What are enablers?*** For this Section, specific questions were given as a guideline to get insights into related enablers and barriers. These questions are listed in Annex 1. For each case study, different components or categories will vary in relevance. The tool includes questions to evaluate the presence of enabling or constraining factors. Its purpose is to ensure a thorough analysis and prevent overlooking critical issues. However, it is recommended that the questions be adapted to suit the specifics of each case study. The tool also provides examples of enablers and barriers, though these are not exhaustive. The interpretation of a factor as an enabler or a barrier depends heavily on the context.

4.3 Application in case studies

In the Menengai Forest Reserve, Kenya case study, stakeholders were interviewed and asked what barriers and enablers they experienced, using the questions presented in Table A1 (Annex 1) in an interactive way. This was done in the context of applying the landscape canvas (Section 3) and yielded the enablers and barriers listed below.

Enablers and barriers that are related to the food system, for example, business services, food supply, markets and consumer characteristics:

- Organisational strengthening and linking of groups of people to businesses (Enabler).
- Increasing market demand for organic produce (Enabler).
- Limited access to finance (Barrier).
- Little investment space (Barrier).
- Lack of organic fertilisers due to lack of organic certification for manufacturers (Barrier).

Barriers and enablers that are related to the socio-economic context, such as policies, individual and social organisation, science and technology:

- Legal frameworks (Climate Change Act, 2021) (Enabler).
- Government promotion of natural regeneration programs (Enabler).
- Participatory Forest Management Plan (Enabler).
- Livelihood security and diversification (Enabler).
- Decreased Government funding due to other, competing demands (Barrier).
- Insufficient accountability mechanisms (Barrier).

Enablers and barriers that are related to the environmental conditions, for instance, land, soil, climate, water, biodiversity, fossil fuels and mineral resources:

- Individual land ownership (Enabler).
- Climate change effects (Barrier).
- Lack of long-term connection to the land for non-landowners (Barrier).

In the case study around ethnoveterinary medicine (EVM) in Gujarat, India, stakeholders were asked in interviews what is needed for nature positive practices such as EVM. A critical enabler was the dairy development model, Anand Pattern, which helped in making herbal products easily available. Other enablers were the support and training provided by the National Dairy Development Board, as well as the increasing consumer preference for milk from cows not treated with antibiotics. The support in Gujarat may also

indicate a barrier in other areas where such support is absent. Other barriers included the loss of traditional knowledge over generations and the increasing production pressures experienced by farmers.

4.4 Analysis of barriers and enablers

In order to carry out the analysis of both case studies, the case study reports were coded in a qualitative manner, in which an identified barrier would be highlighted in red, and an identified enabler was highlighted in green. A quantitative count of the occurrence of enablers and barriers was then carried out based on the coded words or phrases and categorised in a table which followed the previously defined Food Systems Framework (see Annex 2 for full tables of both case studies).

Figures 5 and 6 present a landscape-level analysis for two case studies. In Kenya's Menengai Forest Reserve, the analysis identified barriers and enablers for practices, such as organic farming and sustainable pesticide use, forest protection, which include activities like tree planting on farms and fencing the forest, improved water access, and alternative cooking stoves. In India, the focus was on barriers and enablers related to the adoption of ethnoveterinary medicine (EVM) and other crop production practices among smallholder dairy farmers in Anand, Gujarat. These insights provided an overview of challenges and opportunities for sustainable practices in both regions.

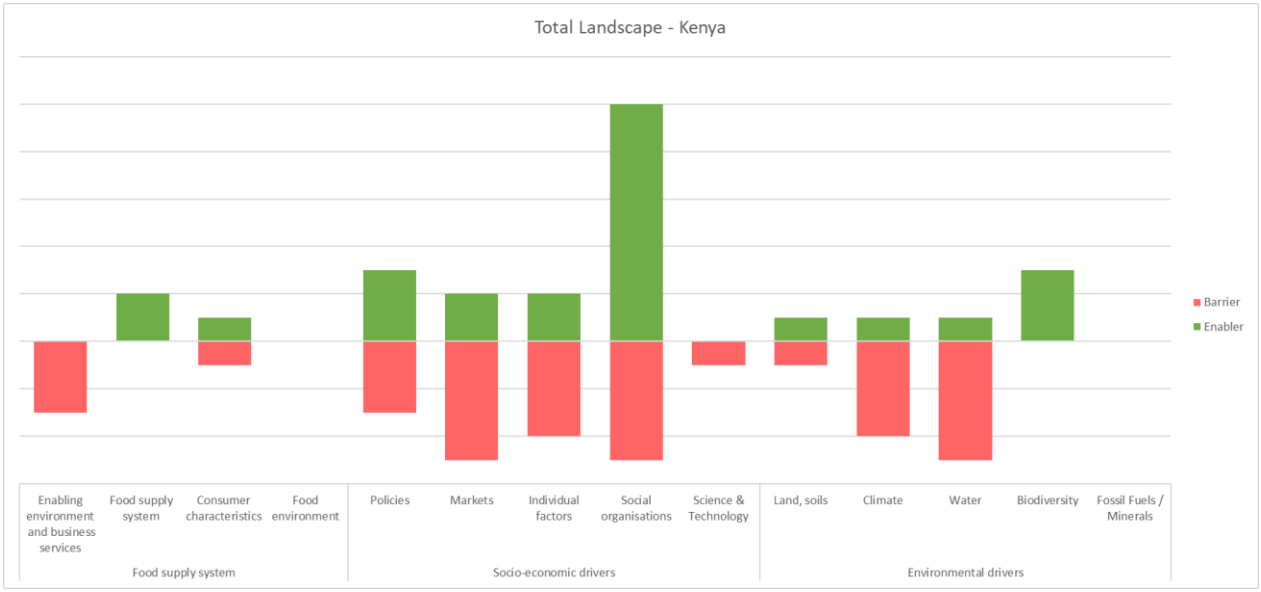


Figure 5 *Summary of barriers and enablers present in the Kenya case study landscape.*

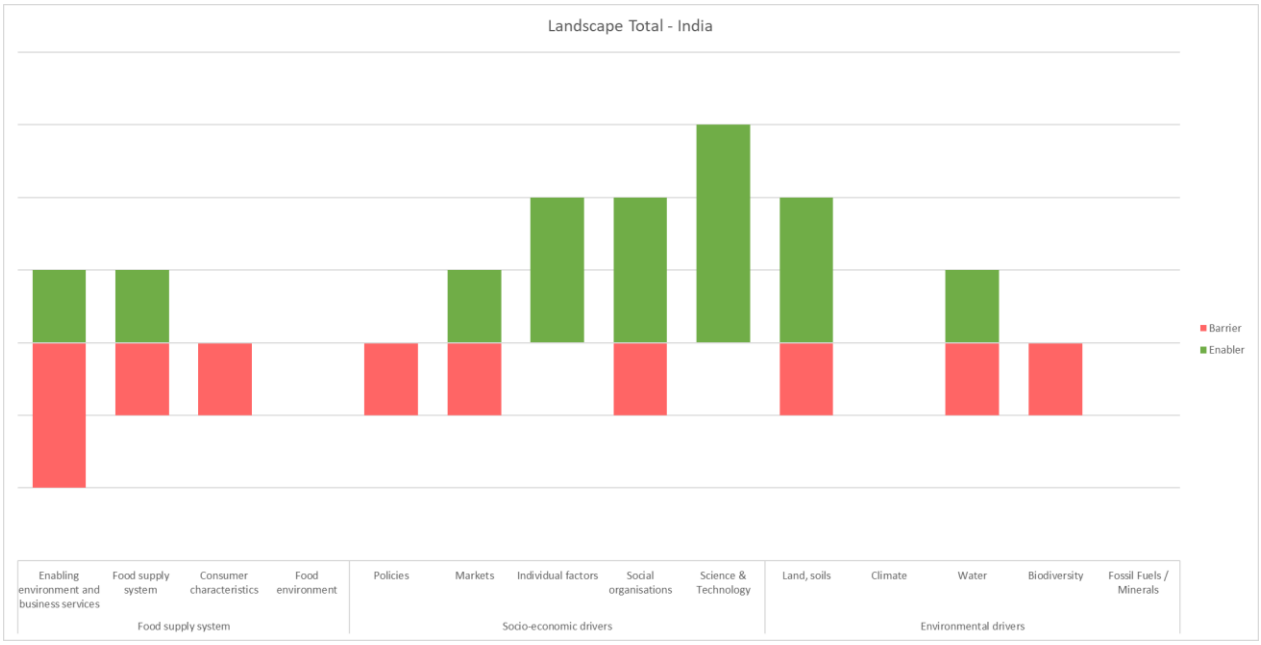


Figure 6 *Summary of barriers and enablers present in the India case study landscape.*

When extrapolating barriers and enablers from these specific case studies to broader contexts, it is crucial to recognise that cases may not be directly comparable due to social, cultural, and environmental variations. Practices must be scalable and adaptable to diverse stakeholder needs and dynamic systems influenced by technological, policy, or environmental changes. Interdependencies between barriers and enablers should also be considered, as the presence of a single barrier might outweigh other enablers, hindering progress. Robust, representative data is essential to avoid biased generalisations, and strategies must prioritise equity and inclusivity to address diverse socioeconomic and gender dynamics, ensuring sustainable and context-sensitive solutions.

4.5 Evaluation

The analysis of barriers and enablers was incorporated into a section of the canvas method but could not be explored in detail due to time constraints. Proper analysis requires methodologies that account for the complexity and context-specific nature of these factors. In-depth qualitative interviews are particularly effective for exploring barriers and enablers, as they allow for rich, nuanced insights into individual and contextual dynamics. Additionally, collecting quantitative and qualitative data through structured surveys, case studies, or field observations helps identify patterns and trends, providing a comprehensive understanding of the factors at play.

The risk of such a long list of questions, prompts and examples is that some of the local enablers and barriers are overlooked. For example, from a Dutch natural science perspective, no questions about spiritual or religious factors will be included, while locally, they may play a role. This can be overcome by explaining thoroughly what we mean by enablers and barriers (without giving examples) and asking an open question about these factors first. Also, the dialogue on the definition of Nature Positive Food Systems, that precedes the exploration of enablers and barriers, may provide clues on the local perspective and where it differs from the perspective of the researchers.

Although not fully applied, the identification of barriers and enablers seems to be the most relevant part of the discussion for stakeholders, and it triggers ideas about actions. To obtain a more structured understanding, follow-up of such an exercise would be required, and was in fact asked for in the case studies.

5 Indicator framework

5.1 Purpose of the tool

An indicator framework was set up to translate the concept of Nature Positive Food Systems into a selected set of concrete biodiversity, nature and food system indicators. Thereby it most strongly links to the *"nature"* and *"food system"* elements of the definition and makes more concrete what can be regarded as positive for nature. The selection of indicators also contributes to the *"What is success?"* box of NPFS landscape canvas (Chapter 3), in making the answers to this question more concrete and tangible. The set of indicators is not (yet) meant to assess whether or not a food system is 'nature positive', but to facilitate stakeholder interaction in developing pathways towards NPFS in the future in different contexts. The selection of indicators is based on existing indicators from existing frameworks (A/RES/71/313, 2017; Bern University of Applied Sciences, 2021; CBD, 2022; FAO, 2019; FSCI, n.d.; United Nations, 2015), complemented with newly constructed indicators. The aim was to arrive at a set that covers the broad scope of Nature Positive Food Systems, is appropriate for tracking progress towards Nature Positive Food Systems, and allows assessment of trade-offs and synergies.

5.2 Quick overview

The indicator framework is organised in six themes, each related to biodiversity, social or biophysical aspects of food systems (Figure 7). Each theme comprises various indicators. Not all are required for each food system or process. The selection depends on the local context, the scale of analysis (farm, international organisation, country, etc.) and the resources available for an assessment. For example, it depends on what data are available and if additional data can be collected, provided that a required accuracy in assessment is obtained. Examples of indicator selections for different contexts are presented in Table 1. A full overview of the selected indicators can be found in (Conijn et al., 2025) and a shortened list is included in Annex 3 of this report.

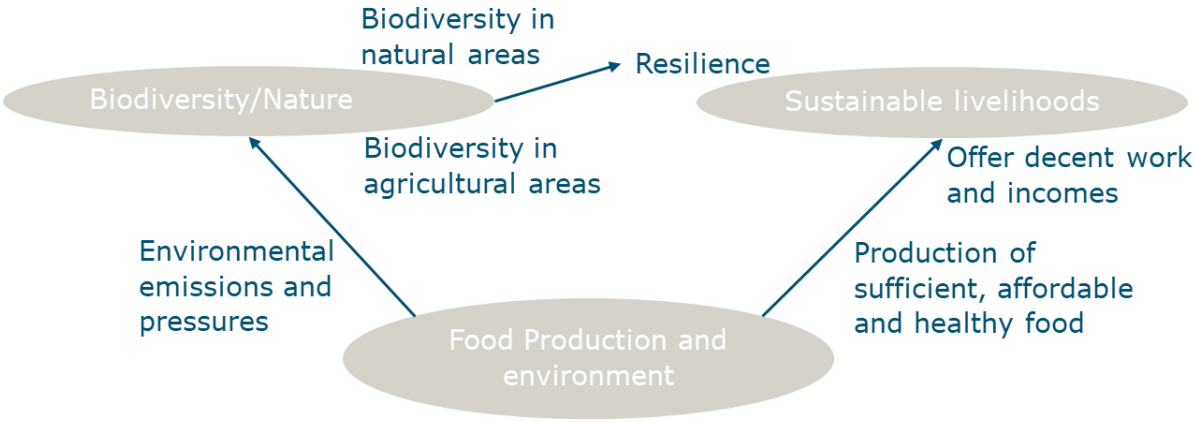


Figure 7 *Relation between food production, biodiversity and ecosystem functioning, and livelihoods, indicating six indicator themes (blue).*

5.2.1 Biodiversity in natural areas

Biodiversity and the functioning of ecosystems inside and outside the food production area may be affected by food system activities in different ways. For example, through the emissions of toxic compounds via air and water, or through increased land use at the expense of natural areas. Conversely, species may also benefit from agricultural areas when migrating between and/or foraging in these different habitat types. Such biodiversity and ecosystem functioning may be measured with indicators like the Biodiversity Intactness Index, which compares biodiversity in a certain location to a reference situation. For this indicator sufficient data should be available, and a means to calculate the index. When this is not possible, in some cases it may be possible to use the area of protected nature or the abundance of key species as a proxy. Four indicators have been included within this theme (Conijn et al., 2025; Annex 3).

Table 1 *Examples of how indicators can be adjusted to the food system setting. Specifications of the indicators and their references are described in (Conijn et al., 2025)).*

	Farmer	**National government**	**International company**
Biodiversity in natural areas.		Nature Area Biodiversity Intactness Index.	Biodiversity Intactness Index.
Biodiversity in agricultural areas.	Food system area covered by natural or diverse vegetation (qualitative). Pollinator diversity (qualitative). Key (soil) species abundance.	Food system area covered by natural or diverse vegetation (quantitative). Pollinator diversity (quantitative). Soil biodiversity function (quantitative). Proportion of fish stocks within biologically sustainable levels.	
Environmental emissions and pressures.	Nutrient surplus. Pesticide use intensity. Water quality of ground and surface water.	Marine ecotoxicity potential. Nutrient surplus. Blue water footprint. Water quality of ground and surface water. Greenhouse gas emission balance.	Marine ecotoxicity potential. Blue water footprint. Water quality of ground and surface water. Greenhouse gas emission balance.
Production of sufficient, affordable and healthy food.	Land productivity. Safe food. Balanced pricing. Animal welfare.	Land productivity. Safe food. Balanced pricing. Animal welfare.	Land productivity. Safe food. Balanced pricing. Animal welfare.
Resilience.	Measures limiting disaster impacts. Agricultural species diversity (Gini-Simpson index).	Uptake of healthy diets. Agricultural species diversity (Gini-Simpson index). Genetic diversity. Measures limiting disaster impacts.	Measures limiting disaster impacts.
Decent work and income.	Access to safe, sustainable and productive employment. Access to finance. Access to markets.	Access to agricultural extension services. Access to land rights. Access to safe, sustainable and productive employment. Access to healthcare. Access to finance. Access to markets. Access to education and skill building.	Access to agricultural extension services. Access to land rights. Access to safe sustainable and productive employment. Access to healthcare. Access to finance. Access to markets. Access to education and skill building.

5.2.2 Biodiversity in agricultural areas

Some aspects of biodiversity are particularly relevant within the context of food production areas. This is, for example, the case for soil biodiversity, pollinator diversity and diversity in species that are able to control pests. These aspects may be measured either quantitatively or qualitatively, depending upon the resources available. A simple proxy for natural biodiversity within food production areas is the area covered by diverse non-food vegetation, such as hedges or vegetation in ponds, relative to the agricultural area used for food production. Seven indicators have been included within this theme (Conijn et al., 2025; Annex 3).

5.2.3 Environmental emissions and pressures

A transition towards Nature Positive Food Systems requires a reduction in environmental emissions to lower the pressures on biodiversity and improve ecosystem functioning. These emissions often also have other unwanted effects, such as climate change or negative effects on human health. The specific set of indicators relevant will depend on the food system studied (if it includes livestock or a marine component, for example), but will, in many cases, include greenhouse gas emissions, nutrient balances, water use and quality, and use of pesticides. Four indicators have been included within this theme (Conijn et al., 2025; Annex 3).

5.2.4 Production of sufficient, affordable and healthy food

The main goal of food systems is to produce food, so the extent to which a food system produces sufficient, affordable and healthy food is something that should be assessed. A key indicator is land productivity, e.g. expressed in the number people that can be fed per hectare of land per year. This also links to biodiversity and ecosystem functioning outside the food production area, as it indicates how much land is required for the food system and how much land can be reserved for natural areas. Another criterion is safe food, which means food without contaminants, such as residues of pesticides. Nine indicators have been included within this theme (Conijn et al., 2025; Annex 3).

5.2.5 Resilience

Several indicators have been selected that refer to the stability of the food system and its resilience towards future changes, such as climate change or increasing food demands. This includes indicators related to agricultural species diversity and genetic diversity of plants and animals used in the food system. Biodiversity, for which indicators were already discussed in other paragraphs, can also have an effect on resilience of the food system. Seven indicators have been included within this theme (Conijn et al., 2025; Annex 3).

5.2.6 Decent work and income

Food systems necessarily are about people, whose livelihoods are for a large part related to food production. For example, because they are involved in food system activities. Livelihoods and food production systems should not suffer from a transition towards Nature Positive Food Systems, and, therefore, such impact should be measured. This can be done by evaluating access to several resources, such as land rights, finances, healthcare and markets and by evaluating balanced pricing. Four indicators have been included within this theme (Conijn et al., 2025; Annex 3).

5.3 Application in case studies

The indicator framework developed has not been applied in the sense that indicators were measured for a specific case. Instead, since this was an explorative project, the indicators were evaluated in the case studies by evaluating how well they resonated with stakeholders.

In the Menengai Forest Reserve, which is the case study in Kenya, participants were presented with a table of indicators, divided into environmental, socio-economic, and food system indicators. The participants were divided into four groups: One covering environmental indicators, one covering social indicators (social inclusion and equity), one covering economic indicators (sustainable livelihoods), and one covering food production indicators. Regarding the environment, soil was the most important indicator for the group as they saw it as the foundation of the food system in their context. In addition, the stakeholders were able to refine certain biodiversity indicators by pointing towards the key species that are important for the area and, hence, the abundance of which should be monitored. Social inclusion and equity were sensitive topics to discuss in focus group discussions, but gender equity and social inclusion, as well as equal voice, treatment, access to resources and benefits were still identified as main indicators in this domain. Access to resources, employment, services and ownership rights were major indicators within the sustainable livelihoods domain.

Particularly youth employment and poverty were new aspects that were not sufficiently covered by initially presented indicators. Higher prices for both inputs and outputs were found to be the top indicators for food production and were seen as a barrier to adoption of organic farming and nature positive practices. A refinement made was that not necessarily access to extension services is to be measured, but specifically access to extension services on nature positive practices. The indicators discussion led to the wish to collect baseline data.

In the case study around ethnoveterinary medicine (EVM) in Gujarat, India, pre-selected key performance indicators in simplified form presented on a set of cards with the indicator in the form of a picture, were used to study what stakeholders define as a successful Nature Positive Food System. Pictures were used because many of the small-scale farmers are illiterate or cannot speak English. An interpreter was present during the stakeholder meetings with limited knowledge on the content. To measure success regarding biodiversity and nature, stakeholders saw water quality and availability, as well as a diversity of animals and plants, and a diversity of crops and livestock, as relevant indicators. For land use and productivity, they widely acknowledged the importance of soil quality. While for environment and climate, stakeholders indicated that use of pesticides, veterinary drugs and artificial fertilisers should be reduced, but manure use should increase. For several stakeholders, success in the social and economic domain meant access to healthcare, resilient and sustainable livelihoods, and gender equity. The group clearly recognised that a meaningful assessment would require collection of a substantial amount of data in a variety of locations.

5.4 Evaluation

The selected set of indicators is based on and has been compared with several existing indicator frameworks (SDG, TAPE, CBD, RISE and FSCI). This has shown that the set of indicators is relatively comprehensive, suggesting that important trade-offs and synergies would be identified when measuring progress towards Nature Positive Food Systems with the framework. Moreover, the indicator themes seem to resonate with stakeholders in the Menengai Forest Reserve (Kenya) and Gujarat (India). It helped the stakeholders to understand the scope of Nature Positive Food Systems and enabled them to talk about it in a more abstract form and, thus, to avoid a 'blame game'. They provided several additions to initially presented indicators and refinements that were necessary to connect to the local situation, such as the monitoring of key species abundance or the availability of locally targeted extension services. They also excluded some indicators which were seen as irrelevant for them (such as marine indicators for an inland location) and ranked some of them as high priority, such as soil health, secure livelihoods and equality.

The set of indicators were targeted at biodiversity/nature and food systems. Therefore, the set has a smaller scope than the sustainable development goals, which also cover themes outside the food system. At the same time, the NPFS indicator set is broader than frameworks that focus on agricultural production at farm level (TAPE) or only biodiversity (CBD). The NPFS selection of indicators tended to define indicators at a higher integration level (such as uptake of healthy diets). Whereas some frameworks use indicators that refer to a sub-level (such as availability of fruits and vegetables in FSCI).

A full evaluation of the NPFS indicator framework cannot yet be made because it has not yet been applied as a measuring instrument. This would require selecting relevant indicators for a specific case study together with local stakeholders, setting targets and measuring progress towards these targets over time, in several types of food systems - At the landscape-, national- lor sector level, for example. Setting such targets is crucial for tracking progress. Targets have not been defined here because they are generally food system specific. Each food system has its own specific characteristics, such as the type of crops, soil type, climate, and cultural factors. Setting targets and start measuring would help to further refine the framework and connect it to actual practices.

Some of the selected indicators may fit less well in the themes in which the indicators have been organised now. The precise organisation is less important than obtaining a comprehensive view on progress towards Nature Positive Food Systems. Whether or not they are used to group indicators, the themes may help in selecting appropriate indicators, with questions such as: *"What indicators should be selected to evaluate how biodiversity in nature areas changes?"* The indicators suitable for such evaluation may also be outside the

themes we used. As per the proposed definition, this is a first proposal for a set of indicators, and it will require more discussion with users and more research for further development. An important question is how flexible a final set of indicators should be. The option to tailor it to a local situation may empower people to act, while a fixed list of indicators may make them feel powerless. However, the freedom to ignore indicators may also allow users to select only superficial indicators.

The current set of indicators focuses more on production rather than consumption. One of the reasons for this is that effects of biodiversity loss are more directly related to food production practices, while the relation with food consumption is more indirect. Nevertheless, changes in consumption (for example, reduced consumption of meat) will likely play an important role in transitioning towards a Nature Positive Food System. Although, some consumption related indicators are part of the set ('Safe food', and 'Uptake of healthy diets by consumers', this is something worth elaborating on.

Also lacking in the framework are suitable indicators for measuring ecosystem functioning. This may be partly measured by some of the biodiversity indicators and indicators of environmental emissions and pressures. However, a general challenge is that the functioning of ecosystems can only be evaluated along a defined purpose: For example, regulating water, maintaining a heathland, or keeping species abundancy in a dynamic equilibrium. Such purposes necessarily relate to context and for different contexts, different purposes and, therefore, different indicators can be designed. More guidance on how to formulate such indicators for ecosystem functioning should be provided in future versions of this framework.

A further addition would be guidance on how to deal with trade-offs: *What if certain food system activities lead to progress in some indicators but deterioration in others?* The current framework does not provide a prioritisation in indicators that would help in evaluating trade-offs. This is on purpose, because a prioritisation is likely to depend on the specific context. Nevertheless, for applying the indicator framework, other approaches, such as multicriteria decision analysis could offer additional benefit.

6 Conclusion

In this report, we have explained the tools that we developed for guiding a transition towards Nature Positive Food Systems. Key in this transition is a collective effort of various stakeholders, depending on the food system context and scale, which we included explicitly in our definition as collective understanding and action. This is the process that these tools intend to guide.

First of all, the project was a collective effort of a multidisciplinary team, including disciplines related to environmental sciences, social sciences, animal sciences, agronomy, food safety research, and economic science. The collective understanding already started with internal discussions that, together with a summary of the relevant literature, have led to a working definition of Nature Positive Food Systems. A key insight from this process was that the concept of being 'nature positive' is dynamic and should evolve while a shared understanding grows. This means that it takes time to build common ground. Another insight is that a transition towards a Nature Positive Food System is about a shift from an unconscious choice to a conscious choice, thus, requiring a change in perspective in which the needs of nature and humans are more balanced.

Using the NPFS landscape canvas as a framing for our research, we aimed to create a comprehensive understanding of Nature Positive Food Systems for each element in different contexts. Each component of the NPFS landscape canvas could be examined through various methodological approaches. In our experience, the canvas effectively streamlined the research and discussion questions across diverse case studies, while allowing flexibility to develop context-specific tools for participant engagement. As a result, it supports the further development and operationalisation of the NPFS concept and serves as a crucial element in the continuous process of experiential learning. With unpacking the canvas elements through applying the developed tools to case studies (definition, indicators, enablers and barriers), we have started to extend the collective understanding of Nature Positive Food Systems from different parts of the world.

- What we learned from the case studies regarding our NPFS definition:
  - As a working definition for nature, the terms 'biodiversity and ecosystem functioning' were used. The definition with its five parts was generally received well and seen as logical. However, we had already recognised that perceptions of what nature consists of differ, and that it can be arbitrary if something can be considered (part of) a food system. Also, the fifth element of collective understanding and action, was not immediately understood by everyone. Therefore, the definition would benefit from continued dialogue.
  - Cultural differences exist in how nature is perceived, but there is a shared recognition of the need to respect nature's capacity to sustain life. The attitudes towards nature differ per culture and per person. Progress towards a Nature Positive Food System is context dependent, and there are challenges in defining what it means across different regions. This does not need to be a problem. Moreover, the tools we offer should allow for being embedded and adopted by local cultures – as long as the biodiversity curve becomes positive in the end.
  - Food and feed production will always impact nature in terms of landscape, water quality and availability, soil quality and nutrient cycles etc., unless we go back to becoming hunter-gatherers again. So making the food system nature positive will always be balanced with people positive outcomes. It is still a question if such a balance allows for bending the curve towards an increase of biodiversity based on a human population of eight billion or more, and the present norms of economic affluence.

Through the analysis of the case studies, it became evident that maintaining a balance between human and ecological well-being is important. A social foundation may be necessary to empower participants, especially in the context of our selected case studies, to invest in nature-positive activities. Additionally, there was a pronounced recognition of the interconnectedness between nature and humanity, and the need for collectiveness to create change. Finally, to further explore and discuss Nature Positive Food Systems, participants frequently referenced specific practices deemed as Nature Positive Food Systems (e.g. organic farming), as these examples provided tangible illustrations.

- What we learned from the case studies regarding enablers and barriers:
  - The enabler and barrier framework proved instrumental in addressing the *"What?"* component of the canvas. By offering structured prompts for stakeholder engagement, the framework facilitated comprehensive discussions on various aspects of the food system, specifically in terms of the enablers and barriers to achieving a Nature Positive Food System.
  - The barriers are still overwhelmingly present. So much so that people report that they do not even achieve the 'no harm' or neutral level, let alone achieving nature positive outcomes. Common barriers are market pricing, poverty, and lack of knowledge.
  - Enablers were also identified, such as new technologies, more equity, more local cooperation to protect natural resources. The transition to more nature-positive practices will require a careful process so that the most vulnerable members of a community are not excluded from the use of common resources. In general, becoming nature positive requires a collective effort and a change in the regulatory context.

- What we learned from the case studies regarding the use of selected indicators:
  - The set of indicators mainly covers the first three elements of the Nature Positive Food System definition (see Section 2.2): nature, positive, and food system. There are no motivational or process-based indicators for 'nature at the heart' or 'collective understanding and action'. Indicators addressing societal and governance aspects need to be added to the list, to bridge the gap between understanding and action.
  - Parameters and indicators used in one culture/country are not always applicable in another culture/country. For example, CO_2 and nitrogen emission calculations are commonly used by Dutch farmers. However, these are not effective indicators to communicate with small scale Indian dairy farmers.
  - In the explorative phase of our project, we took a lot of freedom in talking about the indicators, for example, reducing them to just a few words, and changing them into AI generated pictures. We did not focus on things like unit of measurement or methods for monitoring and calculating. When the indicators are put into practice in a pilot case to actually measure the baseline, we may discover the need to adapt the set of indicators in many ways. This further development should be done while keeping the overall coverage of themes in mind.
  - Stakeholder dialogue guided by indicators helped participants define a "Nature Positive Food System," identify suitable practices, and uncover context-specific barriers, leading to locally relevant, collaborative strategies. Expanding the discussion to the consumption side of the food system may uncover a need for additional indicators.
  - Despite differences between the two case studies in selected indicators for biodiversity, food production, and livelihoods, common themes emerged. Stakeholders acknowledged the reliance of food systems on nature and recognised that their systems often fell short of being nature-positive or even meeting "do no harm" objectives. They emphasised the need for a shared understanding and collective action to drive meaningful change. This suggests that the indicator-based approach is adaptable across contexts to build consensus on defining and achieving a Nature Positive Food System.

As the understanding of Nature Positive Food Systems is dynamic, judging whether or not a food system is nature positive is difficult. It is context dependent and will depend on the targets set within the specific food system. This is then also what is required for a transition towards Nature Positive Food Systems: Setting actionable targets and monitoring progress towards it; also in light of global biodiversity and wider sustainable development goals.

The tools developed to aid the transition towards more Nature Positive Food Systems need further development. To refine and discuss the tools, we used case studies, and in this process, the first stage of the transition took place: Creating awareness and opening the debate. We can say that the tools are effective in that stage of debate, also because we were still open to other views and interpretations. In such a stage, it does not matter yet, if we miss an indicator or if we do not question people's personal views on what nature is. However, when we proceed more towards action, such flaws in the tools will matter and may hinder the process of coming to a consensus on what needs to be done, let alone, on what is done. So, while these tools are useful in this early stage of the transition, they need further development to be effective in later stages.

In this study the tools (working definition, indicators, and enablers and barriers framework) were tested in combination, using the landscape canvas as an overall structure. This mainly served the purpose of gaining basic understanding and starting the dialogue. A more in-depth guidance can be obtained by applying the individual tools more extensively. For example, the indicators can be used for agreeing on targets, which is then followed by measuring and monitoring. The enablers and barriers tool can be followed by acting on identified enablers and barriers and evaluating the result.

What is next?

- Stakeholders in the food system, both in production and consumption, can start using the tools to assess their part of the food system. By publishing their results, they can start with nature positive changes and at the same time add to the further development of these tools. The tools can also be used settings where multiple stakeholders are brought together for discovering options at higher levels of scale and the identification of synergies and trade-offs.
- Different understandings of nature need to be made conscious in a dialogue, allowing for locally based cultural perspectives on Nature Positive Food Systems, followed by a shared understanding and conscious choices towards a more resilient life.
- The selected set of indicators already addresses the current state and driving forces. Indicators focusing on social and governance aspects should be added to improve the understanding of nutritional aspects of sustainably grown food. In addition, the focus is currently more on food production, while indicators relevant for the retail and processing industry, as well as the consumption phase, could be added.
- Indicators can help communicate and discuss Nature Positive Food Systems but should not be too abstract. They need to offer practical guidance to stakeholders, such as farmers or supply chain actors.
- Definitions and indicator frameworks should be adaptable, reflecting the complexity and context-specific nature of Nature Positive Food Systems. Next to this, a globally agreed indicator framework, such as Kunming-Montreal Global Biodiversity Framework (CBD, 2022), may be necessary to monitor overall progress of the contribution of the food system to biodiversity at IPBES level.
- We need to move from understanding Nature Positive Food Systems to actions; the enablers and barriers identified with the enablers and barriers tools can provide a starting point for finding practical solutions and encourage the growth of solutions that already exist.
- More engagement of stakeholders, including policy-makers at state level, and international food corporations, is needed to speed up the transition to Nature Positive Food Systems while also addressing equity, gender issues, and political resistance, particularly in relation to global sustainability efforts. The set of tools presented here provide good starting points for engaging in such a stakeholder dialogue.

References

Abas, A., Aziz, A., & Awang, A. (2022). A Systematic Review on the Local Wisdom of Indigenous People in Nature Conservation. *Sustainability 2022, Vol. 14, Page 3415*, *14*(6), 3415. https://doi.org/10.3390/SU14063415.

A/RES/71/313 (2017).

Bern University of Applied Sciences. (2021). *Response-Inducing Sustainability Evaluation (RISE)*. https://www.bfh.ch/dam/jcr:0540a777-ab97-4555-b7ca-bb71904ae97c/what-is-rise.pdf.

CBD. (2022). *Monitoring framework for the Kunming-Montreal global biodiversity framework*. Convention on Biological Diversity. https://www.cbd.int/doc/c/179e/aecb/592f67904bf07dca7d0971da/cop-15-l-26-en.pdf.

Conijn, J. G., van der Sluis, M., Berkhof, M. J. J., Vriezekolk, E., Kruft, K., Hiemstra, S. J., Klostermann, J.E.M., & Post, P. M. (2025). *An indicator framework for Nature-Positive Food Systems*.

CSB. (2022). *What is a nature-positive approach?* https://getnaturepositive.com/faqs/.

FAO. (2019). Tool for Agroecology Performance Evaluation (TAPE) - Test version. In *United Nations Human Settlements Programme (UN-Habitat): Addis Ababa, Ethiopia. (2021)*. FAO ; https://openknowledge.fao.org/handle/20.500.14283/ca7407en.

FSCI. (n.d.). *Indicator Architecture*. Retrieved December 11, 2024, from https://www.foodcountdown.org/indicator-architecture.

Gibbons, L. V. (2020). Regenerative—The New Sustainable? *Sustainability*, *12*(13), 5483. https://doi.org/10.3390/su12135483.

Gliessman, S. R., Engles, E., & Krieger, R. (1998). *Agroecology: ecological processes in sustainable agriculture*. CRC press.

Haila, Y. (2012). Genealogy of nature conservation: a political perspective. *Nature Conservation 1: 27-52*, *1*, 27–52. https://doi.org/10.3897/NATURECONSERVATION.1.2107.

Hermans, T. D. G., Mubita Zambrano, T. M., Le Roux-Pullen, L., van der Sluis, M., Klostermann, J.E.M., Wang, Y., Conijn, J. G., Bebe, B. O., Kigiri, D., & Hiemstra, S. (n.d.). Towards a nature-positive food system: insights from an indicator-based approach. *Submitted*.

Hermans, T., Kruft, K., Omedo Bebe, B., Murage, P., Kigiri, D., & Owino, T. (2024). *Nature positive food system map for Menengai Forest Reserve, Kenya*. https://doi.org/10.18174/678139.

Hooke, D. (2011). *New Perspectives on People and Forests* (E. Ritter & D. Dauksta, Eds.; Vol. 9). Springer Netherlands. https://doi.org/10.1007/978-94-007-1150-1.

IPBES. (2019). *Global assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* (E. S. Brondizio, J. Settele, S. Díaz, & H. T. Ngo, Eds.). IPBES secretariat.

IUCN. (2020). *WCC-2020-Res-116-EN*.

le Roux-Pullen, L., Mubita Zambrano, T., & Nair, B. (2024). *Deliverable D2.2b A case study on the practice of Ethnoveterinary Medicine in India in the context of Nature Positive Food Systems.* https://www.wur.nl/en/research-results/chair-groups/research-funded-by-the-ministry-of-lvvn/soorten-onderzoek/kennisonline/nature-positive-food-systems-1.htm.

Leclère, D., Obersteiner, M., Barrett, M., Butchart, S. H. M., Chaudhary, A., De Palma, A., DeClerck, F. A. J., Di Marco, M., Doelman, J. C., Dürauer, M., Freeman, R., Harfoot, M., Hasegawa, T., Hellweg, S., Hilbers, J. P., Hill, S. L. L., Humpenöder, F., Jennings, N., Krisztin, T., … Young, L. (2020). Bending the curve of terrestrial biodiversity needs an integrated strategy. *Nature 2020 585:7826*, *585*(7826), 551–556. https://doi.org/10.1038/S41586-020-2705-Y.

Locke, H., Rockström, J., Bakker, P., Bapna, M., Gough, M., Hilty, J., Lambertini, M., Morris, J., Polman, P., Rodriguez, C. M., Samper, C., Sanjayan, M., Zabey, E., & Zurita, P. (n.d.). *A Nature-Positive World: The Global Goal for Nature*. Retrieved August 2, 2023, from https://www.naturepositive.org/en/our-work.

Meinzen-Dick, R., Ringler, C., Zhang, W., & Arndt, C. (2021). *KEY MESSAGES Natural Resources and Environment Governance for Nature-Positive Food Systems*. https://doi.org/10.2499/9780896293991.

Mommer, L., Nel, J., van Apeldoorn, D., van Hattum, T., Jones-Walters, L., Polman, N., Richter, A., Westerink, J., Alpízar, F., Candel, J., van Doorn, A., van Duinkerken, G., Maas, J., Fraanje, W., Groot, A., Jongeneel, R., Navarro-Matser, M., Riemens, M., Ritzer, S., … Wertheim-Heck, S. (2022). *Nature-positive futures*.

Muro, M., & Jeffrey, P. (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. *Journal of Environmental Planning and Management*, *51*(3), 325–344. https://doi.org/10.1080/09640560801977190.

Naranjo Barrantes, M., Berkhof, M., Post, P., & Klostermann, J.E.M. (Forthcoming). *Nature-positive food systems: How to move towards food systems with nature at the heart of decision making?.*

Obura, D. O., DeClerck, F., Verburg, P. H., Gupta, J., Abrams, J. F., Bai, X., Bunn, S., Ebi, K. L., Gifford, L., Gordon, C., Jacobson, L., Lenton, T. M., Liverman, D., Mohamed, A., Prodani, K., Rocha, J. C., Rockström, J., Sakschewski, B., Stewart-Koster, B., … Zimm, C. (2023). Achieving a nature- and people-positive future. *One Earth*, *6*(2), 105–117. https://doi.org/10.1016/J.ONEEAR.2022.11.013.

Oosten, C. van. (2021). *Landscape governance : from analysing challenges to capacitating stakeholders*. https://doi.org/10.18174/540838.

Osterwalder, A. (2010). *Business Model Generation*. John Wiley & Sons, Inc.

Post, P. M., Hermans, T. D. G., Naranjo Barrantes, M. A., de Rooij, L. L., & Wang, Y. (2024a). *Nature Positive Food Systems: A working definition*.

Post, P. M., Hermans, T., Naranjo Barrantes, M., de Rooij, B., & Wang, Y. (2024b). *Defining Nature-Positive Food Systems: Background report*.

Rath, D., & Joshi, Y. C. (2020). Prospects and strategies for accelerating the growth of the agriculture and allied sector in Odisha with specific reference to dairying. *Agricultural Economics Research Review*, *33*(2), 251–262. https://epubs.icar.org.in/index.php/AERR/article/view/140633.

Reed, M. S., Evely, A. C., Cundill, G., Fazey, I., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C., & Stringer, L. C. (2010). What is Social Learning? *Ecology and Society*, *15*(4), resp1. https://doi.org/10.5751/ES-03564-1504r01.

Rooij, B. de, Woolderink, H., Breman, B., Budding, A., Graaf, M. de, & Rooij, S. van. (2023). *'Water en bodem sturend' vraagt om een brede blik - WUR*. https://www.wur.nl/nl/show-longread/water-en-bodem-sturend-vraagt-om-een-brede-blik.htm.

Runhaar, H. (2017). Governing the transformation towards 'nature-inclusive' agriculture: insights from the Netherlands. *International Journal of Agricultural Sustainability*, *15*(4), 340–349. https://doi.org/10.1080/14735903.2017.1312096.

SBTN. (2021). *"Nature-positive" -- an opportunity to get it right. Science Based Targets Network*. https://sciencebasedtargetsnetwork.org/news/business/nature-positive-an-opportunity-to-get-it-right/.

Silva-Jean, M. da, & Kneipp, J. M. (2024). "Social learning, innovation, and sustainability: The search for directions beyond a systematic literature review." *Heliyon*, *10*(7), e28431. https://doi.org/10.1016/j.heliyon.2024.e28431.

United Nations. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development*. https://sdgs.un.org/2030agenda.

Van Berkum, S., Dengerink, J., & Ruben, R. (2018). *The food systems approach: sustainable solutions for a sufficient supply of healthy food*. www.wur.eu/economic-research.

van Doorn, A., Melman, D., Westerink, J., Polman, N., Vogelzang, T., & Korevaar, H. (2016). *Food-for-thought Natuurinclusieve landbouw*. https://doi.org/10.18174/401503.

van Rooij, S., Sterk, M., de Haas, W., de Rooij, B., van Linge, J. M., Timmermans, W., & Roosenschoon, O. (2022). *Met circulaire landbouw naar circulaire landschappen : Naar een rijkere legenda voor het Nederlandse landschap*. https://doi.org/10.18174/572548.

von Schönfeld, K. C., Tan, W., Wiekens, C., & Janssen-Jansen, L. (2020). Unpacking social learning in planning: who learns what from whom? *Urban Research & Practice*, *13*(4), 411–433. https://doi.org/10.1080/17535069.2019.1576216.

WBCSD. (2021). *What does nature-positive mean for business?* https://www.wbcsd.org/contentwbc/download/13439/196253/1.

WEF. (2020). *New Nature Economy Report II - The Future Of Nature And Business*. www.weforum.org.

Wenger, E. (1998). *Communities of Practice*. Cambridge University Press. https://doi.org/10.1017/CBO9780511803932.

Wildemeersch, D. (1995). *Een verantwoorde uitweg leren (Learning a responsible way out)*.

Wildemeersch, D. (2007). Social learning revisited: lessons learned from North and South. In A. E. J. Wals (Ed.), *Social Learning towards a Sustainable World: Principles, Perspectives, and Praxis*. Wageningen Academic Publishers.

Zu Ermgassen, S. O. S. E., Howard, M., Bennun, L., Addison, P. F. E., Bull, J. W., Loveridge, R., Pollard, E., & Starkey, M. (2022). Are corporate biodiversity commitments consistent with delivering 'nature-positive' outcomes? A review of 'nature-positive' definitions, company progress and challenges. In *Journal of Cleaner Production* (Vol. 379). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2022.134798.

Annex 1 Guidance questions for barriers and enablers

Table A1 *Questions related to three main components in food systems framework for identifying enablers and barriers:*

Questions on 'Food System Activities'

- Enabling environment and business services.
  - What current conditions help you produce in a nature positive way?
  - What current conditions hinder you to produce in a nature positive way?
  - Simplified cards/prompts:
    - Transport, infrastructure and roads
    - Training
    - Agricultural inputs
    - Technical support
    - Financial services
    - Information/technical assistance
    - Access to credit
    - Regulations.
  - Ask for every selected card: why is such a topic relevant either as enabler or barrier?
- Food supply system (is there added value for production, transport, processing and retail)
  - How easy is it for you to process and convert your product in a nature positive produced product (add value)?
  - What is currently available and what is missing?
- Consumer characteristics (match consumer preferences)
  - How easy is it for you to sell a nature positive produced product?
  - What is currently available, and what is missing?
- Food environment (supportive food environment)
  - Do you feel you have the support of a food environment? (for example: is it well known and accepted to be nature positive)?
  - What is currently available, and what is missing?

Questions on 'Socio-Economic Drivers'

- Policies
  - How do current policies help you with nature inclusive production?
  - How do current policies hinder you in nature inclusive production?
  - What policies are currently available and what is missing?
- Markets
  - Question not needed and answered above.
- Individual factors
  - What are you motivations for producing in a nature positive way?
  - Do you feel supported in producing in a nature positive way, and why?
  - Do you feel capable of performing your activities in in a nature positive way, and why?
  - Ask for every selected card: why is such a topic is relevant either as enabler or barrier?
- Social organisations
  - Are there existing organisations that give support/support to you in the process of in a nature positive production?
  - What is currently available, and what is missing?
- Science & Technology
  - Do you have access to the tools, inputs and information for in a nature positive way production?
  - What is currently available, and what is missing?

Questions on "Environmental Drivers"

What are enablers and barriers related to the biophysical context in which the food system operates?

- Land, soils
  - How does land availability help you in nature positive production?
  - How does land availability hinder you in nature positive production?
  - Does the soil help you in nature positive production, and how?
  - Does the soil hinder you in nature positive production, and how?
- Climate
  - Is climate change affecting your nature positive production, and how?
  - What is currently available and what is missing to protect against climate change?
  - Cards: Temperature, Rainfall, Droughts, Wildfire (these cards are context related!).
  - Ask for every selected card: why is such a topic is relevant either as enabler or barrier?
- Water
  - How do water conditions help you with nature positive production?
  - How do water conditions hinder you in nature positive production?
  - What is currently available and what is missing to improve water conditions for nature positive production?
  - Cards; water quality, water availability.
  - Ask for every selected card: why is such a topic relevant either as enabler or barrier?
- Biodiversity
  - Does biodiversity help you with nature positive production, and how?
  - Do you experience a decline in biodiversity? (e.g. pollinators)
  - Do you experience a decline in biodiversity as a barrier to nature positive production, and how?
- Fossil Fuels / Minerals
  - Are fossil fuels/minerals enablers or barriers to in a nature positive production, and how?
  - Prompts: resources, pollution?
  - What is currently available, and what is missing?

Annex 2 Analysis of barriers and enablers

		Practices				
		Organic farming	**Forest protection**	**Water access**	**Alternative cooking stoves**	Landscape
Food supply system	Enabling environment and business services	- Low access to finance - Little investment space - Lack of organic fertilisers, and they are too high risk	- Low access to finance		- Low access to finance	- Low access to finance - Little investment space - Lack of organic fertilisers, and they are too high risk
	Food supply system	- Organisational strengthening of groups - Increased volume of agricultural produce for sale				- Organisational strengthening of groups - Increased volume of agricultural produce for sale
	Consumer characteristics	- Demand rising			- Lack of wanting to change practices	- Demand rising
	Food environment					- Lack of wanting to change practices
Socio-economic drivers	Policies	- Climate Change Act 2021 - 2023-2027 climate change policy	- Climate Change Act 2021 - 2023-2027 climate change policy - Natural regeneration programme			- Climate Change Act 2021 - 2023-2027 climate change policy - Natural regeneration programme
		- Organic fertiliser testing and promotion of products by the government only happens at the large farms, and do not reach smaller farms	- Government funding has reduced - Kenya Forest Act Kenya 2016			- Organic fertiliser testing and promotion of products by the government only happens at the large farms, and do not reach smaller farms - Government funding has reduced - Kenya Forest Act Kenya 2016
	Markets	- Decreased trust on what is organic or not, as farmers can lie - Difficult to access supermarket as a potential market due to contracts on consistent number of products sold - Certification of organic products required but the threshold cannot be too high - Aggressive marketing from agro-dealers to sell their chemicals needs to change			- Developing capacity for creating added value can decrease the need for firewood collection for charcoal burning	- Decreased trust on what is organic or not, as farmers can lie - Difficult to access supermarket as a potential market due to contracts on consistent number of products sold - Certification of organic products required but the threshold cannot be too high - Aggressive marketing from agro-dealers to sell their chemicals needs to change
					- Need to lower threshold to access the required finance for alternative cooking stoves, such as micro-credit	- Need to lower threshold to access the required finance for alternative cooking stoves, such as micro-credit
		- Social media used to connect to potential markets or sell directly products				- Social media used to connect to potential markets or sell directly products - Developing capacity for creating added value can decrease the need for Firewood collection for charcoal burning
	Individual factors	- Most communities own their land so motivation to invest in agriculture - Livelihood secutiry and especially diversification	- Livelihood secutiry and especially diversification			- Most communities own their land so motivation to invest in agriculture - Livelihood secutiry and especially diversification
		- However motivation to invest in regeneration in itself is low - Lack of long term connection to the land - Dilemma between going to look for work (money) or going to be with the group (teaching, learning)	- Lack of long term connection to the land -			- Gender based violence and inequality However motivation to invest in regeneration in itself is low - Lack of long term connection to the land - Dilemma between going to look for work (money) or going to be with the group (teaching, learning)
	Social organizations	- Some organic farmers make their own fertilisers and insect repellents and sell to their neighbours - Need capacity strengthening and knowledge sharing - NGO training received on added value technologies, practices and seed banks have been helpful - Aim to train women on solar energy, britchers, or little fuel for cooking - Nakuru Living Lab	- PELIS user group to plant trees in exchange for land - KFS is stewarding through landscape planning and permissions - Participatory Forest Management Plan engaging various stakeholders in managing forest and its resources - More ownership at the community level for forest preservation - Nakuru Living Lab		- Changing the cooking style would be more positive impact on the forest compared to building a fence around it	- Some organic farmers make their own fertilisers and insect repellents and sell to their neighbours - Need capacity strengthening and knowledge sharing - NGO training received on added value technologies, practices and seed banks have been helpful - Aim to train women on solar energy, britchers, or little fuel for cooking - Nakuru Living Lab - PELIS user group to plant trees in exchange for land - KFS is stewarding through landscape planning and permissions - Participatory Forest Management Plan engaging various stakeholders in managing forest and its resources - More ownership at the community level for forest preservation - Changing the cooking style would be more positive impact on the forest compared to building a fence around it
		- Lack of certification for individuals to sell their own fertiliser and insect repellents to the markets	- However little incentive to invest in NPP as temporary arrangement - Not all user groups in the forest are member of the MCFA are therefore are not represented - KFS has a challenge on how to implement accountability for forest activities e.g. permissions for forest access payments cannot be too high - Introduction of beehives and beekeeping provides alternative income sources			- However little incentive to invest in NPP as temporary arrangement - Not all user groups in the forest are member of the MCFA are therefore are not represented - KFS has a challenge on how to implement accountability for forest activities e.g. permissions for forest access payments cannot be too high - Introduction of beehives and beekeeping provides alternative income sources - Lack of certification for individuals to sell their own fertiliser and insect repellents to the markets
	Science & Technology		- Soil testing services available but expensive			- Soil testing services available but expensive
Environmental drivers	Land, soils		- Soil erosion managed by planting vegetation or building small walls	- High soil erosion through wind and water		- Soil erosion managed by planting vegetation or building small walls
						- High soil erosion through wind and water
	Climate	- Use of pesticides to fight disease - Temperature warming leading to no crops	- Awareness of climate change is due to want to protect forest	- Droughts leading to lack of water		- Awareness of climate change is due to want to protect forest
			- Forest fires are a major challenge			- Use of pesticides to fight disease - Temperature warming leading to no crops - Forest fires are a major challenge - Droughts leading to lack of water
	Water			- Droughts leading to lack of water - No irrigation systems - Borehole expensive to pump and maintain system		- Droughts leading to lack of water - No irrigation systems - Borehole expensive to pump and maintain system
				- Borehole created in downhill area		- Borehole created in downhill area
	Biodiversity	- Farmers active growing fruit trees and creating hedgerows	- Natural regeneration programme - Plant 15 billion trees by 2030			- Farmers active growing fruit trees and creating hedgerows - Natural regeneration programme - Plant 15 billion trees by 2030
	Fossil Fuels / Minerals					

		EVM		other crop production	
Food system activities	Enabling environment and business services	- cost of implementing EVP has decreased	- lack of awareness - absence of institutional backing.		
	Food supply system	- Milk Union, specifically Sabar Milk Union, supplies	- dependency on the Milk Union's structure		
	Consumer characteristics				- to produce sufficient and market-acceptable produce
	Food environment				
Socio-economic drivers'	Policies				- The absence of a policy for handling manure or the use of sustainable fertilizer is recognised,
	Markets		- Production pressures	- Organic fertilizers are employed by some farmers, driven by market demands	
	Individual factors	- trust on EVM - Land ownership among farmers is prevalent,	- loss of traditional knowledge over generations		
	Social organizations	- training provided by the NDDB programs		- the increased collective action of communities to conserve resources, including water, is seen as a hopeful sign	
	Science & Technology	- farmers to manage their herds' health independently - experiment with new plant recipes - the integration of EVM into the veterinary science curriculum at universities			
Environmental drivers	Land, soils	- EVM was highlighted for its minimal environmental impact		- Crop rotation of tobacco and banana crops to maintain soil health.	- high pesticide use
	Climate				
	Water	- avoids leaving harmful residues like painkillers and antibiotics in the environment			- use of groundwater for irrigation over the last 20 to 30 years has been identified as a contributing factor to groundwater depletion
	Biodiversity				- loss of tree plantations leading to reduced populations of bees and birds like crows. Fencing is also mentioned as having a detrimental effect on biodiversity.
	Fossil Fuels / Minerals				

Annex 3 List of indicators for NPFS

Domain	Theme	Indicator name	Definition
Biodiversity/ nature	Biodiversity in natural areas: Offer ample room for natural ecosystems to thrive.		
		Nature area	Nature area is defined as the land/sea area where natural ecosystems can develop with no or minimal impact of direct human activities (measured in km^2). It may be worthwhile for biodiversity to distinguish between different types of major ecosystems and determine their areas separately.
		Biodiversity Intactness Index (BII)	The BII is an indicator of the average abundance of a large and diverse set of organisms in a given geographical area, relative to their reference populations.
		Mean Species Abundance (MSA)	Abundance of each species in a specific situation, divided by its abundance found in an undisturbed situation.
		Key species abundance	Number of individuals of a species in a certain area.
	Biodiversity in agricultural areas: Offer ample room for naturally occurring plants and animals within food systems.		
		Food system area covered by natural or diverse vegetation (quantitative).	Percentage of productive area in a food system covered by natural or diverse vegetation (natural pasture, wildflower strips, stone or wood heaps, trees or hedgerows, natural ponds or wetlands, etc.).
		Food system area covered by natural or diverse vegetation (qualitative).	The productive area in a food system covered by natural or diverse vegetation (natural pasture, wildflower strips, stone or wood heaps, trees or hedgerows, natural ponds or wetlands, etc. also considering communal land) is qualitatively assessed in four categories: absent, small, significant or abundant.
		Pollinator diversity (quantitative).	Number of individuals of a pollinator species in a certain area.
		Pollinator abundance (qualitative).	Pollinator abundance assesses whether pollinators and other beneficial animals are abundant, significantly present, rarely present or absent within the agroecosystem, which is connected to a score.
		Soil biodiversity function (quantitative).	Soil biodiversity function is a composite indicator based on a decision model consisting of 32 (grassland) or 31 (cropland) attributes related to nutrients, biology, soil structure and hydrology, ultimately expressed as low, moderate or high soil biodiversity status.
		Soil biodiversity (qualitative).	Soil biodiversity assesses whether soil organisms are abundant, significantly present, rarely present or absent within the agroecosystem, which is connected to a score.
		Key soil species abundance.	The indicator consists of assessments of earthworm diversity & biomass; collembolan diversity & biomass and microbial respiration.

Domain	Theme	Indicator name	Definition
Food production and environment	Production of sufficient, affordable and healthy food: Produce sufficient, affordable and healthy food for all people while ensuring good animal welfare.		
		Land productivity.	The indicator is defined as the number of people that can be fed annually from the agricultural land in the food system (# people / ha land*year).
		Safe food.	Safe food can be defined as food that has no harmful levels of substances and is therefore in principle safe to be consumed by humans.
		Balanced pricing.	People should be able to afford healthy diets for their households and those that work in food systems should have sufficient income for a decent living. The two are interlinked and therefore need to be assessed in combination.
		Animal welfare.	The feelings and physical wellbeing of individual animals in the food system.
	Environmental emissions and pressures: Produce food with low emissions towards the environment while making sustainable use of natural resources.		
		Marine ecotoxicity potential.	Potentially disappeared fraction of species in the marine environment caused by a toxin.
		Nutrient surplus.	Nutrient surplus is defined by the difference between all inputs of a nutrient and the amount of this nutrient that is removed by harvesting from the production system. At first the focus is on nitrogen and phosphorus.
		Pesticide use intensity.	The amount of active ingredients in pesticides applied per crop per year and applied in storage facilities at farms or factories (kg per year).
		Water quality of ground and surface water.	The EU-Water Framework Directive (WFD) aims to protect and improve the quality of water bodies, including rivers, lakes, coastal waters, and groundwater, across EU Member States. It has adopted a number of physical and chemical indicators, and there are also recommendations to monitor specific components in water bodies, such as metals and micropollutants.
		Greenhouse gas emission balance.	The annual total net emission (emission minus sequestration) of greenhouse gasses by the food system per year (ton CO_2-eq emission per year).
		Blue water footprint.	The volume of surface- and groundwater used to produce a certain amount of food (kg).
		Fresh water resources.	Water levels of groundwater and lakes are defined by the distance between these levels and e.g. the soil surface, expressed in meter. For streams, the indicator is defined by the average flow rate, e.g. in m3 water/s.
		Soil organic matter level.	Soil organic matter (SOM) is defined by the amount of organic matter in the top soil layer and expressed in either % of soil mass (w/w) or tonne SOM per ha.
		Sustainable fish stocks.	A fish stock of which abundance is at or greater than the level that can produce the maximum sustainable yield (MSY), is classified as biologically sustainable.

Domain	Theme	Indicator name	Definition
Sustainable livelihoods	Decent work and income: Offer decent work and incomes for all workers in the food system.		
		Access to agricultural extension services.	% of members in a defined community and household that have access to agricultural extension services, disaggregated by gender and age.
		Access to land rights.	% of members in a defined community and household that have rights such as ownership and control over land and other forms of property and secure and indiscriminate inheritance rights, disaggregated by gender and age.
		Access to safe, sustainable and productive employment.	% of members in a defined community and household that are employed in a safe environment, resulting in a resilient, sustainable livelihood.
		Access to healthcare.	% of members in a defined community and household that have access to water, sanitation and basic healthcare, disaggregated by gender and age.
		Access to finance.	Percentage of members in a defined community and household that have access to (micro-)finance, disaggregated by gender and age (% of total number of members for whom finance is relevant).
		Access to markets.	Percentage of food producing members in a defined community and household that live within acceptable travel times between production location and nearby market in situations where food products are sold at local markets (% of members with travel times <two hours).
		Access to education and skill building.	Percentage of members in a defined community and household that have followed basic education and are able to follow education for specific skill building, useful to their jobs in the food system (% of total number of members that are eligible to follow education).
	Resilience: Be(come) resilient towards future events and changes, such as climate change and increasing food demands.		
		Uptake of healthy diets by consumers.	Percentage of the population that consumes a healthy diet as defined by a national food organisation (such as food-based dietary guidelines).
		Measures limiting disaster impacts.	Number of locally led adaptation interventions in the food system to build resilience of the food system against future disasters.
		Agricultural species diversity (Gini-Simpson index).	A count of crops species and varieties and the relative area occupied, as well as a count of animal species and breeds (calculated for crops and animals separately). A Gini-Simpson index of diversity is calculated, both for crops and animals.
		Genetic diversity.	Genetic diversity is defined as 'the number of genotypes/varieties of the standing crops'. A similar measurement can be made for animals.

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