Back to the Commons

Introducing Regenerative Agricultural Networks in Northwestern Europe

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Students
Kirthan Shekar [5524482]
Nancy Nguyen [4785029]
Raven Van der Steen [4582705]
Stefania Saridou [5866308]
Willemijn Hoogland [5250668]

Tutors
Dr. Nikos Katsikis
Dr Rodrigo Cardoso

Coordinators
Dr. Verena Balz
Dr. Nikos Katsikis
Dr. Roberto Rocco
Dr. Marcin Dąbrowski

2022/2023 - Q3
R & D Studio: Spatial Strategies for the Global Metropolis [AR2U086]
Research & Design Methodology for Urbanism [AR2U088]

MSc1 / Architecture, Urbanism and Building Sciences
Track Urbanism

Faculty of Architecture and the Built Environment
Delft University of Technology

12 April 2023

Abstract.

For the last decades, technologies, new agricultural trade policies, environmental restrictions, high pressure through economic competition in combination with a sharp competition of land lead to the development of intensive farming. As a result, patchy landscapes have been replaced by monofunctional, homogeneous agricultural landscapes that fragment natural landscapes and take away natural and cultural diversity. The consequences of the processes of fragmentation and homogenization are both socio-economic and landscape-ecological and cause biodiversity loss and social injustice among farmers.

Through changing existing paradigms about nature conservation, this project suggests an alternative approach for understanding possible interrelations between nature and agricultural practices. By reintroducing concepts about commons, a synergy can be found that compliments natural connectivity and agricultural landscapes through the establishment of a regenerative agro-ecological network that connects biotopes in a multi-functional way using current agricultural parcels and natural zones. This newly introduced Common Ground network produces a new farming method in which agricultural practice has a temporal character and is a continuous modifiable process. In this way, the vision makes use of the dual crisis as a solution rather than seeing it as the source of the problems.

The Commons also resemble a new way of practising agriculture, in which land, knowledge, resources and financial risks are shared among farmers in a socially just way. In addition, these shared landscapes reflect on the social context in which farmers are considered as environmental stewards who share some of the responsibility for an ecologically balanced system.

Keywords
agriculture, nitrogen, biodiversity, fragmentation, commons, non-urban landscape, environmental stewardship

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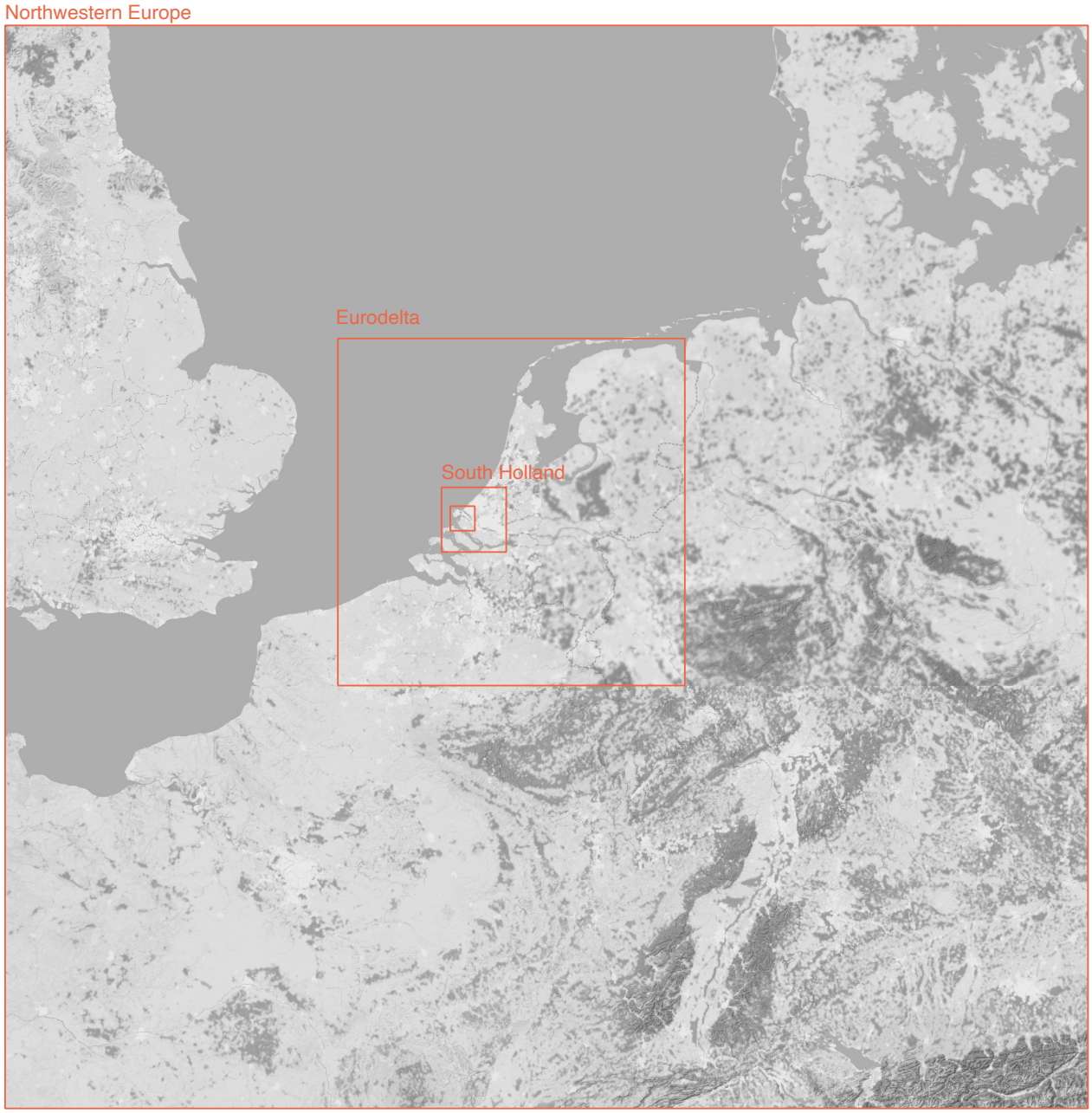
Introducing the Dual Crisis

1

The issue of excessive nitrogen pollution has been a major environmental challenge the last decades that poses a threat to both the environment, ecosystems, and human health. The Eurodelta area, and especially, the Netherlands is one of the highest productive agricultural landscapes, and also one of the biggest nitrogen emitters within Europe. Intensive agricultural practices in the area have led to significant environmental degradation, specifically in the form of nitrogen pollution and biodiversity loss.

This dual crisis of fragmentation of natural landscapes and excessive nitrogen pollution has raised questions among the institutions such as the UN and the EU and is one of the most pressing environmental challenges of the 21st century. The revelation of this dual crisis has raised concerns regarding the future of the agricultural sector in the Eurodelta region. This pressing matter thus calls for the re-evaluation of current farming practices.



Map of Northwestern Europe higlighting Eurodelta and the province of South Holland

The region under investigation of this report is the province of South Holland(PZH) in the context of both the Eurodelta region and Northwestern Europe. The PZH is located in the Rhine, Meuse, and Schelde deltas, covers approximately 3,400 km2 (including 600 km2 of water), and has a population of approximately 3.7 million people.

The primary research question of this report is:

“How to transition agricultural practices to revitalise biodiversity in a socially just way?”

Addressing this question is important in order to ensure the Eurodelta region’s environmental stability as well as the economic and social health of its farmers. The main objectives of this initiative is to connect biotopes, introduce regenerative landscapes, fixing nitrogen cycles from a linear one into a circular one and focusing on the question of social injustice.

One of the key elements to achieve this is the reintroduction of a regenerative landscape, the “commons”. The vision proposes the creation of common grounds, which will serve as a shared resource of water, land, facilities, and knowledge for the farmers, who will undertake the role of environmental steward in maintaining the connection between biotopes and fixing nitrogen cycles towards localised circular flows.

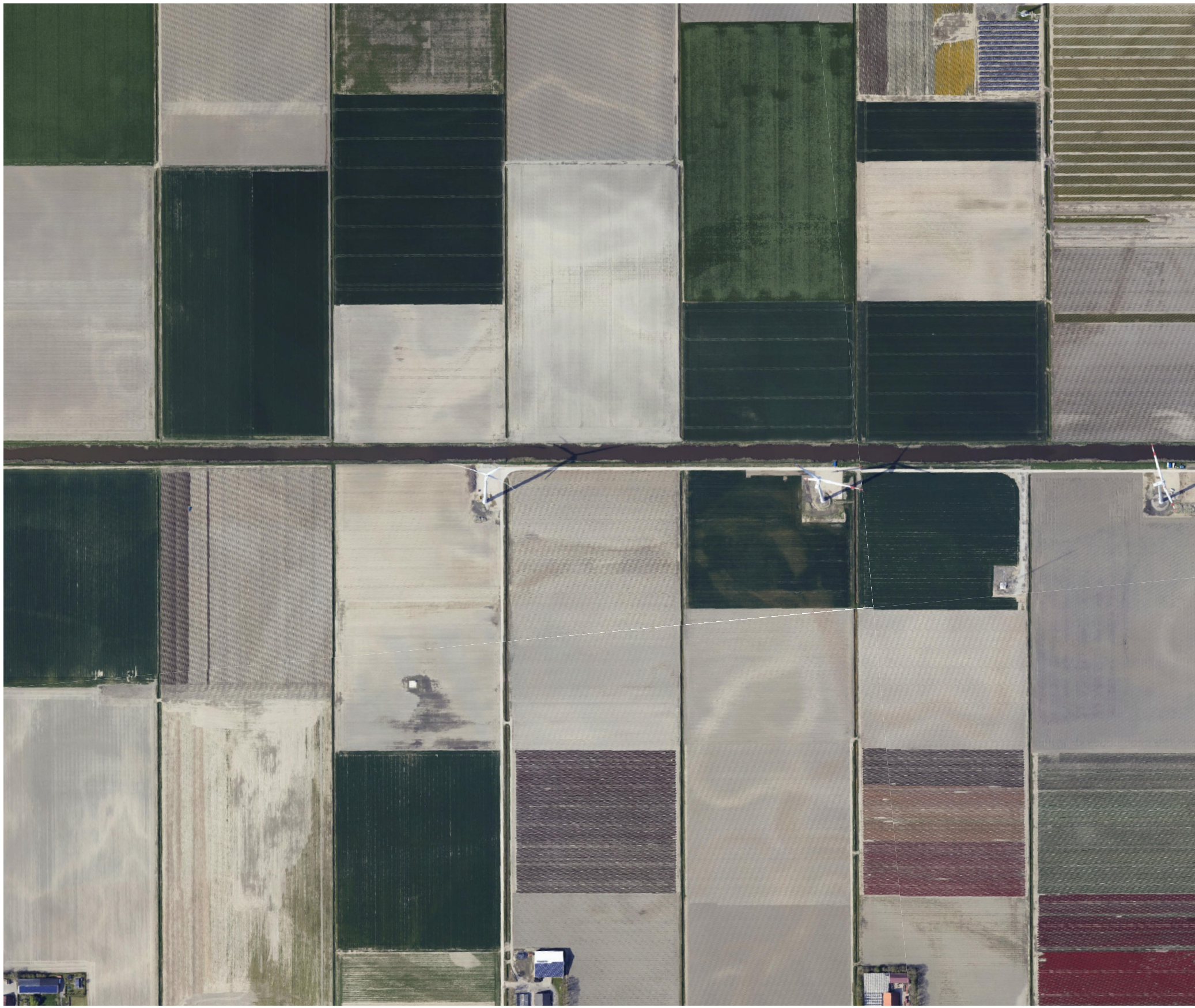
The great societal challenges of the 21st century also include inequality, poverty, climate change, biodiversity loss etc. At the same time, the increasing complexity of our societies and systems add to the problem of how to solve these great societal challenges. Additionally, technology and technological advancement can both address and become a tool for solving our societal challenges but also create bigger inequalities and create new forms of challenges. Part of our societal challenges is also the preservation of our own needs and at the same time establishing basic living circumstances.

To achieve this vision, a strategy has been created and proposed, which consists of several design and policy steps that aim at promoting the establishment of agricultural commons, in which farmers and other stakeholders manage knowledge and resources jointly. There is a need for a paradigm shift from biodiversity conservation as a protected zone to landscape regeneration through system understanding and utilisation of the potential of human activities to revitalise biodiversity.

This report seeks to contribute to the development of a new paradigm for agriculture in Northwestern Europe that promotes environmental sustainability, economic viability, and social equity by examining the interconnected challenges of nitrogen pollution, biodiversity loss, and social justice. Through the establishment of agricultural commons and the implementation of innovative policies, we can progress towards a future in which farming practices are not only productive but also considerate of the ecosystems and communities that they support.

Satellite image of pasture landscape

Image reference
ESRI, 2023



Satellite image of flower landscape

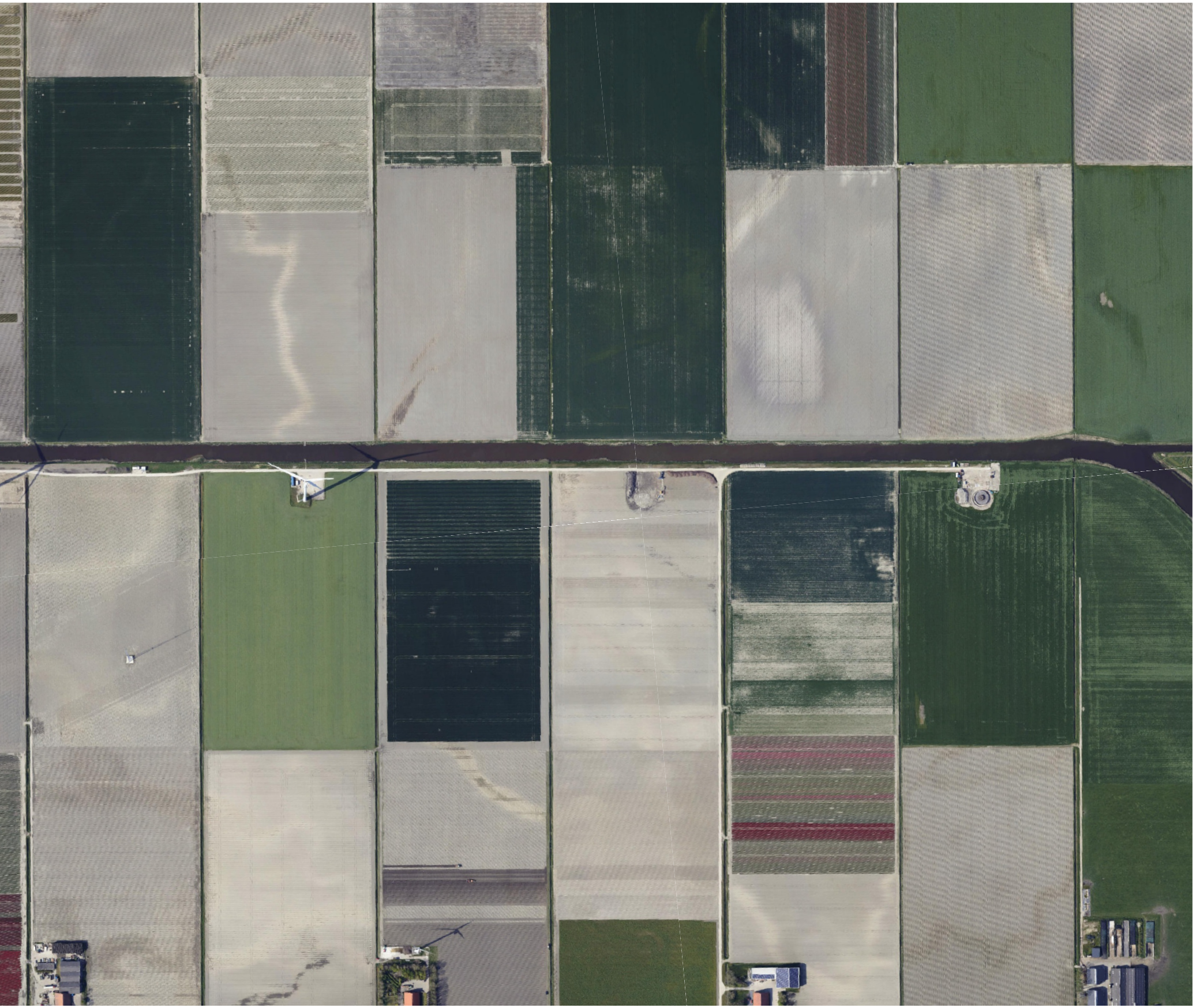


Image reference
ESRI, 2023

Satellite image of culivated lands

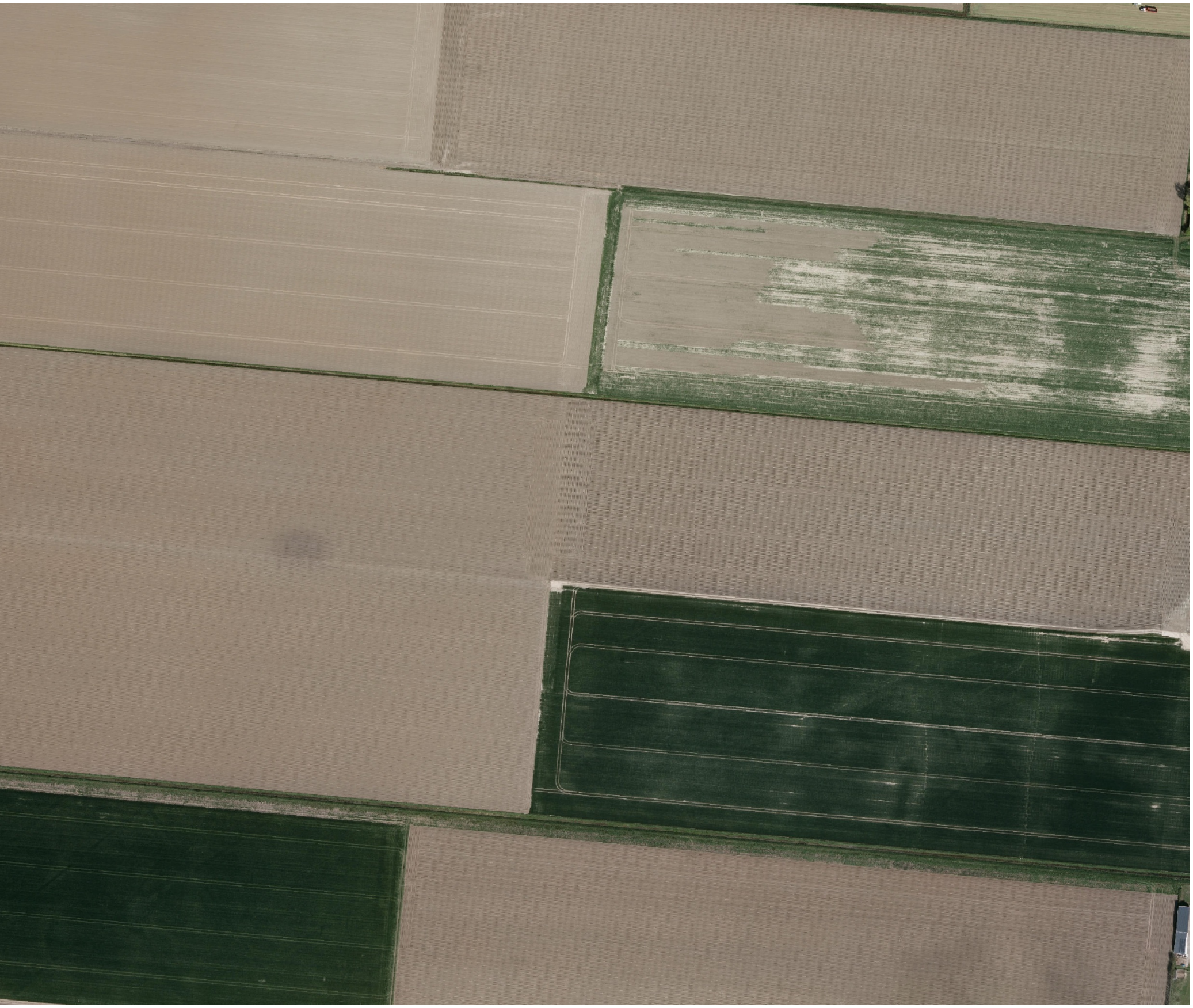


Image reference
ESRI, 2023

Methodology

2

Main research question

“How to transition agricultural practices to revitalise biodiversity in a socially just way?”

Subquestions

Which land covers contribute the most to nitrogen pollution?

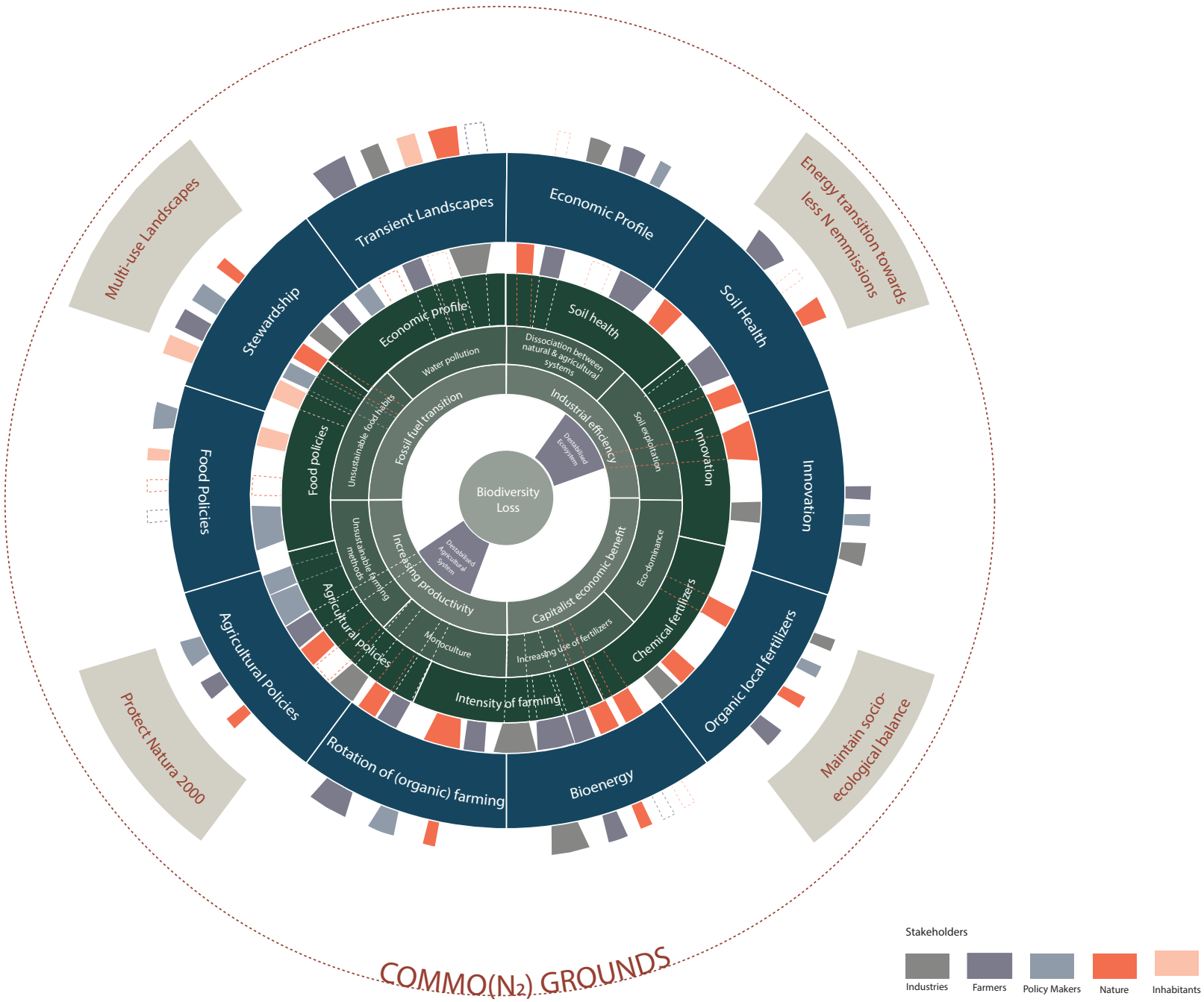
Which parts of Northwestern Europe contribute mostly to nitrogen pollution?

What are the nitrogen polluted processes that are happening in the current landscape?

What are the socio-spatial implications of nitrogen pollution in the current landscapes?

How can you make the nitrogen landscapes circular?

How do nitrogen policies influence the role of the farmer within the nitrogen imbalanced landscape?



Project framework describing the domains, concepts and theories of the research

Theoretical framework

The theoretical framework for this report includes the concepts of environmental science, agricultural economics, social justice, and policy analysis to give a full picture of the problems and possible solutions related to nitrogen pollution, biodiversity loss, and the move to sustainable agriculture in the Eurodelta region.

Environmental Science: This framework is based on a solid scientific understanding of the ecological processes that make nitrogen pollution and biodiversity loss possible (Galloway et al., 2008). The concepts will be used to evaluate the efficacy of different sustainable agricultural practices in addressing the problems of nitrogen pollution and biodiversity loss, as well as their causes, consequences, and interrelationships (Pretty et al., 2018).

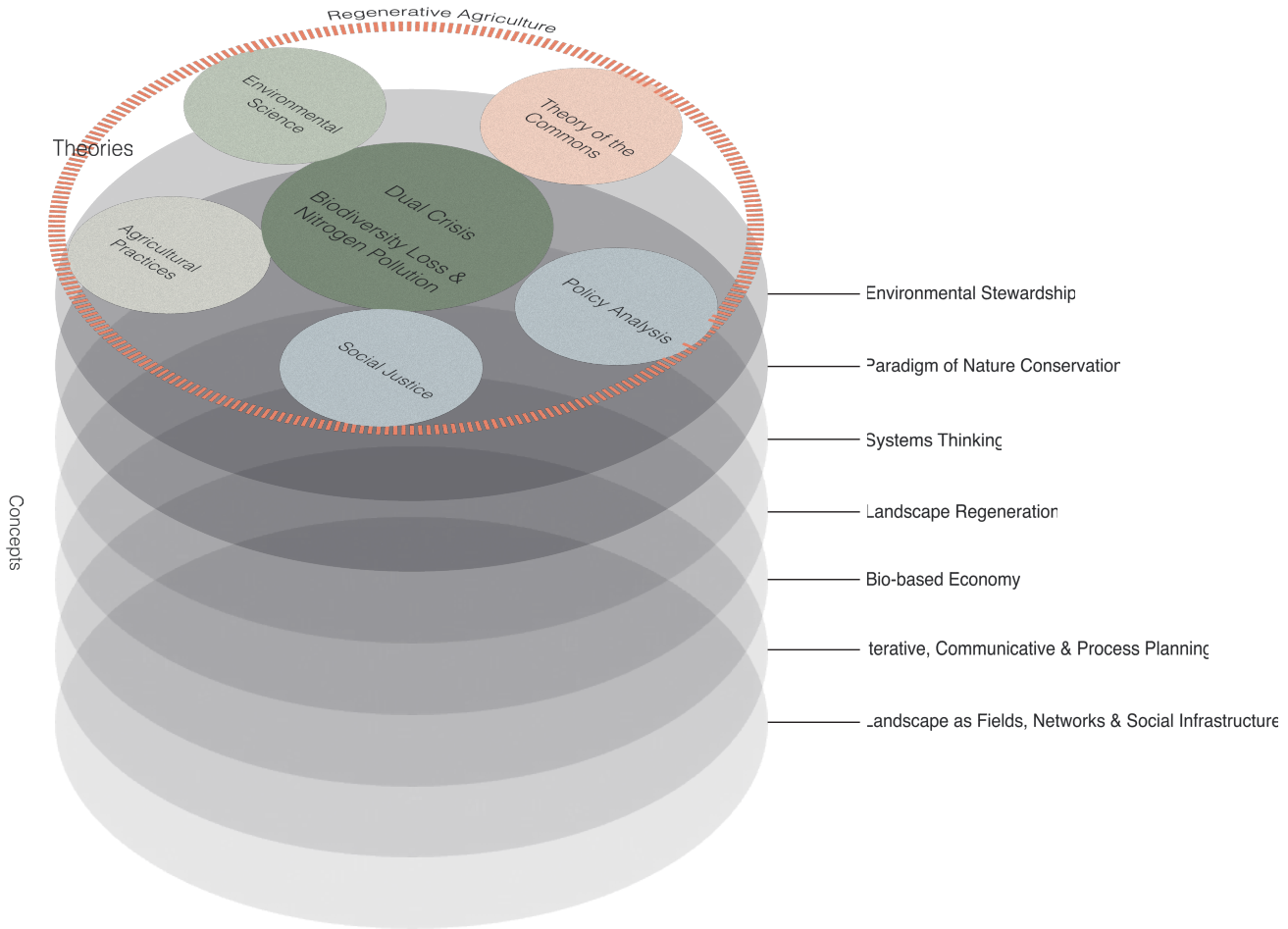
Agricultural Practices: The current agricultural practices in this report are being evaluated and new, more sustainable, practices are being proposed (Siebert et al., 2006).

Theory of the Commons: In order to promote environmental stewardship and social justice in agriculture, the framework uses the theory of the commons to investigate the feasibility of shared resource management and collaborative decision-making (Rose, 2020, Ostrum, 1990).

Social Justice: To guarantee a fair and inclusive transition to sustainable agriculture, the framework also incorporates principles of social justice (Schutter, 2014).

Policy Analysis: Last but not least, the theoretical framework will use ideas from policy analysis to assess the success of current policies and recommend alternative approaches. The ability of existing policies to promote sustainable agricultural practices and social justice, as well as their implementation, enforcement, and coherence, will be evaluated (Dessart et al., 2019).

By combining these five areas of research, the theoretical framework will provide a broad and multidisciplinary lens through which to look at the complicated problems of nitrogen pollution, biodiversity loss, and the transition to sustainable agriculture in the Eurodelta region.



Conceptual framework
of the research

Conceptual framework

The conceptual framework for this report shows how nitrogen pollution, biodiversity loss, and the change to sustainable agriculture in the Eurodelta region are all linked to each other. The main parts of the framework are the following:

Environmental Stewardship: This concept serves as the framework's foundation, emphasising farmers', policymakers', and other stakeholders' responsibility to manage and protect the environment, including efforts to reduce nitrogen pollution and promote biodiversity conservation (Pretty et al., 2018).

Landscape Regeneration: Landscape regeneration is a key part of the framework for the transition to sustainable agriculture. It focuses on restoring ecosystems, promoting biodiversity, and making agricultural landscapes more resilient (Lyle, 1994).

Biobased Economy: The idea of a biobased economy is built into the framework to encourage the development of new, sustainable agricultural practices, products, and markets that are based on biological resources that can be used over and over again.

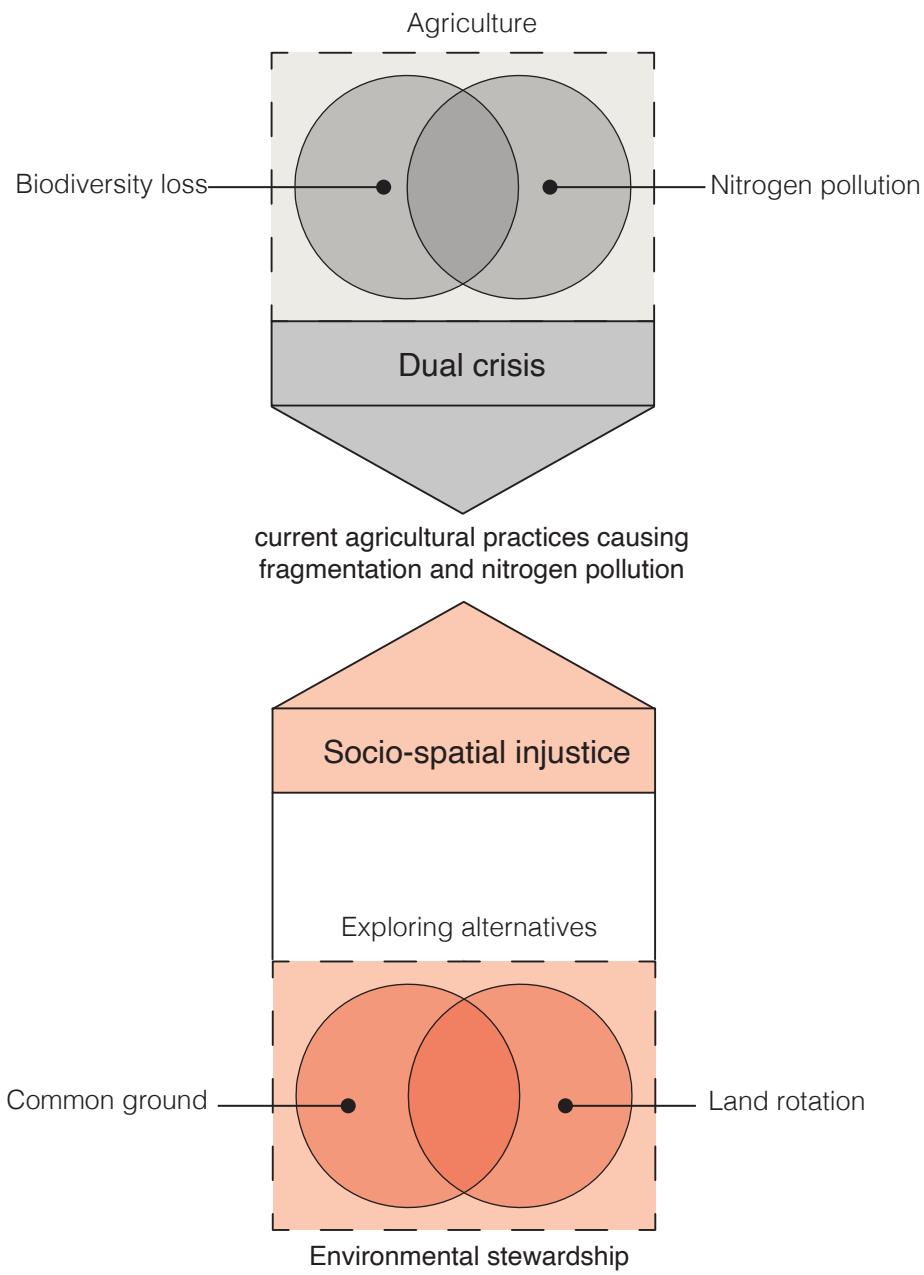
Paradigm of Nature Conservation: This part of the framework shows how important it is to protect nature in a way that takes into account how ecosystems, species, and human activities are all connected.

Iterative, Communicative and Process Planning: These planning methods are built into the framework to show how important ongoing stakeholder engagement, communication, and flexibility are when it comes to making and putting into place sustainable agricultural practices and policies.

Systems Thinking: The framework takes a system thinking approach, where the landscape is a system nesting smaller systems and takes into account how environmental, social, and economic factors affect nitrogen pollution, biodiversity loss, and the change to sustainable agriculture (Montuori, A. 2011).

Landscape as Fields and Networks, and Landscapes as Social Infrastructure: The framework is based on theories, which stress how important it is to think about both the physical and social aspects of landscapes when making and using sustainable agricultural practices.(Bargmann, 2013)

The combination of these ideas and creating a conceptual framework makes it possible to investigate the complex problem of nitrogen pollution, biodiversity loss, and the change to sustainable agriculture in the Eurodelta region from a wide range of perspectives. The framework's goal is to help stakeholders come up with ideas that support not only the protection of the environment, but also help the economy, and social justice, while also encouraging a sense of shared responsibility and stewardship.



Argument structure of the research process

Argument structure

This report's argument structure is based on a systematic approach, employing a variety of research methodologies to address the complex issues surrounding nitrogen pollution, biodiversity loss, and the transition to sustainable agriculture in the Eurodelta region.

Firstly, the report will address the existing dual crisis of biodiversity loss and nitrogen pollution, outlining the causes, repercussions, and interdependence of these two issues. This overview will rely on scientific literature to lay the groundwork for a discussion of potential remedies. Critical mapping graphically depicts the spatial distribution of nitrogen contamination, biodiversity loss and biodiversity fragmented areas, as well as the different landscapes that contribute to the nitrogen pollution. This data allows us to identify patterns, trends, and potential areas for intervention.

The literature review then provides a synthesis of extant knowledge on the environmental, social, and economic aspects of the issue, which informs our theoretical and conceptual framework. Then, policy evaluations are discussed, demonstrating the efficacy of current policies and regulations in addressing the dual crisis and highlighting policy improvement opportunities. Interviews with key stakeholders provide valuable insights into the obstacles and opportunities associated with the transition to sustainable agriculture and the potential for collaborative resource management.

Following that, the report will look at a variety of sustainable agriculture approaches that could help reduce nitrogen pollution while also promoting biodiversity conservation.

Additionally, the report will assess current policies and their effectiveness in tackling nitrogen pollution and biodiversity loss in the Eurodelta region and will propose new policies that aim to promote a more holistic and efficient strategy to resolving the dual crises of nitrogen pollution and biodiversity loss. These recommendations will stress the need for stronger, more coordinated action at the regional, national, and European levels, as well as a stronger focus on involving farmers as partners in environmental stewardship.

Lastly, the report will provide a developed strategy that will try to answer the research questions that was set for this report. The iterative process is emphasised throughout the research, and makes sure that new findings are always added and that changes are made as needed to deal with new ideas and problems.

Finally, the last part of the report consists of the main conclusions that were made through the investigation of the dual crisis, the vision and strategy creation, as well as a reflection on the topics developed through this report.

By incorporating these diverse research methodologies, this report's argument structure provides a solid foundation for the development of innovative design solutions to the challenges of the dual crisis faced by the Eurodelta region.

Scope

This report's scope focuses on the complex difficulties of nitrogen pollution, biodiversity loss, and the transition to sustainable agriculture in the Eurodelta region and northwestern Europe, with the main argument around transitioning agricultural practices to regenerate biodiversity in a socially equitable way. In this context, the report focuses particularly on the following factors:

Taking into account the specific physical, ecological, socioeconomic, and demographic features of the Eurodelta region, this research analyzes the spatial distribution of nitrogen pollution, biodiversity loss, biodiversity fragmentation and different (agricultural) landscapes in the area. The geographical implications of various interventions and policies are also examined in order to find potential synergies and trade-offs between environmental, social, and economic outcomes at various spatial scales, such as local, regional, and transboundary levels. Although the idea of industrial ecology provides helpful insights for comprehending the material and energy fluxes in industrial systems and their environmental implications, the emphasis of this report is on the agricultural sector and its connection to biodiversity and nitrogen pollution. Without going into the domain of industrial ecology, the report's scope highlights agricultural practices, policies, and strategies that promote environmental sustainability, economic viability, and social equality.

By focusing on these factors, the report aims to provide a thorough comprehension of the challenges and opportunities associated with nitrogen pollution, biodiversity loss, fragmented habitats and the transition to sustainable agriculture in the Eurodelta region. In addition, the report aims to create concrete recommendations and methods for building a more sustainable and socially equitable agricultural system that helps to the region's biodiversity regeneration.

Unpacking the Dual Crisis

Biodiversity Loss
Nitrogen Pollution
Correlations
Status Quo

3

A Dutch flag flown upside down in protest against the government’s nitrogen policy on a farm in Hazerswoude, the Netherlands.

Image references
Photographer: Peter Boer/Bloomberg

Biodiversity Loss

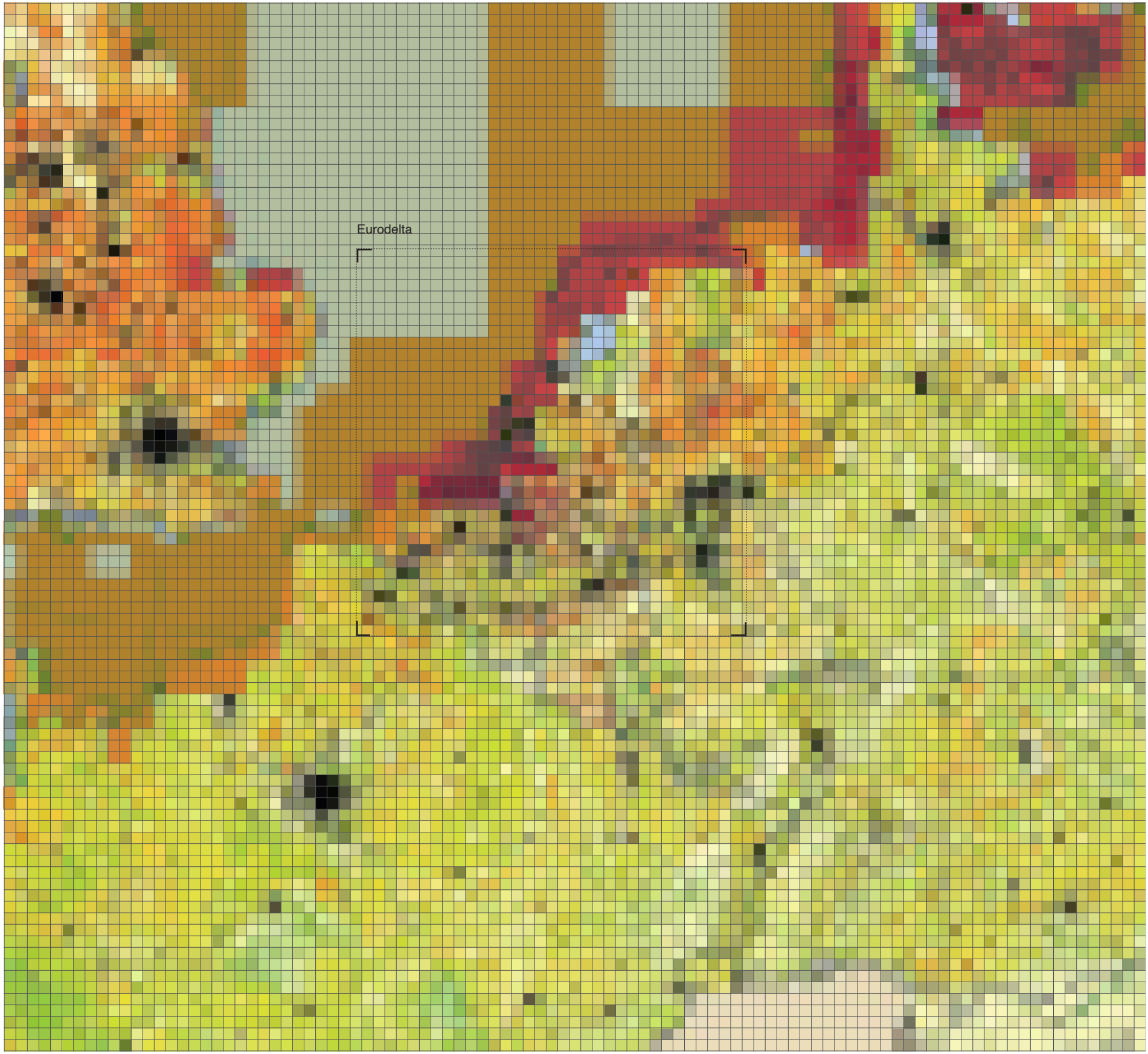
In the last decades, biodiversity loss has been one of the most crucial problems-to-be-solved that threatens not only vulnerable ecosystems but also humans. Caused mainly due to human activities like deforestation, burning fossil fuels, overfishing, and pollution (Ceballos et al., 2015), the consequences become evident in the decrease in species diversity and abundance in local and global ecosystems.

A remarkable amount of progress has been made regarding the understanding of how biodiversity loss affects the health of different ecosystems. Following the Rio de Janeiro Earth Summit in 1992, there was a rapid increase in interest in investigating the impact of biodiversity loss on ecosystem dynamics, ecosystem function, and the provision of goods and services and so the Convention on Biological Diversity was signed by 150 government leaders (Cardinale et al., 2012). The Convention acknowledges that the biological diversity is not only about plants, animals and microorganisms and their ecosystems, but also about the wellbeing of humanity and how it is linked to the environment (Unit, 2022).

The Millennium Ecosystem Assessment (MEA) came out in 2005. It was the result of a four-year scientific study that found that more than 60% of the world's ecosystems had been damaged or were being used in a way that was not sustainable. This meant that many important ecosystems had been lost. This report also pointed out the different interrelationships between ecosystem services and human well-being, demonstrating how ecosystem service loss can have serious consequences for human health, food security, and poverty reduction. There is a need to call for immediate actions to reverse ecosystem degradation and promote their sustainable use, while at the same time emphasising the need for a more comprehensive strategy for managing ecosystems that considers both social and economic factors. Since then, the MEA has become a source used worldwide for better ecosystem management and has influenced the creation of many policies on global and local levels (Powledge, 2006).

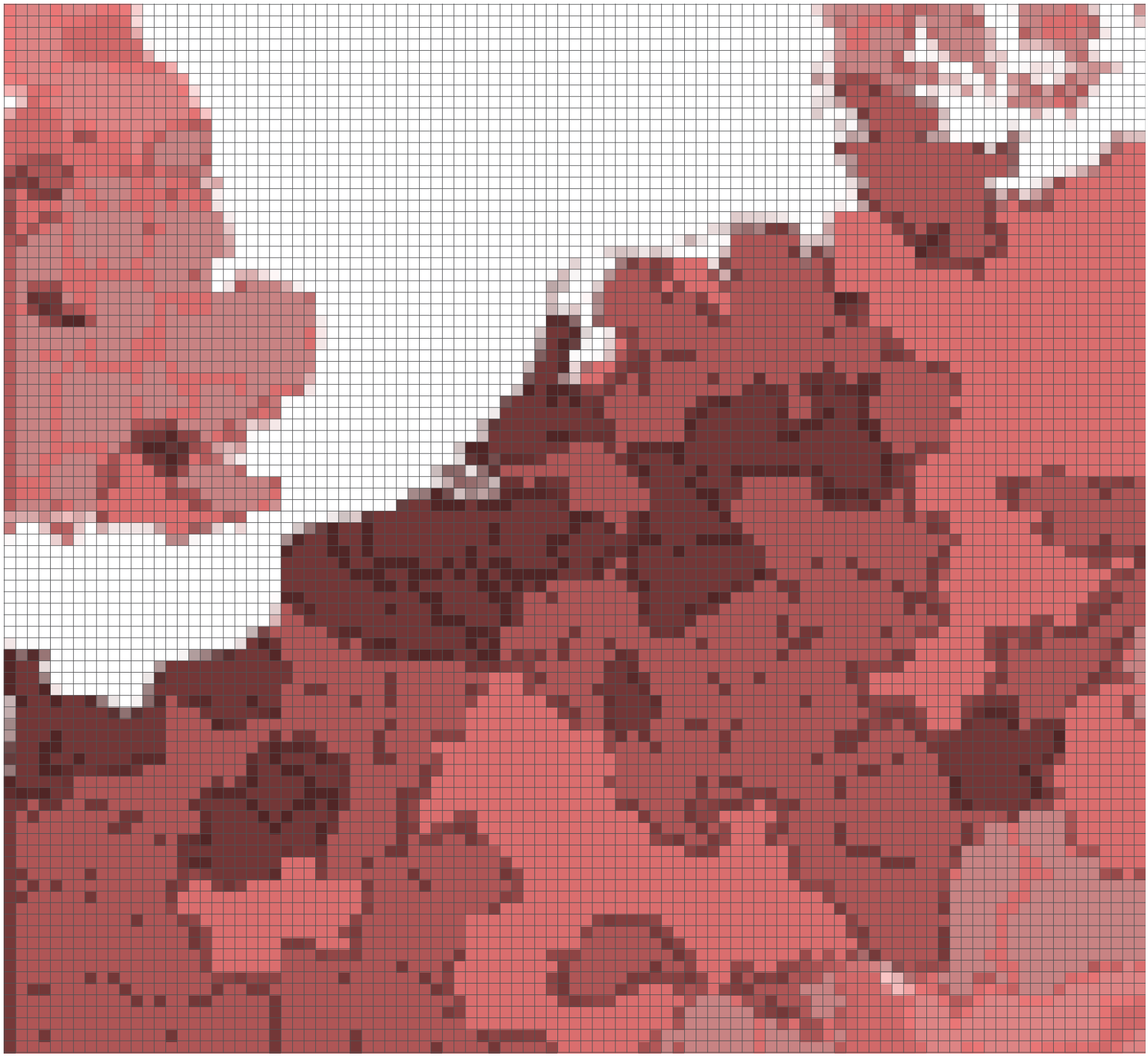
In 2017, a study by Ceballos et al. (2017) was conducted, reporting that with species vanishing at a rate that is 100 to 1,000 times greater than the rate of natural extinction, the Earth is currently experiencing its sixth mass extinction event (Ceballos et al., 2017). By this day, evidence of biodiversity loss can be found around the world.

The investigation of biodiversity loss in this project is taking place in the context of Northwestern Europe. Significant soil and marine biodiversity threats can be spotted along the coastline of Northwestern European mainland. Over the years, intensive farming and maximising farmlands resulted in a decrease of natural elements, therefore resulting in fragmented natural areas.



Map illustrating the soil and marine biodiversity threats in Northwestern Europe

Low High

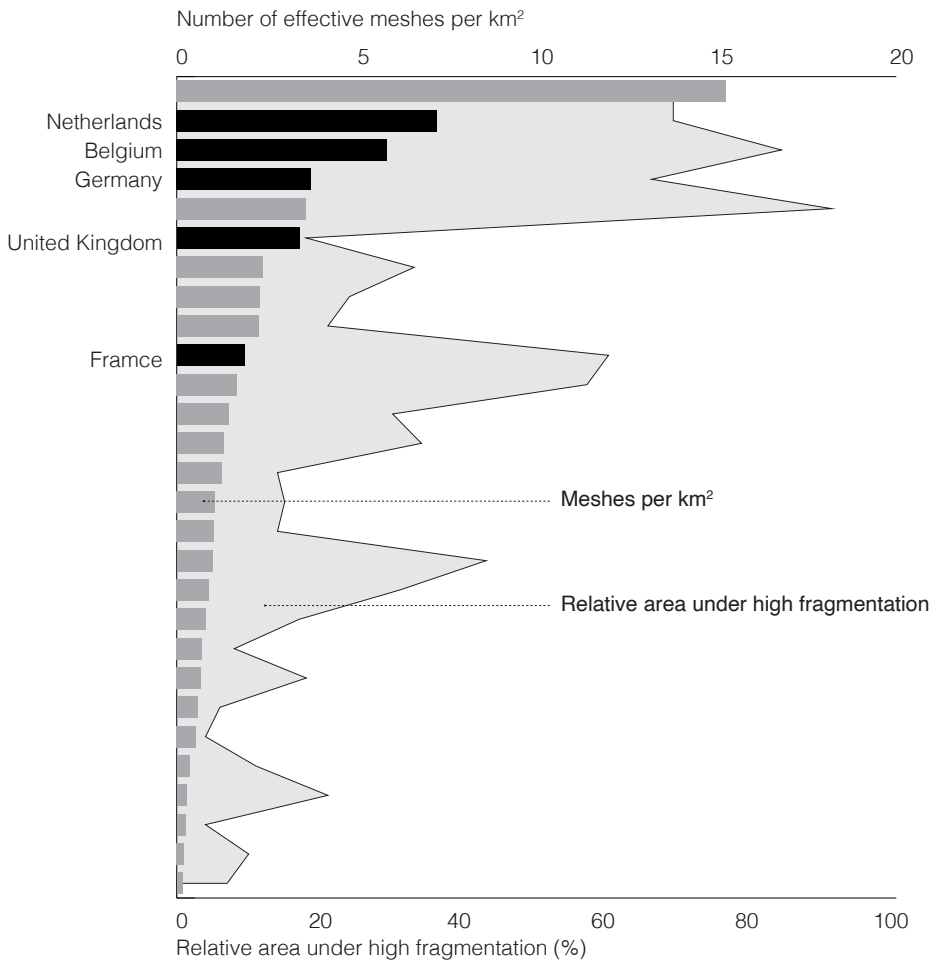


Map illustrating the degree of biodiversity fragmentation in Northwestern Europe

Low High

Cartographic references
European Soil Data Centre (ESDAC)
BEAT+ Integrated classification of biodiversity condition in Europe's seas, European Environmental Agency (EEA)
Landscape fragmentation pressure (Copurnicus + EEA)

Landscape fragmentation through ground infrastructure
in the Eurodelta region



Graph highlighting the Nortwestern European countries with high degree of landscape fragmentation

Biodiversity Fragmentation

According to Wilcove et al. (1986) the process of habitat fragmentation can be defined as “a large expanse of habitat that is transformed into a number of smaller patches of a smaller total area, isolated from each other by a matrix of habitats unlike the original”. According to this definition, a landscape can be classified as either continuous (containing continuous habitat) or fragmented, with the fragmented landscape representing the endpoint of the fragmentation process.

According to Fahrig’s study, it was found that habitat fragmentation is caused mainly by human activities such as urbanisation, land-use changes, and agriculture, which can lead to biodiversity loss. Breaking up the landscape into smaller sizes of land disrupts the connectivity of the ecosystems and affects the movement and interaction of species (Fahrig, 2003).

In the case of Northwestern Europe as it was previously mentioned, significant threat of biodiversity loss can be found in the scale of Eurodelta. The Eurodelta metropolitan region is characterised by a large number of fragmented areas in the Netherlands, Belgium and a part of Germany and France due to human intervention, mainly the ground infrastructure.

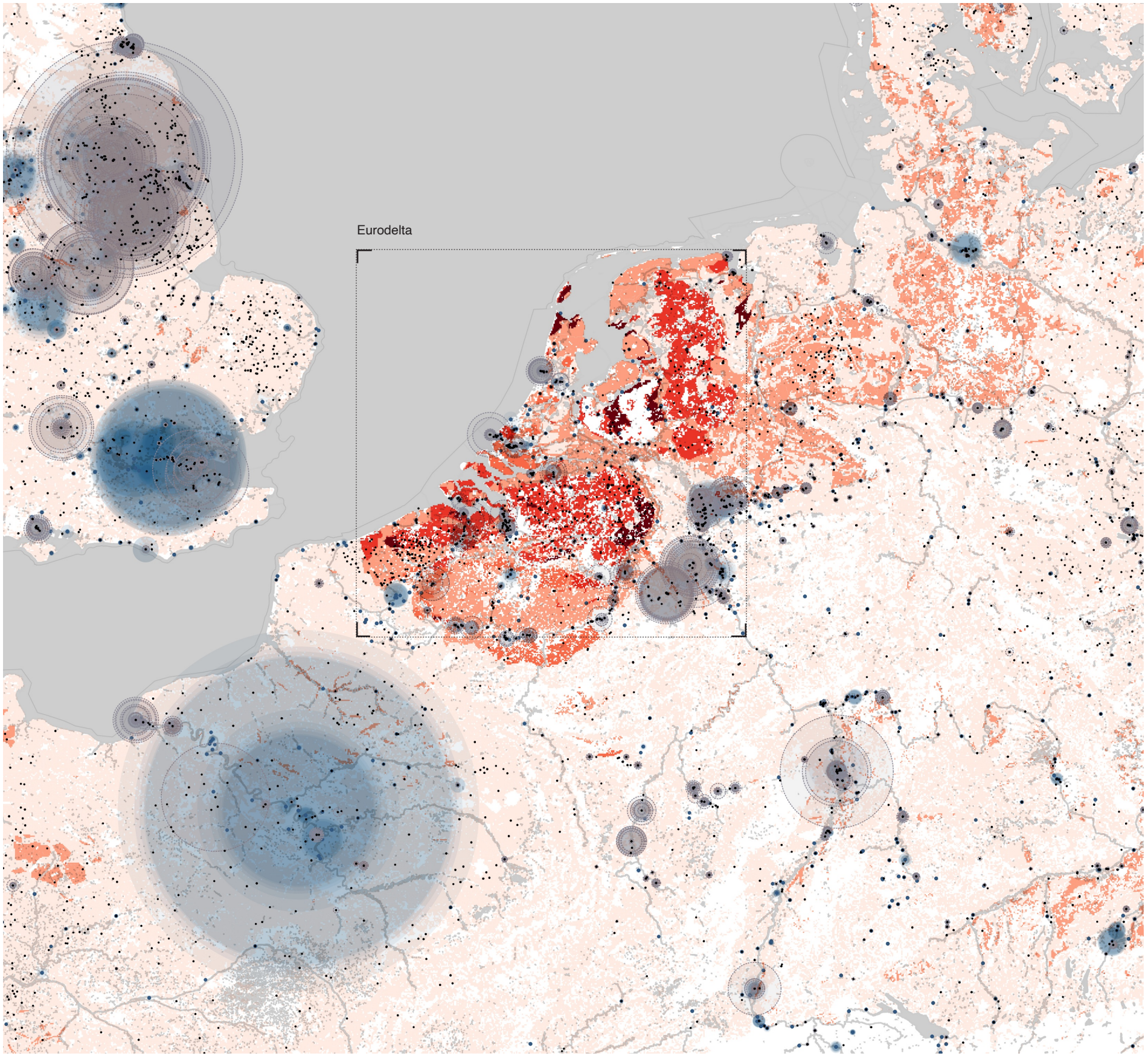
Cartographic and data references
Corine Land Cover data: Copernicus programme, 2018 (EEA)
Openstreetmap, 2023
Landscape fragmentation Effective Mesh Density: major and medium anthropogenic fragmenting elements (FGA2-S), 2016 (EEA)

Nitrogen Pollution

Nitrogen is an essential element of the agricultural sector because it helps plants and crops grow. However, excessive amounts of nitrogen can become harmful not only for the environment but also for different ecosystems and biodiversity. Although different sources of nitrogen can be found in the natural environment, as it can occur, for example, from lightning, wildfires, and volcanic eruptions, the majority of it is produced from human activities in the agricultural, industrial, and transportation sectors (Galloway et al., 2003).

Nitrogen pollution poses a complex and evolving threat to both the environment and public health. The pollution enhances almost every significant existing environmental problem, from air and water pollution to biodiversity loss, stratospheric ozone depletion, and climate change (Kanter et al., 2020).

In 1909, Fritz Haber, from the University of Karlsruhe, discovered a way to convert nitrogen gas, which is abundant in the atmosphere but nonreactive and therefore unavailable to most living things, into ammonia, the main component of synthetic fertilizers. Carl Bosch upscaled Haber's idea into practice on an industrial scale, and the world's capacity for food production exploded. Through this process, farmers were suddenly able to convert infertile land into fertile fields and grow crop after crop in the same soil without having to wait for soil nutrients to naturally replenish. However, the purposeful production of reactive nitrogen causes many problems, not only to the well being of humans but also to the environment. Reactive nitrogen, when found in natural habitats, often causes eutrophication, coastal dead zones, and ozone pollution. Recent studies have added biodiversity loss and global warming to the list of negative effects that occur due to nitrogen pollution (Townsend & Howarth, 2010).



Map illustrating nitogen pollution in Northwestern Europe

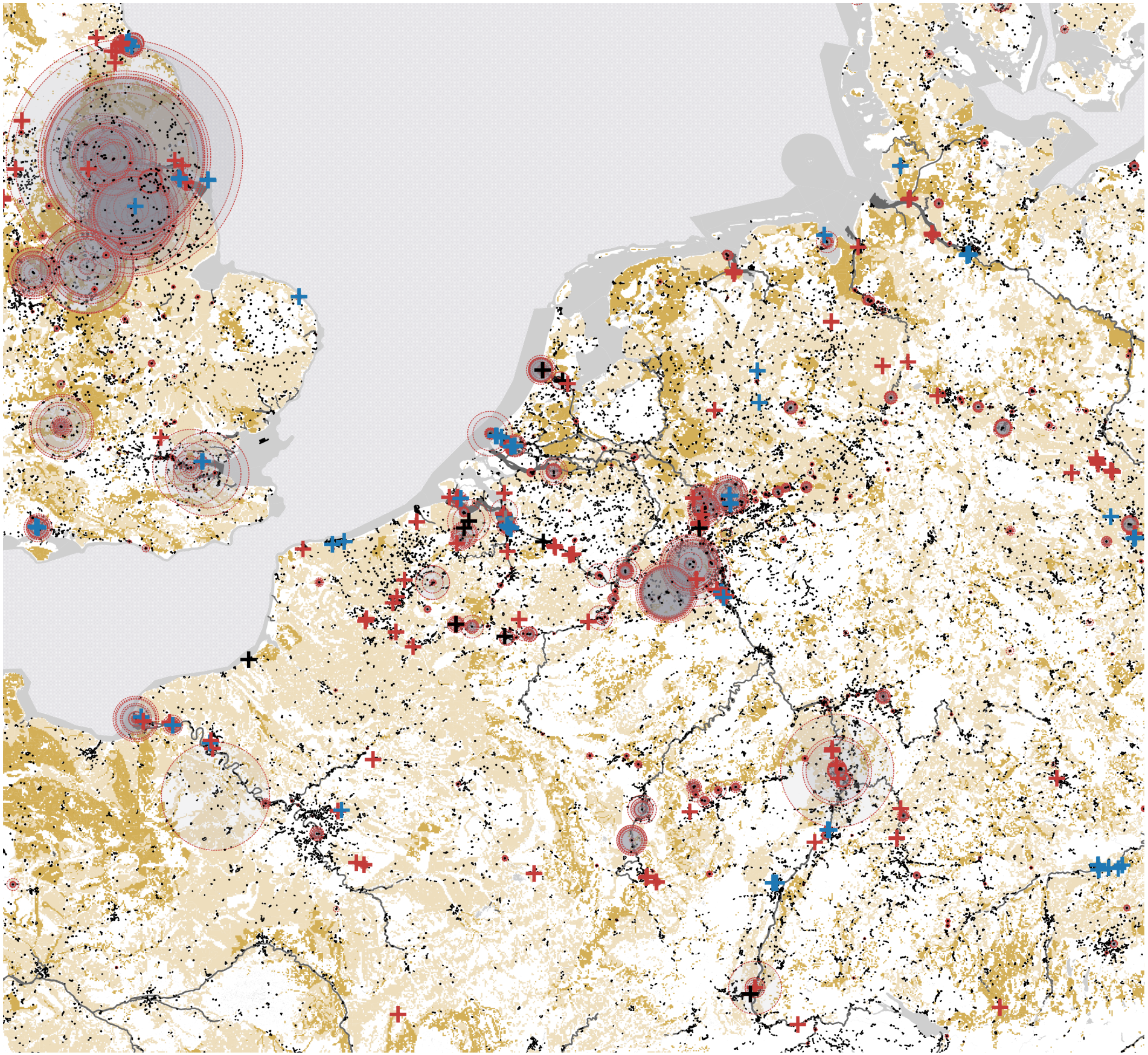
The following map showcases the total nitrogen pollution that exists in the Eurodelta area. In this map, the nitrogen pollution becomes apparent in two different categories: the nitrogen emissions into the air and the nitrogen leaching into groundwater or runoff nitrogen. It was created to better understand the nitrogen pollution that exists in the Eurodelta area.

By visualising the nitrogen pollution happening both in the air and on the ground, preliminary conclusions can be drawn: the Eurodelta area has high percentages of nitrogen pollution, especially when it comes to nitrogen leaching into groundwater or runoff.

According to the European Environment Agency (EEA), nitrogen oxides (NOx) and ammonia (NH3) are produced as a result of nitrogen emissions from industrial, transportation, and agricultural activities. These compounds can combine with primary pollutants (NOx and NH3) to create secondary pollutants like particulate matter (PM) and ozone (O3) (EEA, 2019). According to an EEA study, between 1990 and 2018, nitrogen oxide emissions in the EU fell by 49%. The levels of ammonia emissions, however, remained largely constant during that time. The Netherlands and Belgium have the highest atmospheric nitrogen emissions in Northwestern Europe. In these nations, the agricultural sector accounts for most nitrogen emissions, with livestock farming and fertiliser use serving as the main contributors (EEA, 2020). Next, high amounts of atmospheric nitrogen are being found in parts of the United Kingdom, the Paris metropolitan region, areas of the Rhine–Meuse–Scheldt delta, and areas across the coastline of the Netherlands.

Mapping nitrogen-leaching practices into groundwater shows that high amounts of nitrogen run-off come from agricultural practices. This is mainly caused by fertilisers and animal waste that add to excessive amounts of nitrogen in the soil, which then leads into the groundwater. This may result in eutrophication of water bodies and contamination of sources of drinking water (Coyle et al., 2016). According to a study conducted by the Joint Research Centre (JRC), it was discovered that Europe's average annual nitrogen leaching rate is 75 kg per hectare of agricultural land (Europe's average annual nitrogen leaching rate is 30 kg per hectare of agricultural land). In areas with intensive livestock farming, like the Netherlands, Belgium, and Denmark, the rates of nitrogen leaching were highest (Velthof et al., 2009).

Cartographic references
European Pollutant Release and Transfer Register (E-PRTR), 2019
European Topic Centre on urban land and soil systems, 2020
Openstreetmap, 2023



Landscapes contributing to Nitrogen release

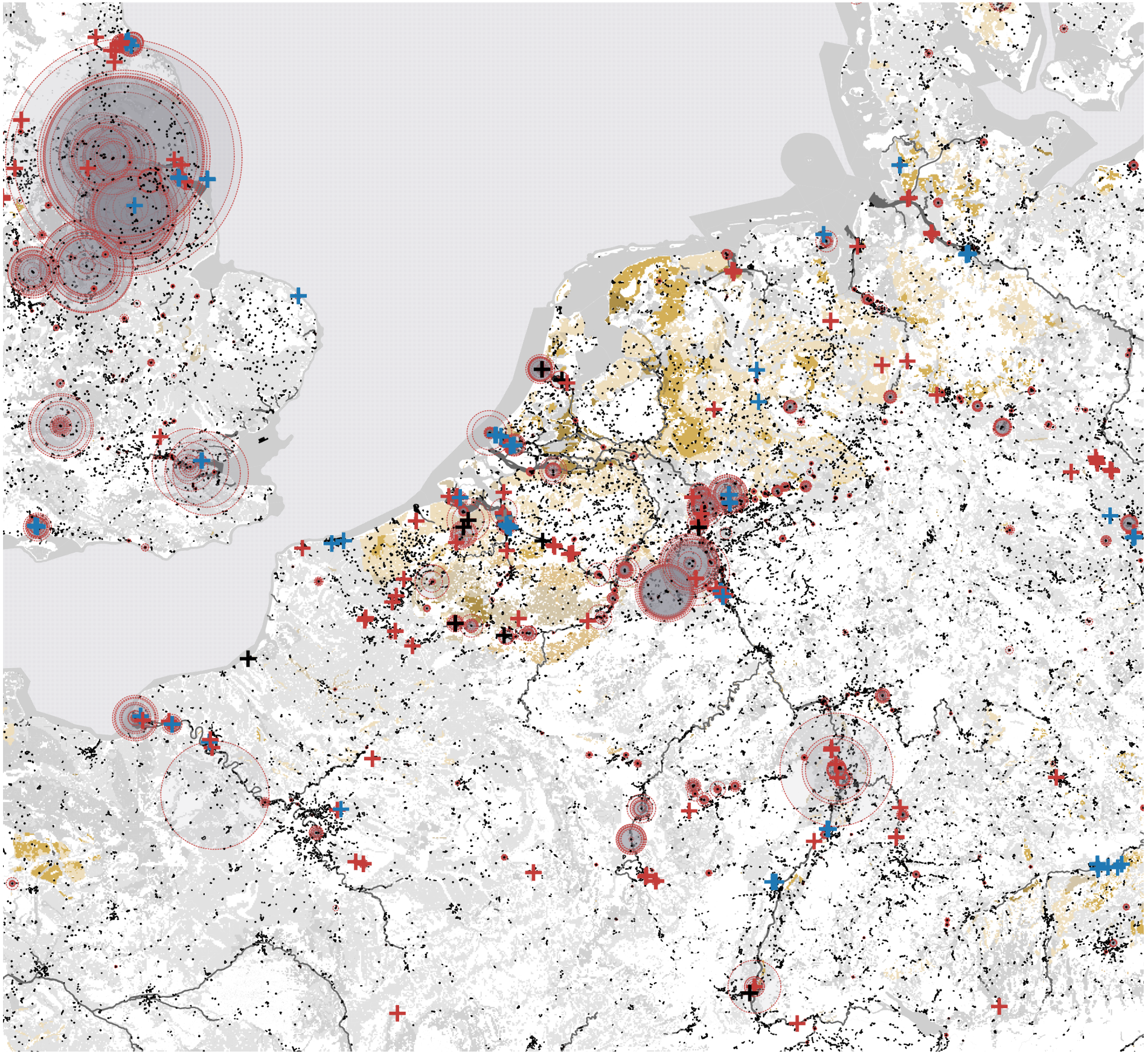
Nitrogen intensive industries

- Basic inorganic chemicals and fertilisers
- Compound fertilisers
- Mineral oil and gas refineries

Land covers

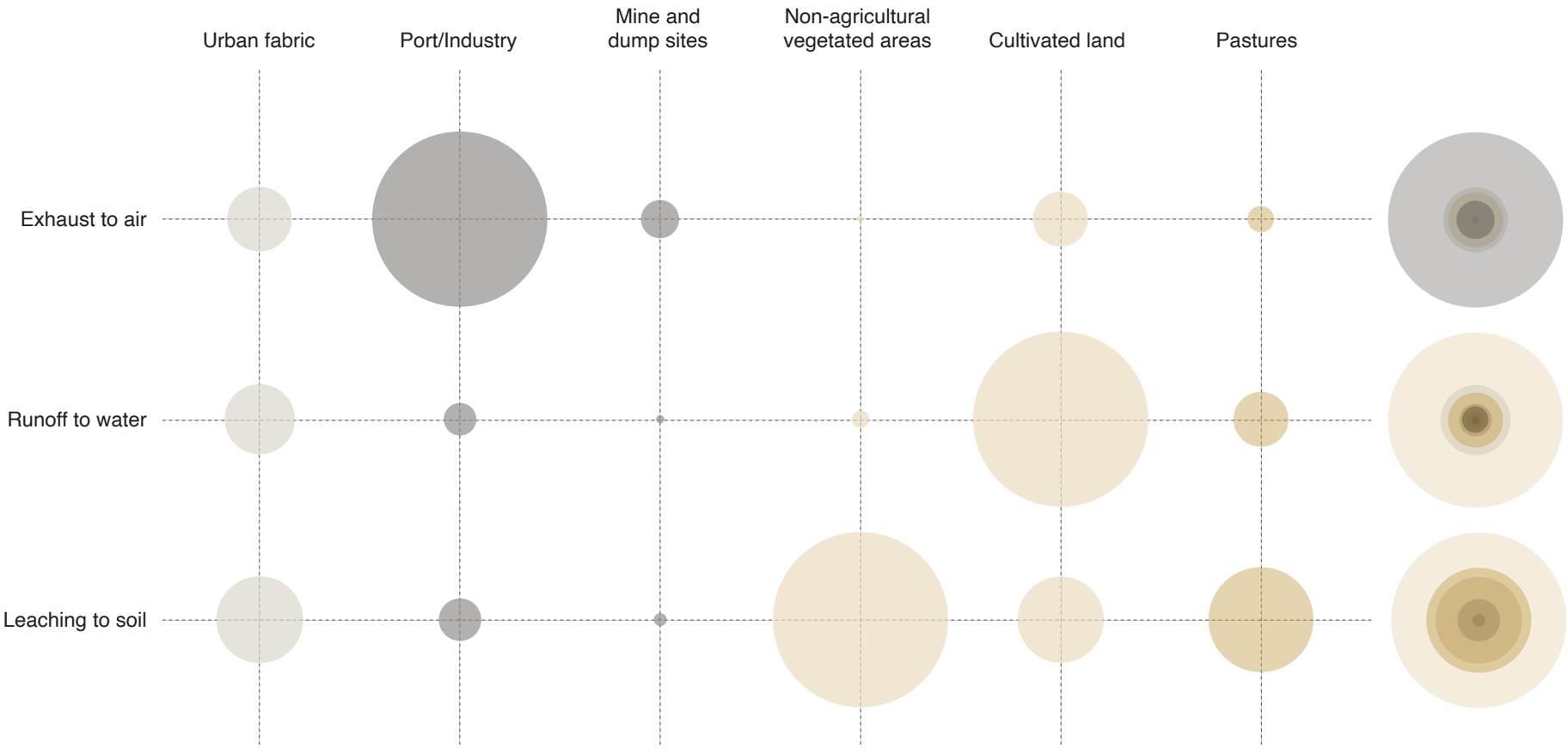
- Agriculture
- Pastures
- Industries
- Ports

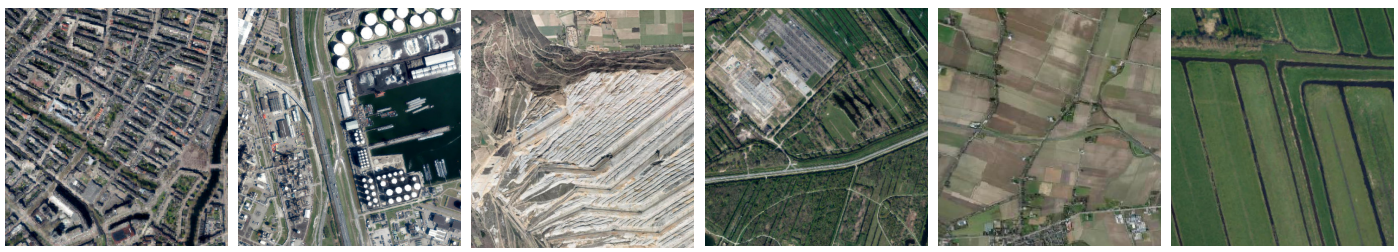
Atmospheric NO_x and N_2O emission hotspots



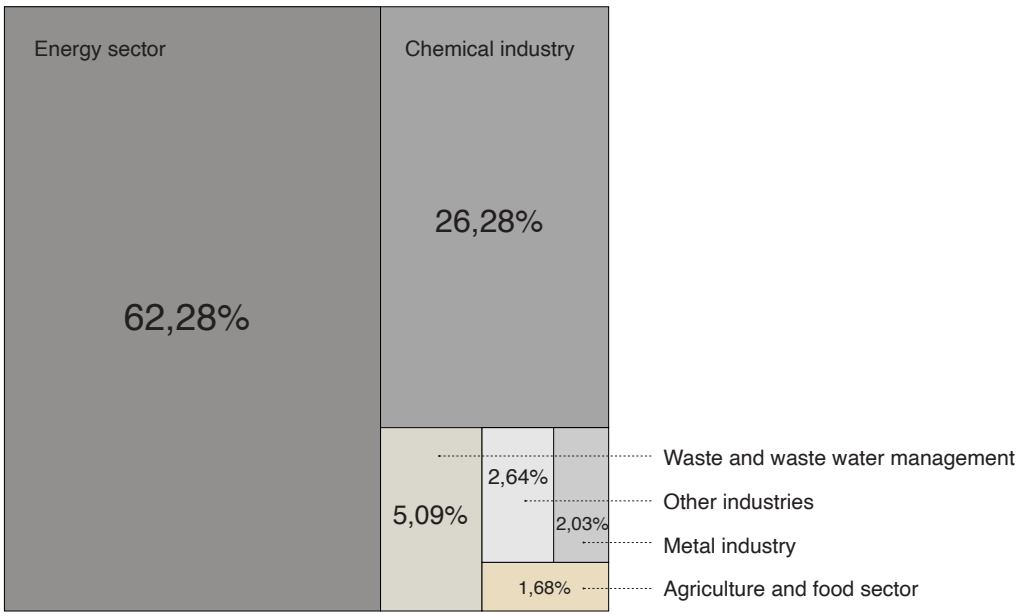
Nitrogen landscapes polluting the environment above critical limits (>25 kg ha^{-1} yr^{-1})

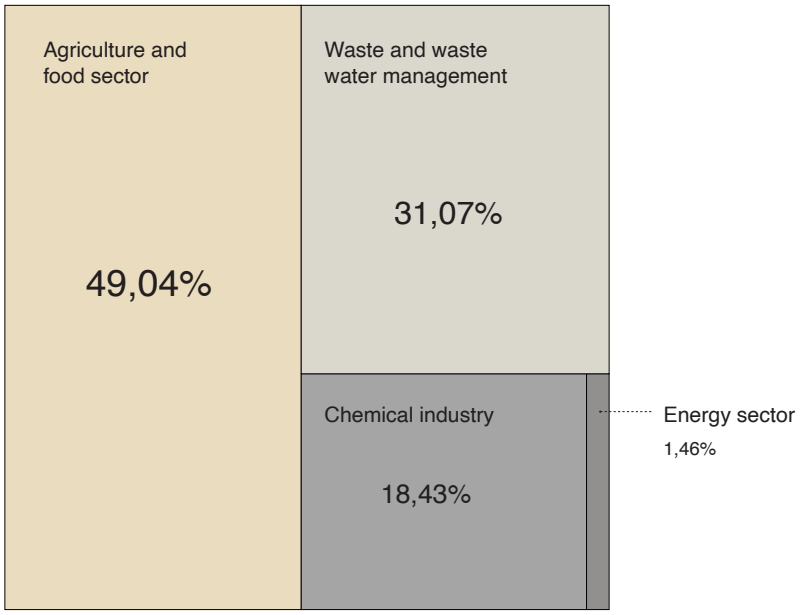
Cartographic references
European Pollutant Release and Transfer Register (E-PRTR), 2019
European Topic Centre on urban landand soil systems, 2020
Openstreetmap 2023





Landcovers adding to Nitrogen pollution by different media





Main sectors contributing to nitrogen exhaust to air and leaching into ground water

To better investigate which landscapes are linked to the nitrogen pollution in the Eurodelta area, a second map was conducted that overlays the nitrogen pollution from air and soil, groundwater, and surface water with existing land covers. Here it became evident that most of the land cover in the Eurodelta area is assigned to agricultural and pasture landscapes. Next, a large amount of nitrogen can be found in the Rhine–Meuse–Scheldt delta, which is mostly made up of factories and port areas.

In addition to mapping the landscapes contributing to nitrogen pollution, the critical nitrogen polluting landscapes visualise the pollution above critical limits (>25 kg per hectare per year). Fig. 1 showcases how the Eurodelta consists mostly of critically nitrogen polluting landscapes. When plotting the land covers against the pollution media, it infers the high contribution of the agricultural land covers to the nitrogen leaching and runoff to groundwater and surface water, respectively.

While energy and the chemical industries are the main sectors contributing to atmospheric nitrogen pollution, the terrestrial pollution by leaching and run-off comes from the agriculture and food sectors with waste and waste water management. As it seems portrayed in the map of nitrogen landscapes polluting the environment, the Eurodelta region consists mainly of agricultural and pasture landscapes, apart from the urban and industrial landscapes. The agriculture and food sectors are responsible for 49.04 percent of nitrogen leaching into groundwater, while at the same time pastures and cultivated landscapes are responsible for not only nitrogen emissions into the air but also nitrogen leaching into soil and runoff into water.

Although industrial landscapes are responsible for the most nitrogen emissions into the air, agricultural and pasture landscapes and cultivated land are the biggest emitters regarding nitrogen pollution of soil and groundwater, and the exploration of this phenomenon could provide many answers in order to tackle the nitrogen pollution problem in the agricultural sector from a spatial perspective.

Data and cartographic references
European Pollutant Release and Transfer Register (E-PRTR), 2019
Corine Land Cover data: Copernicus programme, 2018
Satellite imagery from ESRI-2022

Correlations

While nitrogen is a crucial nutrient for plant growth, it can also have a number of negative effects on the environment, including eutrophication, acidification, and the loss of biodiversity. Because of the intensive farming methods used in the Eurodelta area, nitrogen pollution is a particularly serious issue in Northwestern Europe and the Netherlands. According to a study by Bobbink et al. (2010), nitrogen pollution significantly affects the variety of plant species and the structure of grassland communities (Bobbink et al., 2010).

In Europe, the nitrogen pollution crisis has taken over the last decades creating significant problems such as deterioration of ecosystems, water quality, and human health. Apart from that, nitrogen pollution has also contributed to the process which leads to the increase in the nutrient content in water bodies. This process called eutrophication can be observed in many lakes and rivers across Europe, leading to the growth of harmful algal blooms and the decline of fish populations (Tournassat et al., 2011).

Northwestern Europe, particularly the Netherlands, is facing severe nitrogen pollution caused mostly by agricultural operations. The region's intensive and dense livestock farming has resulted in an overabundance of nitrogen in soils and rivers, causing eutrophication, acidification, and biodiversity loss. In response, the Dutch government has introduced nitrogen-emission-reduction measures such as restrictions on livestock numbers, fertiliser usage, and land use adjustments. These initiatives, however, are frequently contentious and encounter criticism from farmers and other stakeholders (Bobbink et al., 2010).

A combination of actions are needed in order to address these interconnected issues, including better land use planning, more environmentally friendly agricultural methods, and more robust nitrogen emission reduction laws.

Idea of conservation as a seperation between nature and human activities

Paradigm of nature conservation

In the past, measures were taken and policies were created in order to ensure that nature is protected and biodiversity is being restored. All bird species that naturally occur in the EU are protected under the 1979 Birds Directive (as amended in 2009). It included a classification of Special Protection Areas (SPA) by Member States for all migratory birds as well as 194 species of birds that are particularly threatened. The 1992 Habitats Directive expanded on this strategy by calling for the creation of a representative network of legally protected areas across the EU. The 233 habitat types and more than 900 species listed in Annex I of the Directive are intended to be conserved in these areas, which are known as Sites of Community Importance (SCI). The Special Areas of Conservation (SAC) designation for SCIs must be made as soon as possible, but no later than six years. The Natura 2000 network is made up of both SPAs and SCIs/SACs (EEA, 2023).

But nowadays, it seems that a paradigm shift is happening: nature can not be protected as it used to be. On a local level, more and more communities are realising the value of land preservation as a permanent form of land protection. People can look up national parks to visit, stroll along nearby waterways that are protected, or drive past the freshly installed sign on the edge of a farm that is now protected from redevelopment. Efforts to preserve and restore nature/landscapes can be dated back to the 1800's, but nowadays the definition of this protection has a different meaning (Moscovic et al., 2015).

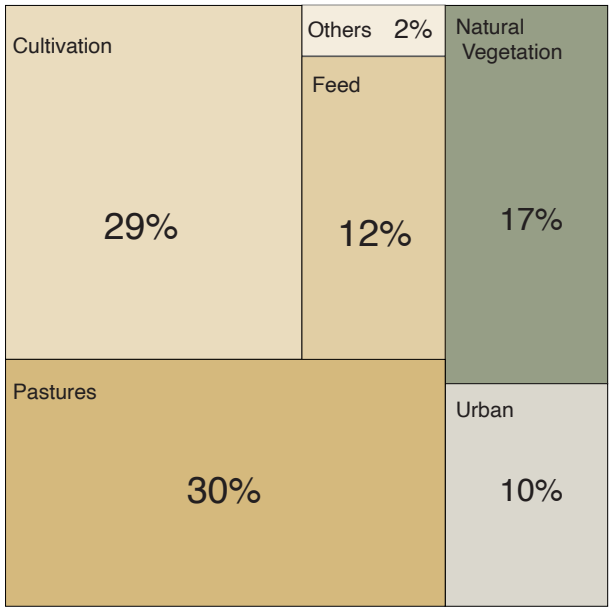
Slowly but steadily people realise that nature's conservation is in their hands: a fact that has been changing the way urban designers and stakeholder involved in the process view nature's protection.

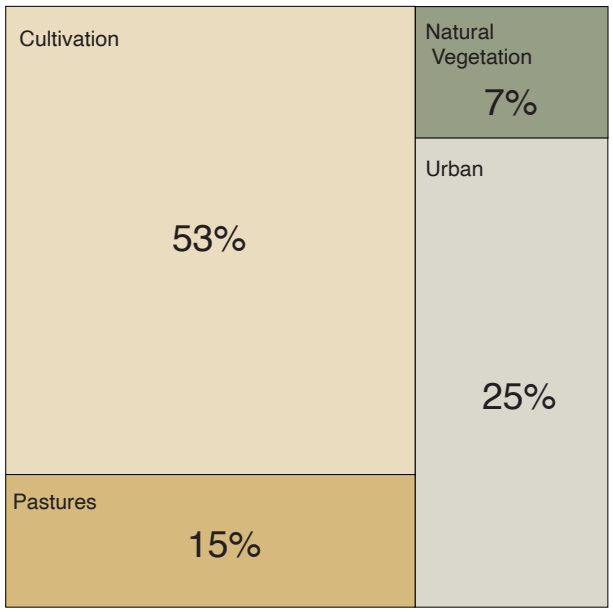
The era of preserving land for the future has changed. Multidisciplinary actors are leading the field in a new direction during this period of cooperation and quick decision-making. A fresh approach to land preservation is required in order to take into account the difficulties experienced by field personnel and the disconnect between daily efforts and overarching conservation objectives. Yet, there is still a gap in the literature regarding the multidisciplinary actors involved in land protection(Moscovic et al., 2015).

Academics, government employees, financiers, executive directors, educators, ecologists, and computer technicians are among the occupations involved in land preservation. Everyone contributes to the common objective of protecting natural resources through land preservation. To maximise land preservation efforts and maintain sustainability over time, these challenges must be researched, examined, and overcome (Moscovic et al., 2015).

To overcome the opposing viewpoints of those who do not yet completely understand the complexities and advantages of safeguarding land both regionally and in their own communities, outreach, education, and perseverance are necessary. In the context of the Eurodelta area, public understanding of the necessity of continued land protection is crucial for the new paradigm to be successful. The need for ongoing conservation of our country's lands shall be articulated by bringing these discourses together (Moscovic et al., 2015).

Status Quo





Treemaps of landcover percentages and ground nitrogen pollution in the Eurodelta region

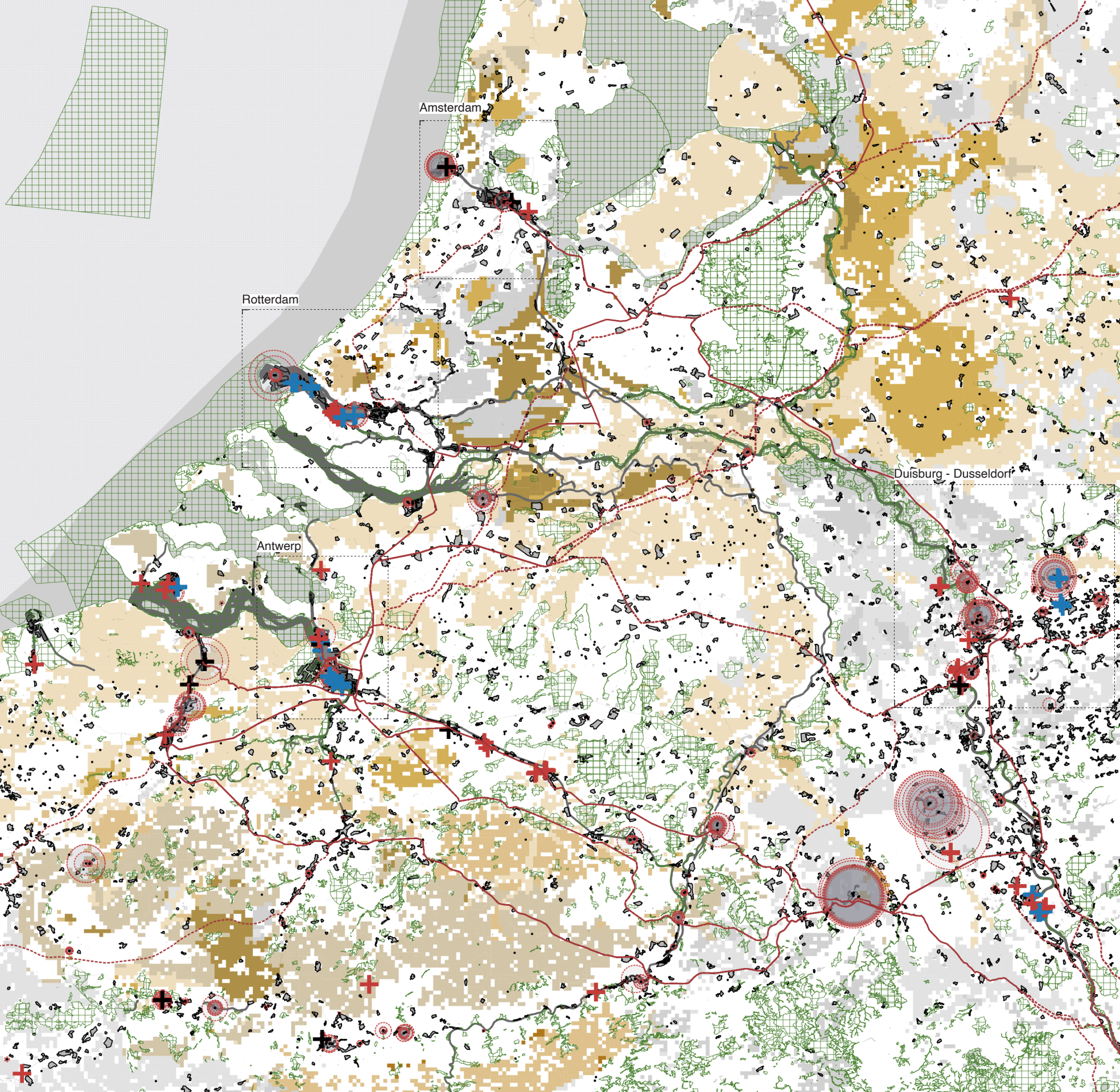
The nitrogen cycle is an essential process in nature, but human activities, particularly agriculture, have increased the input of reactive nitrogen into the environment, thereby disrupting the natural nitrogen cycle and causing environmental issues. Agriculture is the dominant source of nitrogen pollution in Europe, resulting in eutrophication, acidification, and greenhouse gas emissions.

In Northwestern Europe, intensive agricultural practices have resulted in high concentrations of reactive nitrogen, causing severe environmental and public health issues. Two regions have struggled to mitigate the effects of nitrogen pollution while maintaining agricultural productivity: the Eurodelta region and the Netherlands.

The Eurodelta region is distinguished by its high population density, intensive agriculture, and industrial activities, all of which contribute to elevated nitrogen emissions. Due to its dense population, intensive livestock husbandry, and extensive use of nitrogen-based fertilisers, the Netherlands is a global hotspot for nitrogen pollution. To reduce the environmental and public health impacts of nitrogen pollution, sustainable agricultural practices and effective policies are necessary.

While only 29% of Eurodelta's land cover is for food production, the cultivated land is responsible for half of nitrogen pollution that can be detected in the Eurodelta region. On the other hand, while urban land cover of the region is around 10%, it contributes to this pollution around 25%.

Data references
European Pollutant Release and Transfer Register (E-PRTR), 2019
European Topic Centre on urban land and soil systems, 2020
Corine Land Cover data: Copernicus programme, 2018

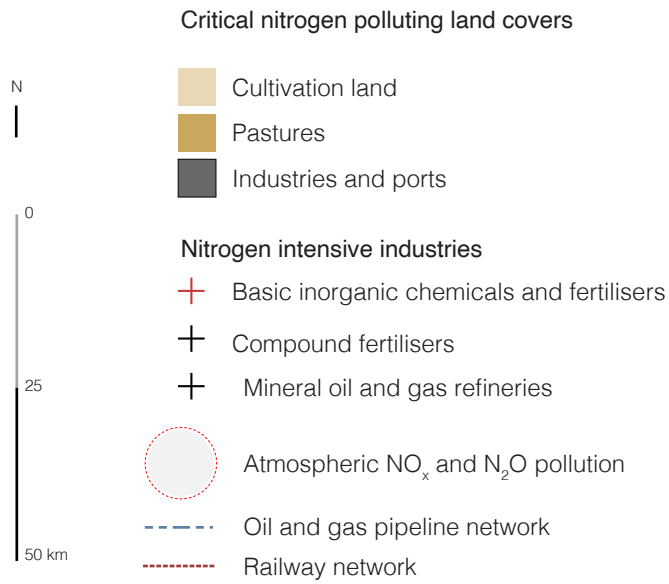

Amsterdam
Rotterdam
Antwerp
Duisburg - Dusseldorf

Nitrogen Flows

The nitrogen cycle is a biogeochemical process that converts nitrogen into different forms, such as inert atmospheric nitrogen (N2), reactive nitrogen compounds (such as ammonia, nitrate, and nitrite), and organic nitrogen compounds (e.g., proteins, DNA). By increasing the amount of reactive nitrogen in the environment, human activities such as industrial production and agriculture have drastically altered the natural nitrogen cycle. Nitrogen fixation is the transformation of atmospheric nitrogen (N2) into reactive nitrogen compounds, including ammonia (NH3)

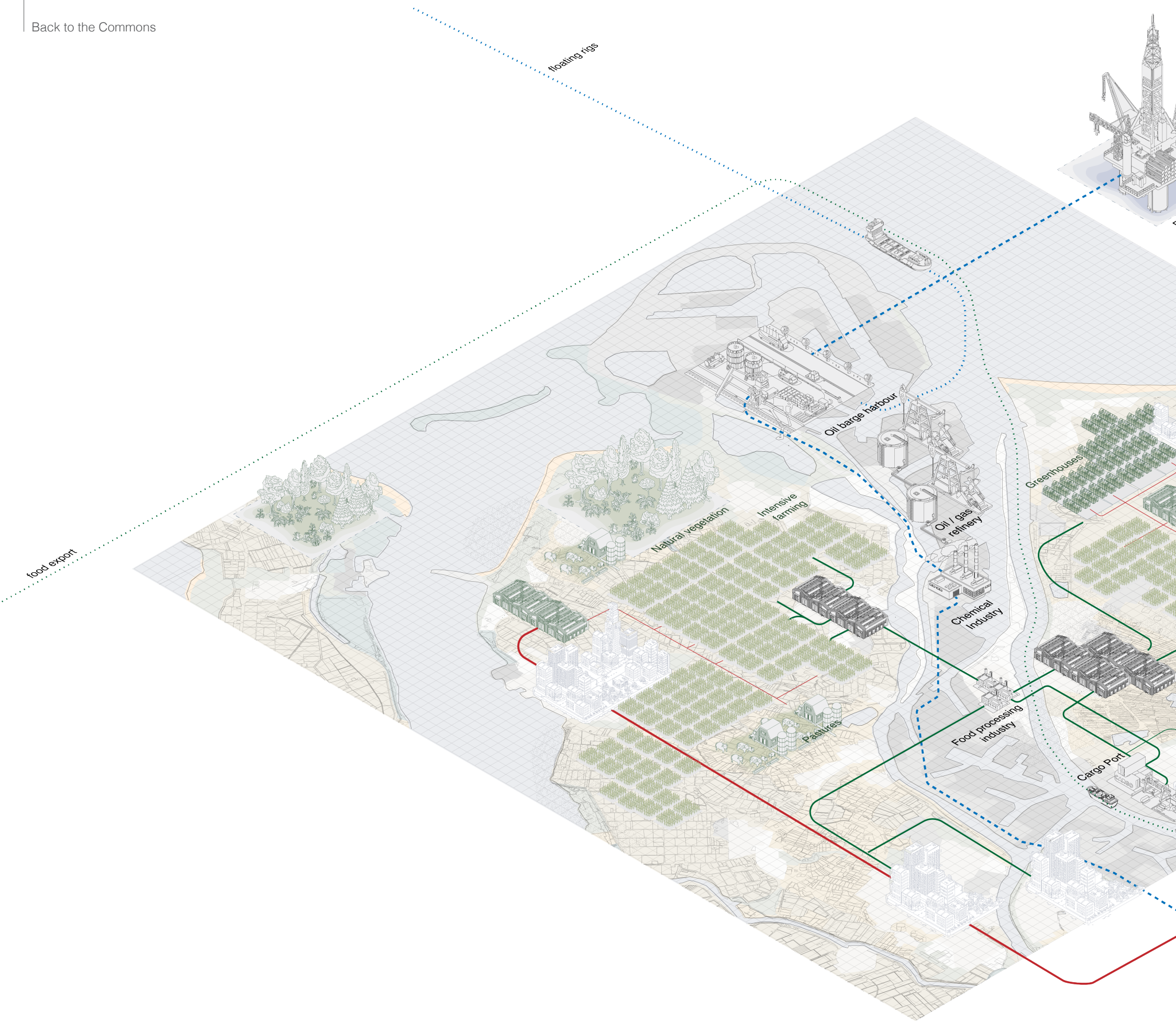
Ammonia produced through industrial nitrogen fixation is utilised in the fertiliser production process to create nitrogen-containing fertilisers such as urea, ammonium nitrate, and ammonium phosphate. When nitrogen-based fertilisers are applied to agricultural lands and greenhouses, plants take up a portion of the reactive nitrogen compounds for growth and reproduction.

However, a significant portion of the applied nitrogen can be lost to the environment through volatilization, leaching, and runoff. Industries, agricultural land, greenhouses, and the production of fertilisers are interconnected processes and components of the human-altered nitrogen cycle. In aquatic ecosystems, the leaching and discharge of reactive nitrogen compounds can cause eutrophication, algal blooms, and dead zones. Some reactive nitrogen compounds can be denitrified to mitigate the environmental effects of nitrogen pollution.



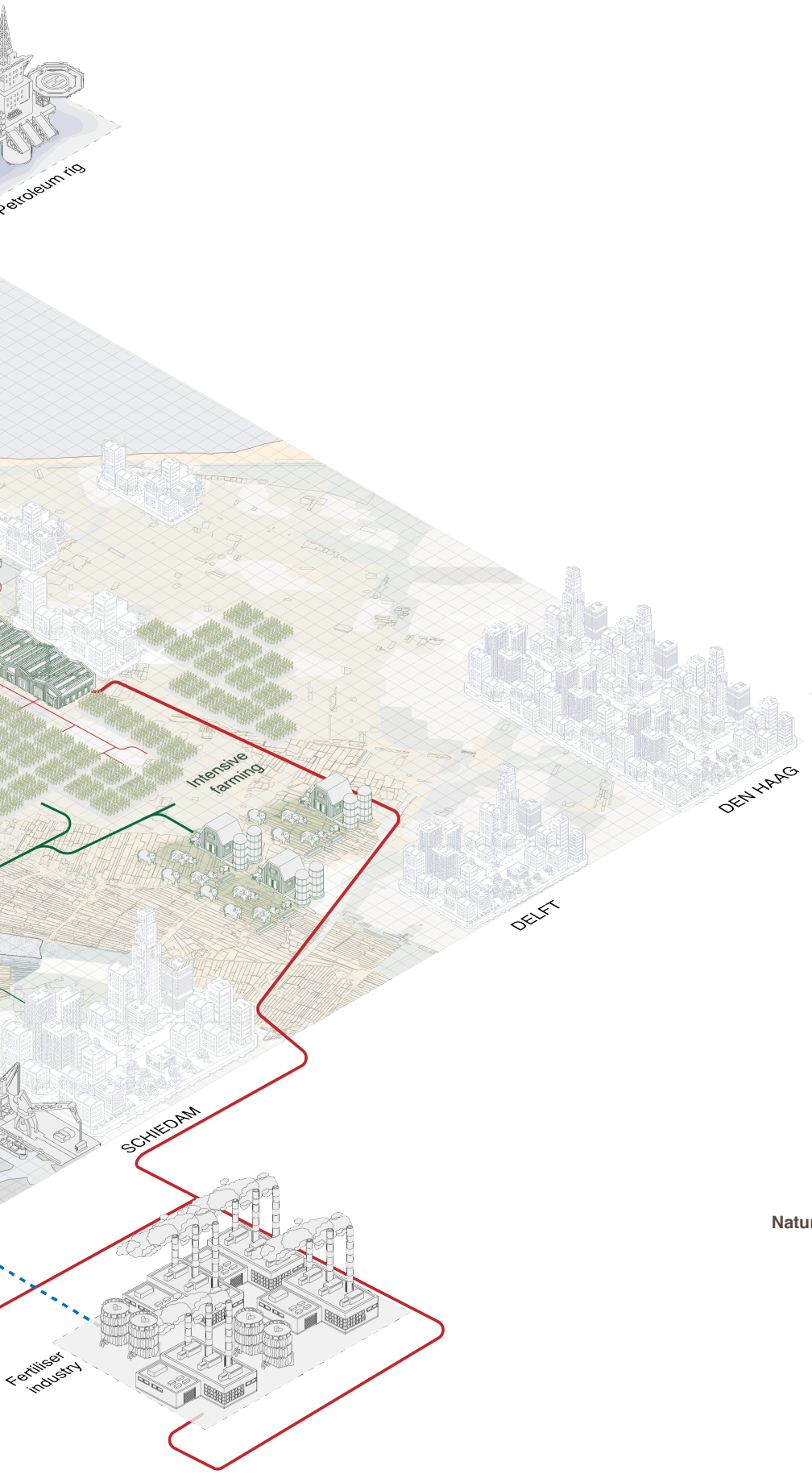
Map illustrating nitrogen flows in Eurodelta region

Cartographic references
European Pollutant Release and Transfer Register (E-PRTR), 2019
European Topic Centre on urban land and soil systems, 2020
Corine Land Cover data: Copernicus programme 2018
Natura2000, European Environment Agency, 2022
SURE & Association Deltametropolis, 2020
Openstreetmap 2023



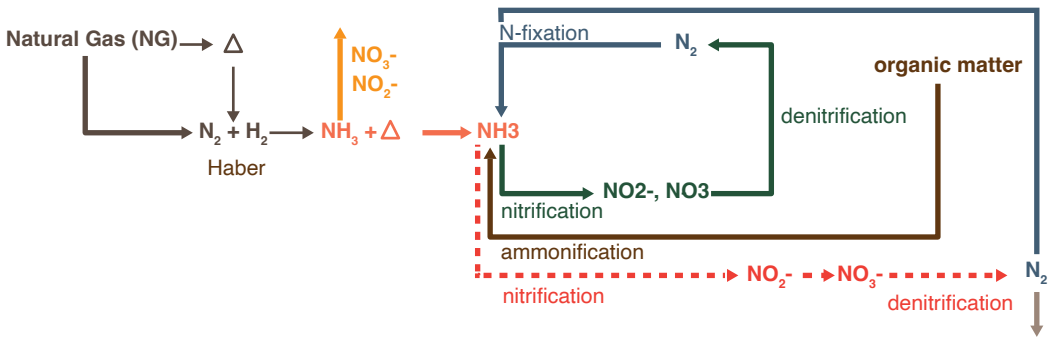
Material flows in local scale region of Westland and Voorne-Putten in South Holland

- fertiliser
- natural gas
- agricultural products
- Freight / sea transport
- Ground transport
- Pipelines

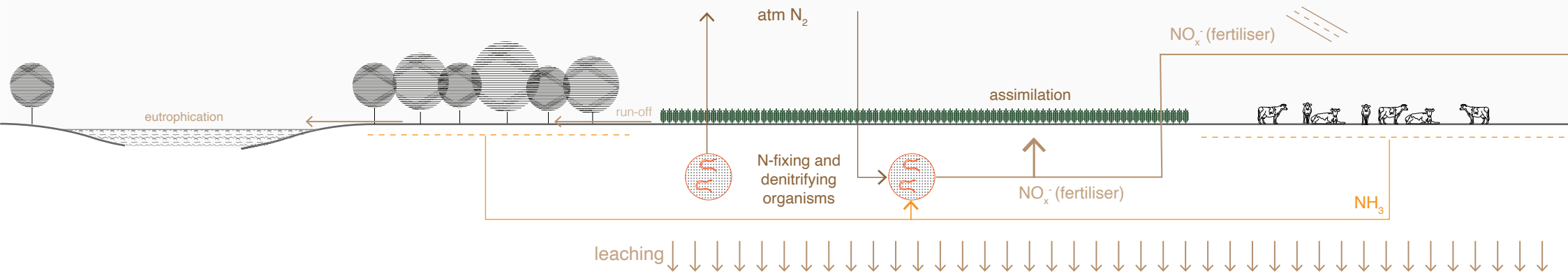


Other industries contribute to the nitrogen cycle through the emission of reactive nitrogen compounds during combustion processes, which can contribute to air pollution, acid rain, and the formation of ground-level ozone. For example, in Westland of South-Holland,most nitrogen flows are linear, especially when it comes to fertiliser production. Most fertiliser production is based on the petrochemical industries (gas and oil industries). Additionally, the flow of agricultural materials is also taking place in a linear way. Among the direction of these flows, patterns are created and are easily recognised especially in the agricultural landscapes.

Understanding the complex interactions within the nitrogen cycle is necessary for devising effective strategies to mitigate the negative environmental and public health effects of nitrogen pollution.



Schematic nitrogen flows and forms

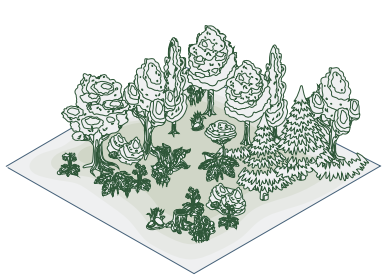


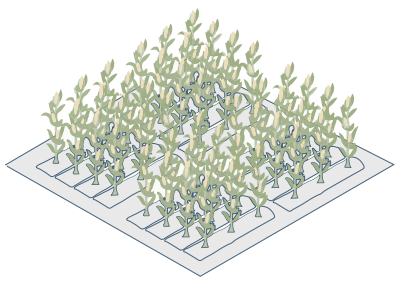
Inland water

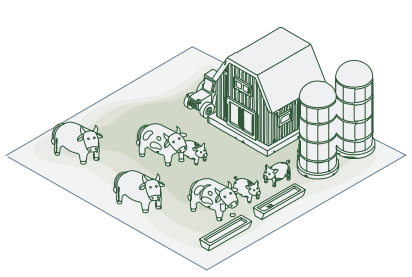
Natural vegetation

Cultivation land

Pastures



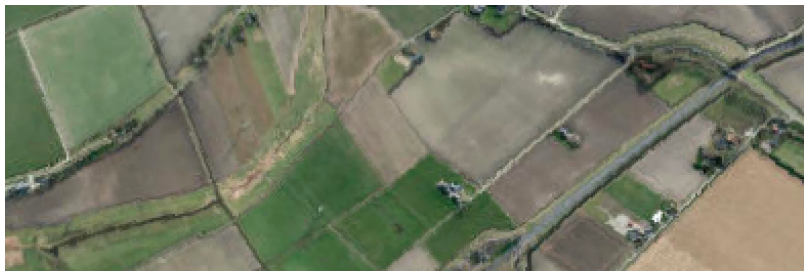




Natural vegetation

Intensive Cultivation

Pastures



Systemic section of
nitrogen flows

atm N_2 Atmospheric dinotrogen

NH_3 Ammonia

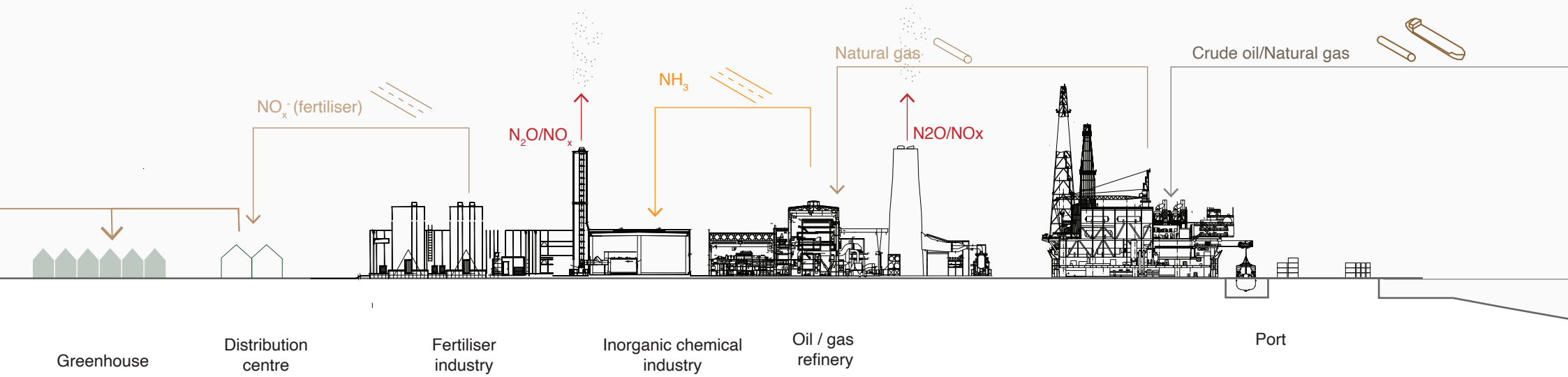
NO_x^- Nitrates / nitrites (fertilisers)

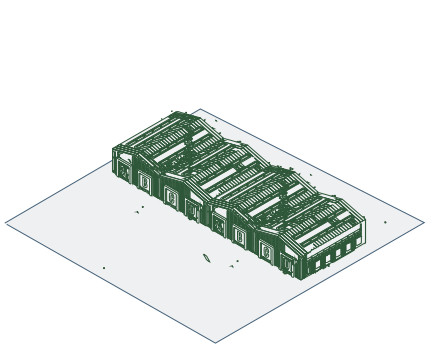
N_2O / NO_x Nitrogen oxides

Ground transport

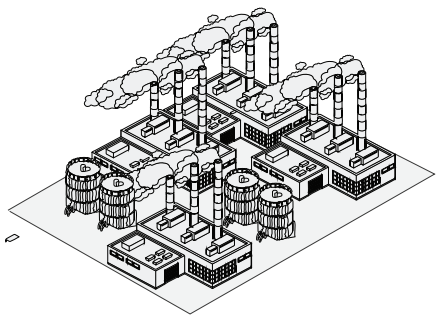
Freight / sea transport

Pipelines

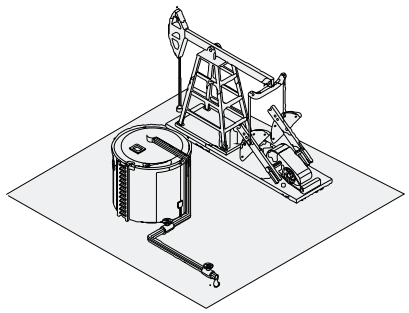




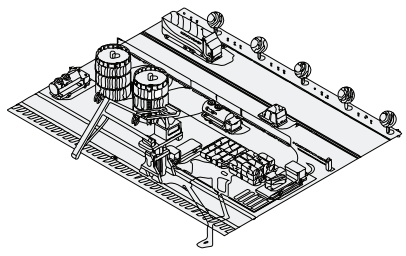
Warehouses



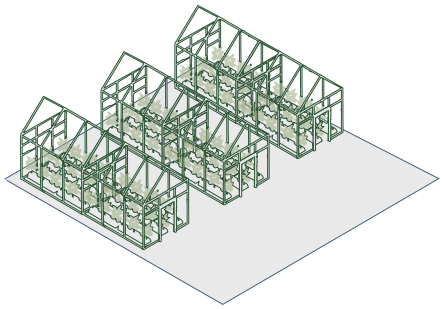
Industries



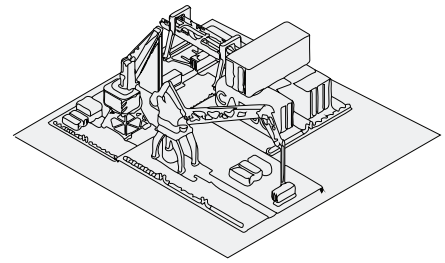
Oil / gas refineries



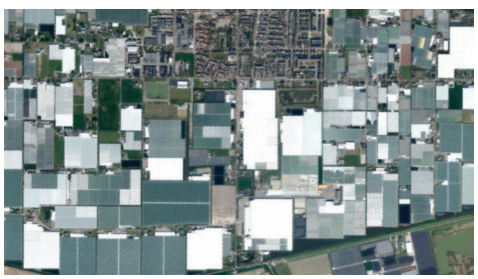
Cargo

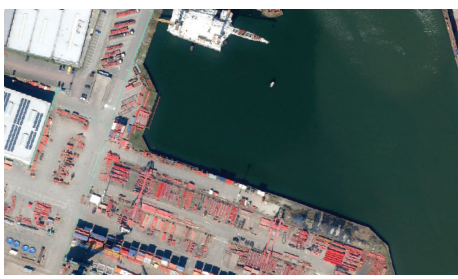


Greenhouses



Port





Cartographic references
Satellite imagery from ESRI-2022

View of the Dutch landscape
from Holysloot, Netherlands

Image reference
Dutch landscape by Ronnie Overgoor licensed under CC0 (Public Domain)

Reaction of BBB leader Caroline van der Plan
to the election results of the provincial state

Social implications

After the great hunger of the Second World War, the Dutch Euro commissioner, S. Mansholt wanted to ensure that Europe would ''never be hungry again. (Bohlmeijer, 2022). European farmers were encouraged to produce as much food as possible. With the rise of mechanization and synthetic fertilizers, an important base for intensive agriculture was formed, in which farmers made big investments to largely mechanize their farms and strongly increase their harvest.

Over time, the perception of farmers as providers of healthy, reasonably priced food changed into one of environmental saboteurs, nature haters, and subsidy slackers (Bohlmeijer, 2022). However, farmers often feel like they are unduly penalised while big CO2 emitters like Tata Steel and Shell are left unmentioned (Rocco & Debrowski, 2023,). In addition, many farmers consider farming like a lifestyle and they often feel like their role in Dutch culture is underestimated (Velzen, 2019). The current Dutch government relies on innovating technologies to combat challenges in climates a bit too much, therefore risking to overlook the complexity of the issue crisis and its important interconnections with culture, institutions, politics and social structures (Rocco & Debrowski, 2023). According to R. Rocco, a democratic perspective allows for citizen participation, co-creation co-control insofar they ''allow vulnerable voices to be heard and to be taken into account in decision-making'' (Rocco & Debwroski, 2023). Current Dutch policy makers took a utilitarian approach to solving the current nitrogen issue. Here, actions and rules are determined that are beneficial for the larger number. An important deficiency here is that the smaller group is overlooked and sometimes neglected. In this strategy, current policy makers clearly overlooked the farmer's voices in trying to find a solution to combat nitrogen emissions, which became very evident in the last provincial election of the Netherlands, where the large frustration among farmers got highlighted as a new political party BBB (Farmer-Citizen Movement) ''raised the polls as a representative for farmers who feel betrayed by the government's 10-step plan, designed to reduce nitrogen emissions'' (iamexpat.nl, 2023). Without open discussions, co-creation and citizen participation, frustration among citizens can grow for their demands are not being heard and their trust in democratic institutions declines (Rocco & Debrowski, 2023). Here, a shift to a deontologist approach might be beneficial, for it includes individual situations in debating what is good and bad in the process of decision-making.

With an ongoing development towards natural imbalances, we must take a critical look also at the true source of agricultural practices, which has much more to do with international flows and food demands. Solutions to solve the current nitrogen crisis reach much further than pointing fingers at farmers and must include inclusive decision-making, a paradigm shift in land use, a shift in agricultural practices, and a change in local food demands and supplies.

Image reference
Teunisse, ANP & EenVandaag, 2023

RISE OF INTENSIVE FARMING

Under the motto "never again go hungry," Mansholt shaped agricultural policy after World War II

DEGROWTH FARMERS

Farmer riot for the degrowth of Mansholt shaped agricultural policy

1960

1961

Growth of modern farming and their social implication

SHIFT FOR NATURAL CONSERVATION

Awareness of climate change and the consequences of intensive farming

NEGATIVE FARMER IMAGE

Gradually, the image of farmers as insurers of affordable and good food turned into an image of environmental destroyers, nature haters and subsidy slackers

1971

2023

Image references
Bohlmeijer, 2022; Kromhout, 2022; Van Dinther and Persson, 2022; Van Harskamp, 2022; VPRO, 2020; Het boerenprotest, Willems, M. 2022

Jorden Oostdam

Farmer,
Oostdam livestock farm
Bodegraven, South Holland
3 March 2022

Richard Hartensveld

Partner
Schenkeveld
Westland, South Holland
26 February 2022

‘’But those models occasionally make assumptions, so you could also say, “We’ll see if it’s true.” After that, we’ll attempt to modify the model. You must always be willing to make changes or improvements and avoid becoming too obsessed with one particular model...

...The Netherlands is very much inclined to think in cities or villages, provincial borders, national borders. But when it comes to nature, the environment or the climate, that doesn’t have anything to do with borders at all.”

- Jorden Oostdam

The following interviews have been conducted to get a better understanding of the social framework of the Dutch agricultural sector. The interviewees were selected for their work in the agricultural sector, their methods of operation and the spatial elements associated. In the interview, focus was put on their personal motivation to become a farmer, how current policies affect them, how they see their future and how they would like to alter the current industry. Jorden Oostdam works as a dairy farmer in Bodegraven and Richard Hartenveld works as a tomato farmer in Westland.

The interviewees gave an interesting insight into the complexity of the agricultural sector. By interviewing two farmers with different agricultural focuses, it became really clear how varied the practices can be in terms of methods, policies, goals, and personal motivation.

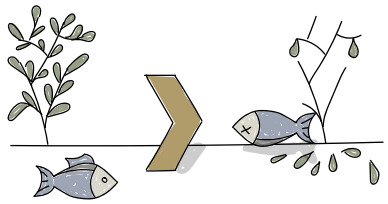
Schenkeveld is a greenhouse tomato cultivator who is motivated to make the tastiest tomatoes. He comes across as an innovative entrepreneur who focuses on maximizing his production with minimal inputs in a sustainable manner. Jordan Oostdam, on the other hand, chose the profession of farming for the lifestyle that goes along with it. By taking over the family business, he feels more in touch with nature, which he prefers.

With the production of milk, the livestock farm Oostdam always has to adapt to nitrogen policies concerning his methods, resources and products. Farmer Jorden Oostdam points out that the current policies around agriculture offer little space regarding the health of the soil, keeping their heads above water and the participation of farmers in finding a solution. He elaborates that the whole departure of the nitrogen crisis is off. The Dutch government formed the nitrogen policy around borders, while the health of the soil can not be restored if we see the Netherlands as an island. Taking only the nitrogen content as a way to measure the health of the soil is too restrictive. Jorden emphasised how the Netherlands is relying too heavily on an arithmetic model to tell them what is right or wrong. Instead of it being adjustable by going to location to take a look or to talk with knowledgeable farmers. This method of operation results in an unfair power distribution between government agencies and farmers.

Despite the Netherlands’ efficient use of farmland in the Netherlands, farmers are continuing to be pressured to reduce the amount of land they are using. Jorden claims that this will result in a comeback of greater quantities elsewhere if cultivation is stopped in the Netherlands. Furthermore, the consumer will pay more at the store as a result of the high government demands. Imports that are less expensive thereby prosper. These conditions are forcing farmers to diversify or differentiate their product in the market to find an additional revenue stream.

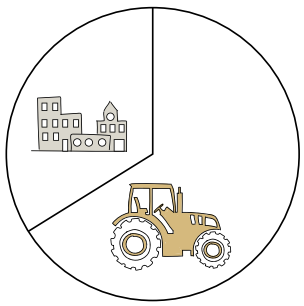
Richard highlighted that working alongside other agricultural practices can be a strength for the agricultural industry. He demonstrated how much more significance a business can have when it joins a cooperative. For instance, Schenkeveld utilises Growers United to sell his tomatoes along with others.

The transcripts of the interviews, which have been translated into English, can be found in the appendix and are summarised in the text that follows. This summary only contains the information that is most essential.

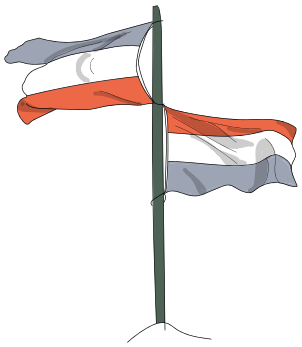


Biodiversity loss

Current paradigm of nature conservation causing fragmentation



Agricultural land cover dominance



Socio-spatial injustice

Conclusion

In conclusion, the chapter provides a comprehensive analysis of the dual crises of nitrogen pollution and biodiversity fragmentation in Europe, with a particular emphasis on Northwestern Europe and the Netherlands. The intricate connection between these problems emphasises the critical need for effective policy interventions and sustainable practices. This analysis highlights the substantial differences in nitrogen flows and their regional and local impacts, notably in PZH and Eurodelta.

In addition, the chapter explores the social framework that governs these environmental challenges, highlighting the crucial role that stakeholders, such farmers, play in addressing and mitigating the negative effects of nitrogen pollution and biodiversity loss. This chapter sheds light on potential pathways toward more sustainable and resilient ecosystems in Northwestern Europe and beyond by examining the interdependencies between nitrogen pollution, fragmentation of biodiversity, and the social context.

The following chapter focuses on presenting a visionary framework for a sustainable future, based on the insights gained from the detailed examination of the combined crisis of nitrogen pollution and biodiversity fragmentation. This vision aims to solve the linked difficulties mentioned in the preceding chapter while also embracing the social and environmental components required for long-term transformation.

Abstractions summarising analysis of the dual crisis

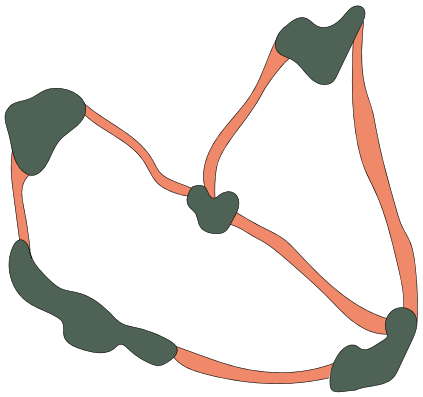
Image references
Buts, n.d.
Hartensveld and Schenkeveld, n.d.

Rethinking Agricultural Practices

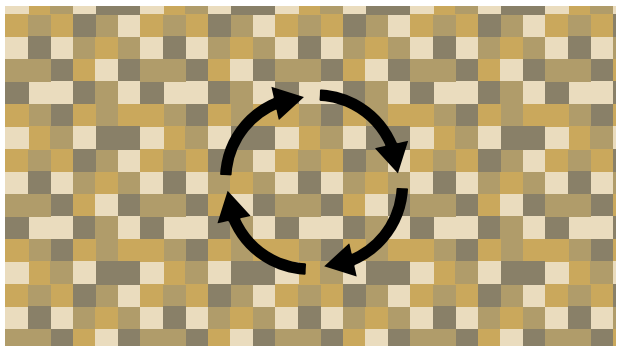
Concepts for Repositioning
Aligning the Concepts
Integration
Elements for Transformation

4

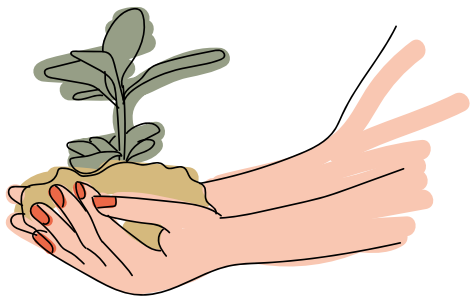
In the past, the interaction between nature and agriculture was expressed through a variety of cultural landscapes in Northwestern Europe. Nowadays, technologies, new agricultural trade policies, environmental restrictions and logistics mostly determine agricultural development which strongly influences the changing diversity in landscapes (Jongman, 2002). The pressure through economic competition results in new intensifying agricultural practices that make the land partly homogenised by the disappearance of natural features (Jongman, 2002). The results can be clearly recognized in European landscapes. According to Jongman and Leemand, forests in the floodplains decreased with 90% in the Netherlands from 1900 to 1980 and hedgerows with 80% (Jongman and Leemans, 1982). In the Czech Republic the natural plantings in cultural landscapes nearly completely disappeared during the collectivisation process (Lipsky, 1992) and in the Picos de Europe, many small fields disappeared and the agricultural field in the valley and villages became larger (Van Rijswijk and Ligtenberg, 1995). Around the same time, the hedgerows in the UK decreased significantly in quantity and quality (Jongman, 2002).



Common land connecting natural zones



Land rotation



Environmental stewardship

The consequences of the two processes of fragmentation and homogenization are manifold and both socio-economic and landscape-ecological. As a result, patchy landscapes have been replaced by monofunctional, homogeneous landscapes that take away both natural and cultural diversity. Western Europe is now intensively used by man, ''with the result that natural habitats are 'fragmented' and sometimes lost'' (p. 11, Bloemmen, 2004). At the same time, homogenisation of the landscape makes traditional, cultural landscapes disappear which diminishes the richness of the European landscape, its culture and in a way its roots. According to Jongman, it is exactly the social ecological context that makes a product important (Jongman, 2002).

The sharp competition for land in Western Europe has had a decisive influence on the large development of segregation of functions (Jongman, 2002). Until now, the main strategy within Europe for the development of the non-urban areas has been one of separating functions in a general, functional sense (Jongman, 2002). This desperation of functions contributes to the fragmentation of landscapes and comes from the paradigm in which nature conservation should be separated from other functions. The ''traditional'' synergy between nature conservation and environmental movement can no longer be taken for granted. The development of the ideal of segregation in the Western European planning has recently caused several debates about whether long-term ecological goals can be achieved at all with such a separation of land-use functions. Principles derived from the 'island biogeography theory' (MacArthur and Wilson, 1967) helped nature conservationists aware that it is not possible to conserve migrating species within the strict boundaries of natural reserves. Here, the idea of landscape linkages and ecological networks in Western Europe was to unite different natural reserves into one integrated territorial system to ''counter fragmentation of the landscape, hence give better conditions for the dispersal, immigration and survival of species'' (Jongman, 2002; p. 218) A strategy should be developed that ''maintains a multifunctional landscape that serves not only agriculture, forestry and urbanisation needs but also the functioning of nature'' (Jongman, 2002; p. 216).

A solution can be found in a shift to multi-purpose development through the restructuring of the non-urban by using sustainable agriculture and building ecological networks at the level of farms, regional levels and the supra-regional level (Jongman, 2002). By doing so, an ecological network strategy can be realised as a complement of human networks by technical infrastructures. In both Western and Eastern Europe, several arguments are given for the development of ecological networks. One of the reasons to develop ecological networks that cross national borders is the growing connectivity of landscapes, giving species a better chance of survival in the long term (Bloemmen, 2004). Another reason for developing the idea of ecological networks is that it could be used to develop a multifunctional use of land that otherwise was restricted for an increasingly agricultural monofunctional use (Jongman, 2002). Integration of functions can be considered as a product procured by both farmers and the forester (Jognman, 2002) in which payment is done in the way of ESA regulations and stewardship agreements.

A paradigm change is needed to look at nature as a stakeholder and assess its demands in terms of ecological balance by re-evaluating human duties towards natural systems. By giving ecological responsibilities to farmers in the form of environmental stewardship, nitrogen contamination can be solved at diverse scales, minimising biodiversity loss. The extension of duties offers a way to facilitate the research of agriculture - nature interactions and explores alternative farming approaches to revitalise biodiversity in a socially just way. By doing so, changes in the current agricultural practices are made that change the systemic part of linear nitrogen flows to a circular and localised one. Hence, nitrogen pollution can be reduced at local scales with large-scale effects.

This balance reintroduces the idea of the commons and farmers as environmental stewards of shared land. Land rotation combines crop rotation with shifting cultivation. Commoning, land rotation, and environmental stewardship interact programmatically and spatially to promote biodiversity regeneration, social justice, and nitrogen remediation.

These synergies create a new landscape of shared grounds that regenerates the landscape towards a nitrogen balanced one and represents the social context in which farmers are not land exploiters but environmental stewards who share responsibility for an ecologically balanced system. This synergistic landscape rethinks land use segregation and achieves regenerative land uses.. Foresters, farmers, and the public manage the common lands. This setting allows non-urban public space experimentation and knowledge and resource exchange.

Concepts for Repositioning

Idea of the Commons

Our perspective recommends reintroducing the concept of shared resources in the form of commons, which was lost during the change to capitalism ideologies. Common space and public space are not the same thing. "The term "urban commons" refers to a community of commoners who actively use and maintain whatever they possess in common, whereas "public space" refers to an asset owned by a local or national government on behalf of the commoners." (Gattupalli, 2021). The commons is a historic manner of sharing resources such as land, water, and infrastructure. Several historical instances demonstrate that commons serve as a bridge between the public and private domains. When land was shared, the spatial activities inside it began to create the cornerstone of the Commons typology. The Dutch called it the Meent, the Brits the Commons, and the Germans Gemeindeland. All of these phrases refer to the shared agricultural land used by farmers. They are derived from pieces of land where people share rights and obligations (Reinilde, n.d.). These rights and responsibilities could include everything from cattle keeping to maintenance.

In his work Tragedy of the Commons, Gerrett Hardin addressed the risks to the concept of the commons. When resources are pooled, there is a greater risk of exploitation, according to Hardin. The most generally cited analogy is that when farmers allow their cattle to graze beyond the capacity of the common land, there is resource exploitation that affects all farmers collectively for the benefit of some (Hardin, 1968). Following the commons disaster, these common lands were either given to the government or privatised.

The principles of producing public and shared goods reflect the political component of space, and thus Shared grounds proposes a space as a result of a social collaboration based on power dynamics. (Hussain, 2018). Elinor Ostrum attempted to establish a third way to manage the common pool resources in order to avoid the tragedy of the commons. Ostrum (1990) defines the carrying capacity of the commons in her book Managing the Commons, emphasizing the potential of common resources and preventing the tragedy of the commons. Ostrom uses systems theories to examine the interactions between social and ecological systems. Understanding the social, cultural, and economic conditions that impact stakeholder communication and enable decentralized resource management is emphasized. Reintroducing the concept of the commons necessitates a rethinking of land management practice.

Clear Boundaries	Context specific rules	Participatory decision making	Good monitoring
Identify Clear separation between common land and the non-shared land	Establish the activities permissible in the land locally	Involve the farmers, foresters, local inhabitants in decision making (forum)	Ensure the optimal conditions and capacities of the common land and soil health
Fair sanctions	**Conflict resolution**	**Right to organise**	**Larger networks**
Hold the actors responsible if the rules are broken and impose sanctions	Develop local means of dispute resolution in the common land at the local scale in the forums	Set clear legal system for the functioning and monitoring the activities in the common lands	Integrate the common grounds to form a larger network for better governance

Adapting Ostrum's eight principles for governing the commons

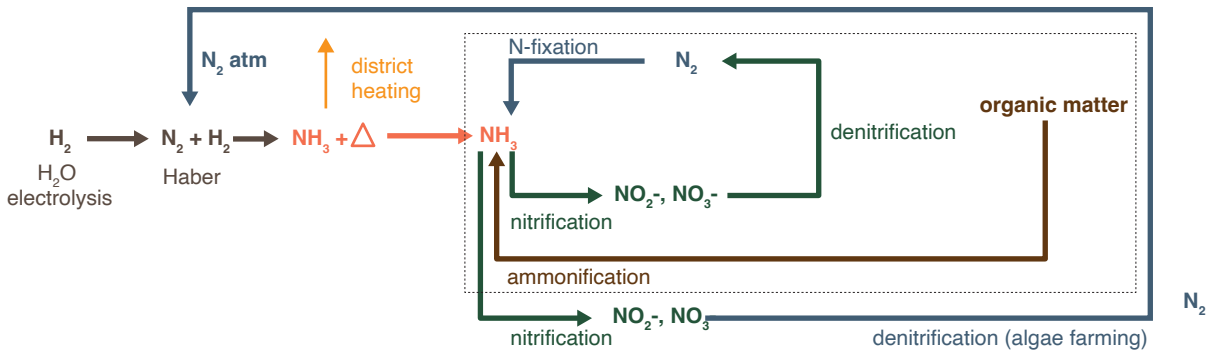
Annual cultivation mode calender highlighting nitrogen adding (blue) and nitrogen extracting(orange) processes

Land Rotation

Land rotation is introduced as a cycle in which farmers cultivate a piece of land according to the needs of the soil. When the soil is in need or has excess of certain nutrients, farmers with the right knowledge and methods will move to that land to restore the biodiversity of the soil. This indicates that there are various forms of cultivation that can adapt to this. By doing this, our food can be safeguarded and simultaneously contribute to a healthy soil. The current soil and different agricultural practices have been analysed in order to gain a better understanding of how the concept of land rotation would function in the Eurodelta and, particularly in South Holland.

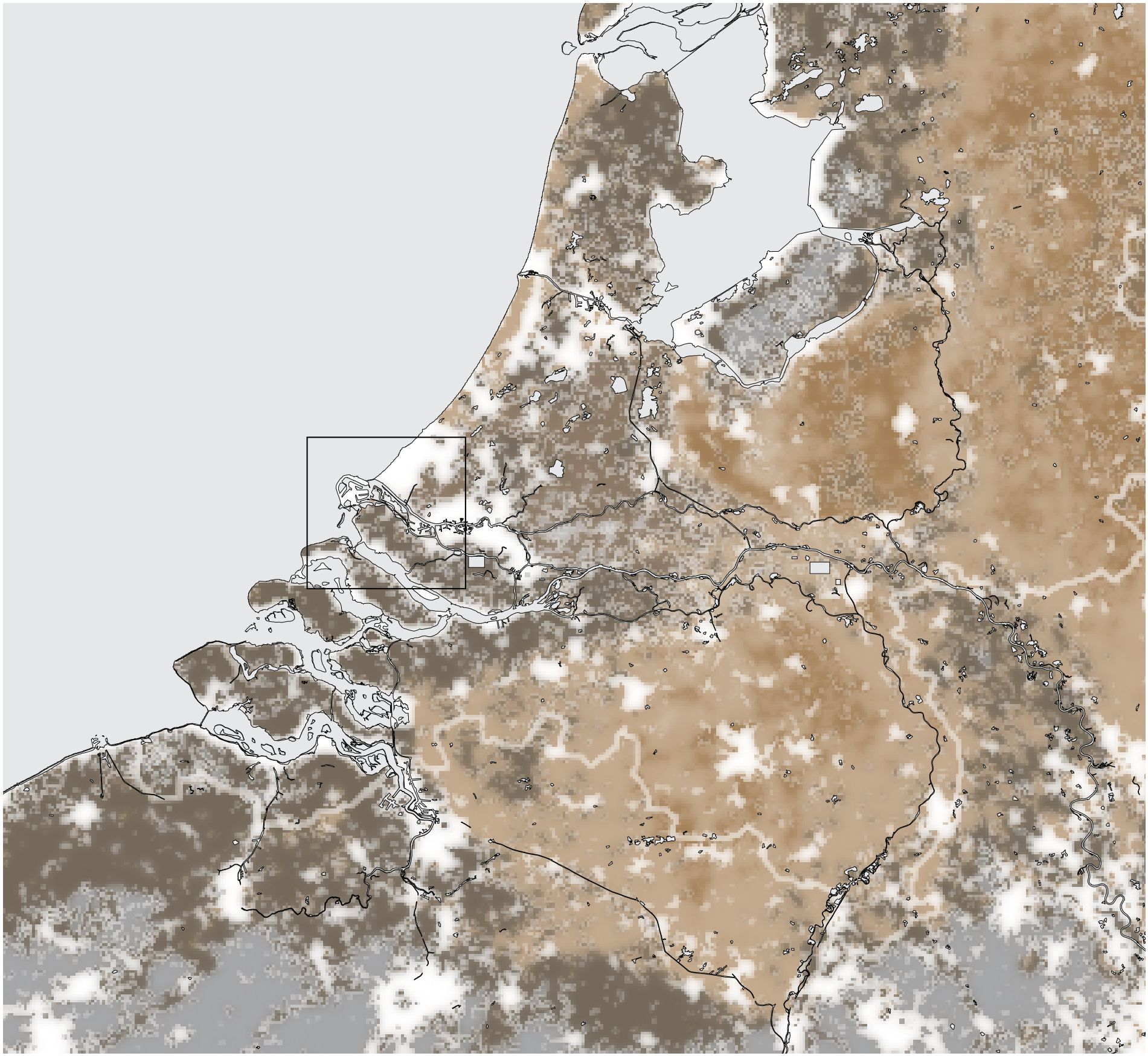
The different types of crops that have been taken into account to balance nitrogen in the soil are pastures, food crops, leguminous crops and algae farming. With the help of pastures and leguminous crops, nitrogen fixation can take place (Dalhousie University and OACC, n.d ; WUR, n.d) : the process where nitrogen is added into the soil and acts as a fertiliser to increase the nitrogen content in the soil without the use of artificial fertilisers. Pasture landscapes contribute to the nitrogen content, because the manure of cows deposit ammonia. Nitrogen fixation is the process where bacteria in the roots of leguminous crops absorb atmospheric nitrogen and convert it into absorbable nitrogen in the soil. The plants absorb and assimilate the nitrogen which is then stored as a plant protein. When the plant dies, the ammonifying bacteria convert it into ammonia. Ammonia is nitrified by nitrifying bacteria from nitrates and nitrites giving nitrogen back to the soil. Food crops and algae farming have the characteristic to absorb and denitrify nitrates and nitrites to atmospheric nitrogen respectively, a process in which the nitrogen content of the soil would decrease (Skiba, U., 2008; Wu, S. et al., 2019). The atmospheric nitrogen from the algae farms could be captured and transported to create green ammonia (Savage et al., 2020)

The cultivation considered for rotation are pastures, food crops, and leguminous crops because algae farming requires water as the primary medium. An organism as adaptable as algae can survive in a variety of environments (Ministry of Environment and Climate Change Strategy, 2022). Freshwater, saltwater, and moving or still waters can all support its growth. The optimal temperature is higher than 8 degrees Celsius and it requires enough sunlight, which is the only significant parameter. The cultivation of algae can be done chemically or naturally.

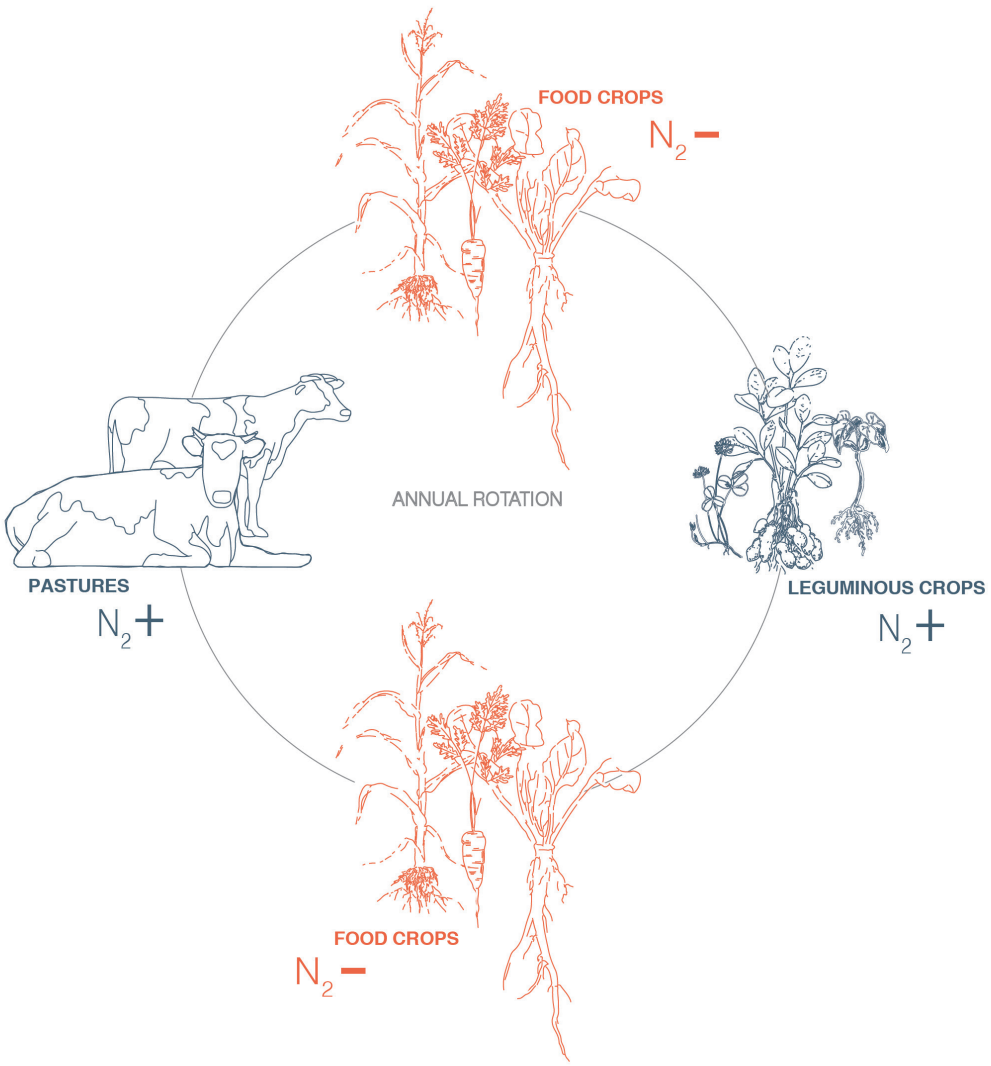


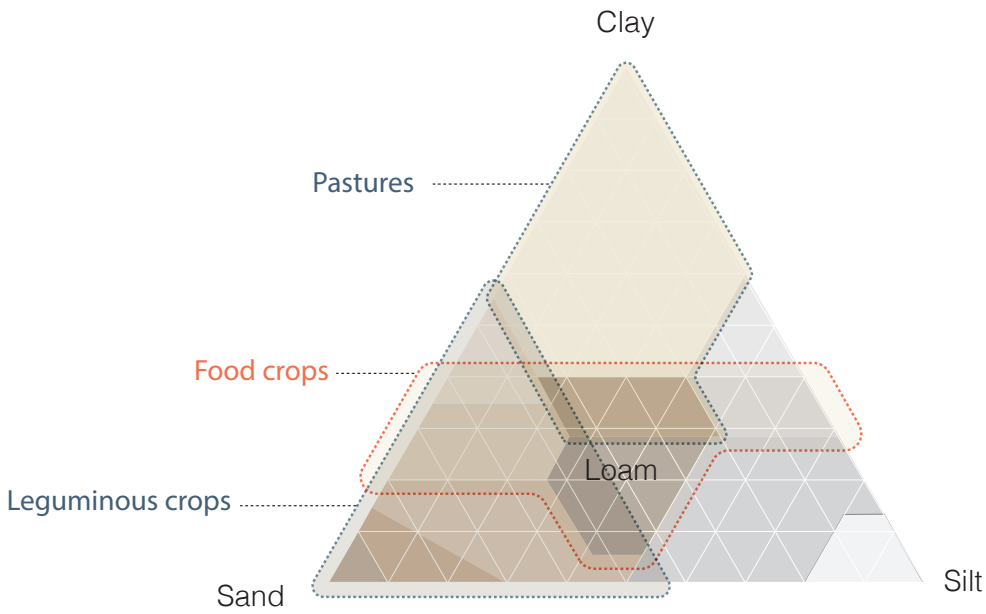
Revised schematic nitrogen flows and chemical forms

Data reference
Centraal Bureau voor de Statistiek, 2022;Ministry of Environment and Climate Change Strategy, 2022; Sundberg, 2020; WUR, n.d.



Map showing the soil textures in the Eurodelta region
for rotation cultivation sequencing



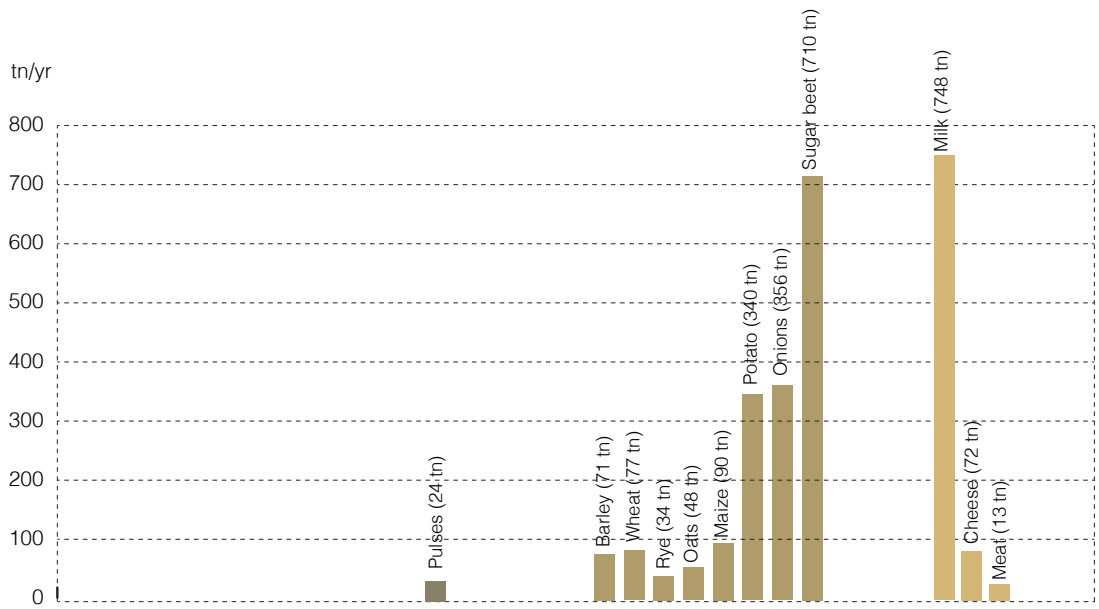


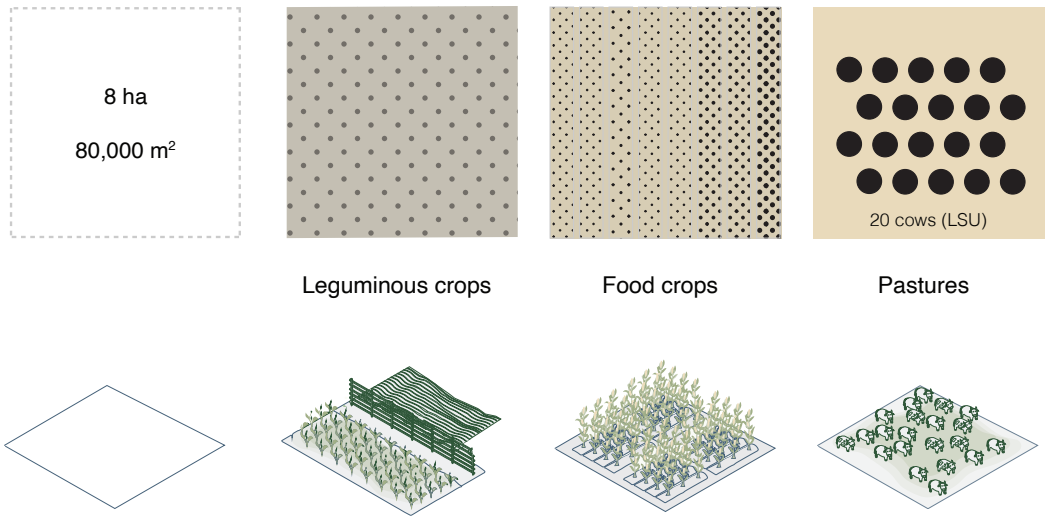
Land rotation sequence and soil texture triangle highlighting the preference of the proposed cultivation modes

There is a preferred soil texture for these types of cultivation. All pastures, food crops, and leguminous crops are adaptable and capable of growing on loam (MLA, no date; Moo-Young, 2011; Parikh and James, 2012), which unites them. When you enlarge South Holland on the soil map, you can see that the region has predominantly a loam texture, which allows for land rotation with these kinds of cultivations.

Cartographic and data references
LUCAS - European Soil Database (ESDB) 2018
Corine Land covers - Copernicus Programme, EEA, 2018
Moo-Young, 2011
Whitney, USDA, 1911;Thies, 2021; Alexandratos, 1999

Map of Westland and Voorne-Putten with parcels sizes
and the number of fragments for optimisation





Optimisation of the land sizes and their productivity for corresponding uses

It takes a minimum of 8 ha to have a productive and efficient plot of land that could be used for cultivation. This is based on the effectiveness of machinery use for food crops and leguminous crops (Sikkema, 2021; Statistics Netherlands, 2023). This also provides grazing space for 20 cows in pastures. For the distribution of plots of land a minimum of 8 ha and multiplexes of 16, to provide more flexibility in space, have been maintained. The distribution of the plots in the region of Voorne-Putten of South Holland are showcased in the map.

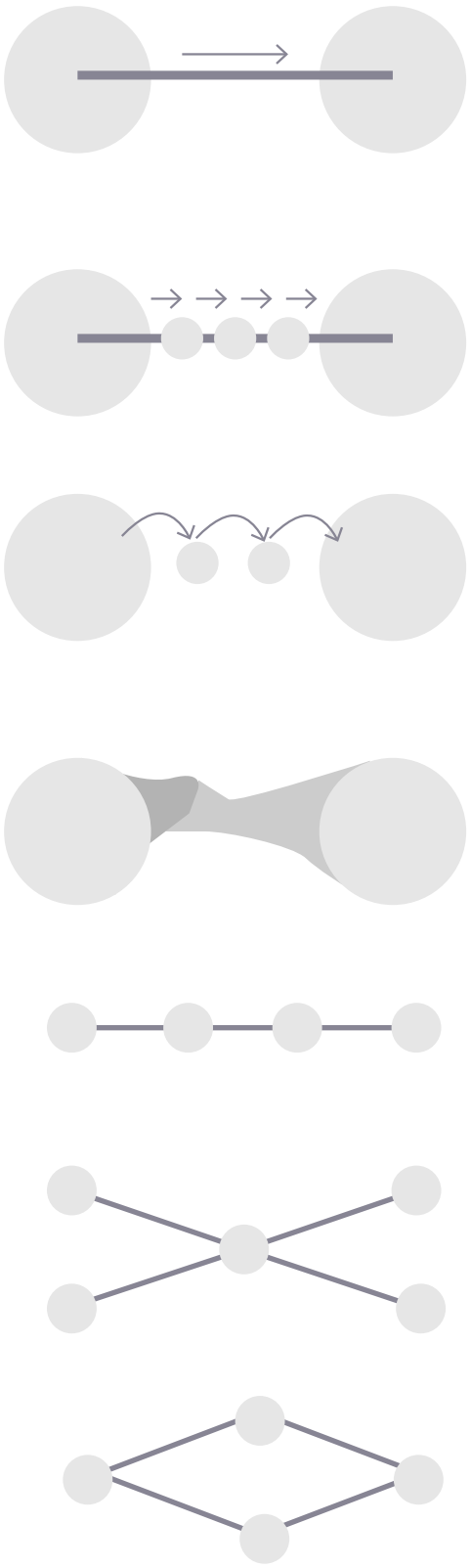
Cartographic and data references
Corine Land covers - Copernicus Programme, EEA,, 2018
Eurocrop, D'Andrimont, Verhegghen et al., 2021
Sikkema, 2021; CBS, 2021

Environmental Stewardship

Multidisciplinary approaches that facilitate integration ideals, such as sustainable development, Agenda 21, and ecological networks, are recently gaining popularity (Jognman, 2002). However, these concepts maintain to focus on possibilities and impossibilities of the integration of several functions. Often, economic trends are used to determine a logical transition of certain land covers, which often does not allow integration of functions. The changes in land-use of the last decades are not much different from what has happened historically, although the space time and impact is much bigger (Jongman, 2002). This leaves us with the question whether natural systems and the existing cultural landscapes can adapt. It seems that current landscape structures and species have many difficulties in coping with the consequences of the open market policy, privatisation and current agricultural processes. There is an existing relationship between tendencies and driving factors that are determining land-use change in Europe for both intensification and extensification. Here, the reactions of society are rather complex and they almost always depend on the existing perception of natural landscapes and the position of man towards these contexts. In this existing paradigm, an important notion maintains that many current environmental issues on a global scale can not be solved with local actions (Benett, 2018). With the current environmental issues, we must reflect on existing, local patterns in flows and demands for it is the sum of local actions that have global effects.

One way to get people more involved in promoting sustainability is through the engagement of local environmental stewardship actions and initiatives. Environmental stewardship can be defined as ‘’the actions taken by individuals, groups or networks of actors, with various motivations and levels of capacity, to protect, care for or responsibly use the environment in pursuit of environmental and/or social outcomes in diverse social-ecological contexts’’ (Bennett, 2018).

An interesting solution can therefore lie in the opportunity to assign farmers an extended responsibility of taking care of the natural environment. By doing so, a synergy arises between agricultural practices and nature conservation. Existing land plots could be used as ecological corridors, protecting cultural landscapes, while re-imagining agricultural practices and its impact on natural systems. Given the fact that stewardship takes place in very complex social-ecological systems, attention is needed to monitoring, feedback, trade-offs and different synergies between ecological and social considerations that take place in a framework that needs to be evaluated as a continuous part of activities. This way of organising new land structures asks for active participation from both farmers, (local) governments, the forestry, local inhabitants and other stakeholders. By extending the responsibility to a shared understanding of nature protection, a larger sense of responsibility can be established that reaches further than existing land plots.



Forms of ecological corridors and networks

Ecological networks

As explained, the intensification of cropland and pastures in Northwestern Europe in recent centuries resulted in the loss and fragmentation of natural landscapes which decreases the size and connectivity of natural habitats (Bruinderink, 2003). Because of this, ecological core areas become more isolated which seriously affect the survival of species (Jordán, 2000). As the total amount of area of suitable habitats decreases, one way to avoid local extinction of isolated populations due to the exposure of several risks, is to migrate between habitats through ecological corridors and utilizing the large metapopulation landscape. Therefore, natural and designed corridors need to be established to restore the important spatial connectivity of fragmented habitat areas and can be key elements for the survival of species.

Ecological corridors can be defined as ''basic components of metapopulation landscapes'' (Jordán, 2000; p. 213) since they connect local populations and can reduce the extinction rate.

A healthy ecological network usually consists of assigned core areas, corridors and buffer zones (Bloemmen, 2004). A crucial role in ensuring spatial cohesion in the ecological network is therefore assigned to corridors. Here, the patter design of corridors can be crucial for whether their arrangements are or are not reliable enough for safe emigration from isolated and disturbed areas. For example, the 'necklace' arrangement of natural landscape elements can be very unreliable for a safe migration since it is left futile whenever one landscape element is unusable. The 'loop' arrangement on the other hand can secure safe migration possibilities, even when one of the landscape elements is unusable (Bloemmen, 2004).

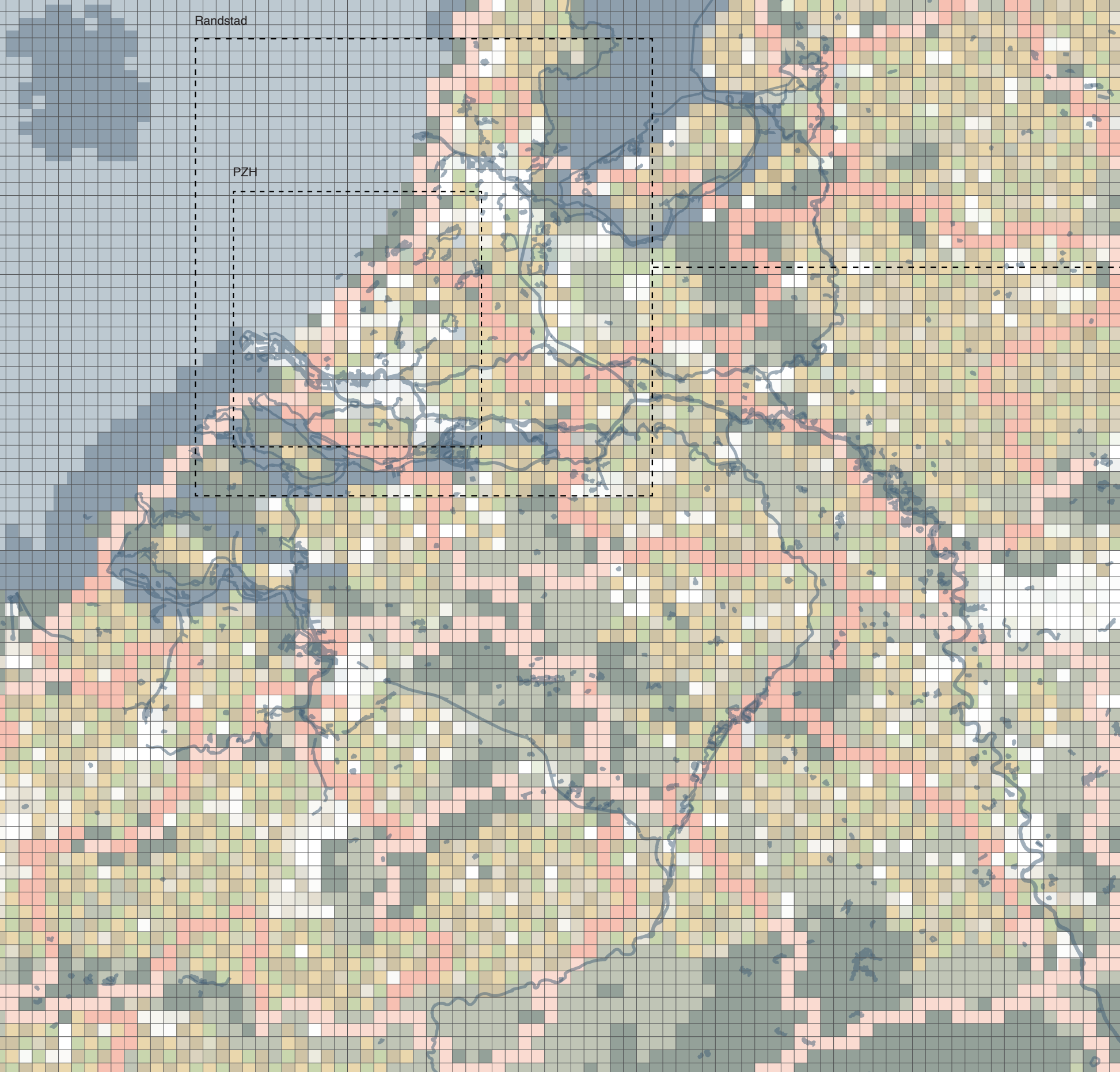
In 1995, the Pan-European Biological and Landscape Diversity Strategy (PEBLDS) was endorsed in 54 states in Europe and called for the development of a Pan-European Ecological Network (PEEN). With the rising concept of PEEN, the importance of ecological networks was officially recognized and it presents a new approach for the conservation of biodiversity in Europe. Here, nature connection and active engagement in establishing and maintaining a pan-European ecological network becomes an important backbone for nature conservation.

In 2022, EU farms used 157 millions hectares of land for agricultural production (ec.europa.eu), which is 38% of the total land area of the EU. This means that much of the PEEN-corridors touch or go over existing agricultural lands. Here, agricultural lands can play a key-role in both establishing and taking care of PEEN-corridors.

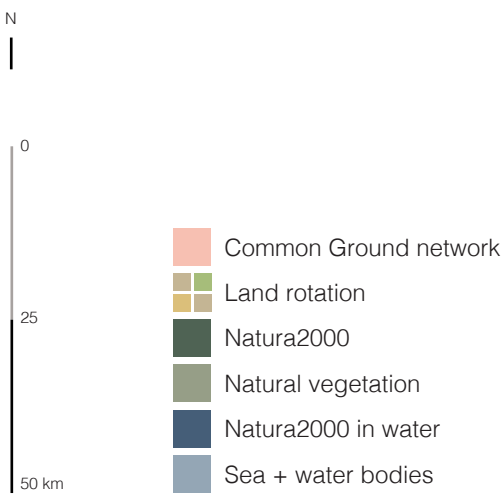
Data reference
Bloemmen, 2004

Aligning the Concepts

The nexus between commons, land rotation, environmental stewardship, and ecological networks builds a vision for the Eurodelta to tackle the dual crisis in a just way. These concepts feed on each other in creating space for healthy interactions between human activities and soil and biodiversity. The spatialisation of this is represented in the form of a mosaic that addresses landscapes as fields where the interactions have their effects on a larger scale. The mosaic also indicates the transient nature where the interactions, like the practice of land rotation, form an ever changing landscape. While this landscape forms the foundation for the development of the common ground network, the iterative planning processes at smaller scales will provide a structure for landscapes to emerge at the regional scale. The common ground network here works as a biodiversity corridor between various biotopes. The manifestation of these corridors tries to shift the paradigm of perceiving nature as something that has to be conserved and protected from human intervention to the idea of finding synergies between regenerating nature and human intervention.

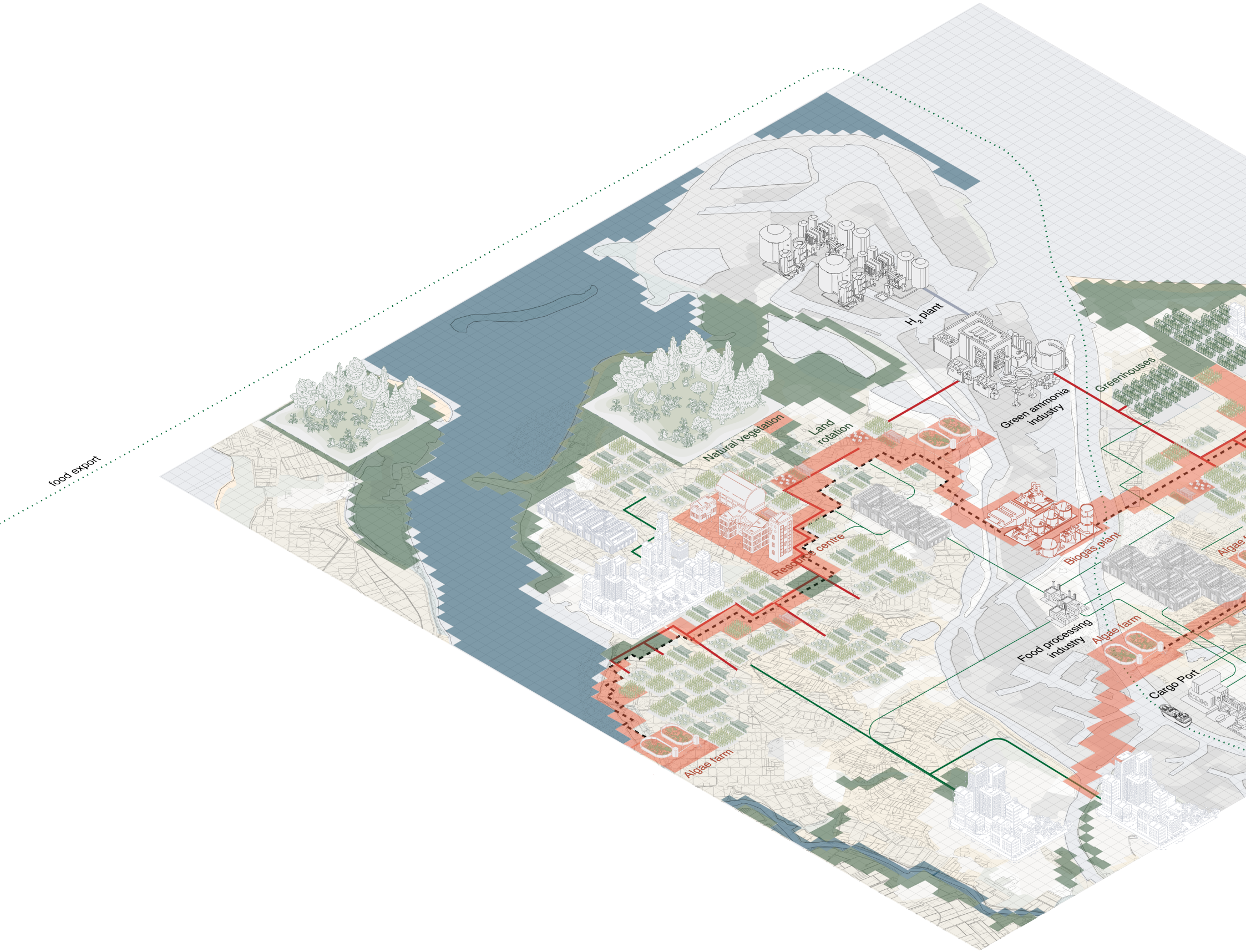

Randstad
PZH

Common ground network in
Randstad region



Spatial network mosaic of
the vision at Eurodelta scale

Cartographic and data references
Openstreetmaps, 2023
Corine Land Cover data: Copernicus programme 2018
Natura2000, European Environment Agency, 2022
Eurocrop, D'Andrimont, Verhegghen et al., 2021



Vision for the common ground patterns and circular movements of materials at local scale

Ground transport

Freight / sea transport

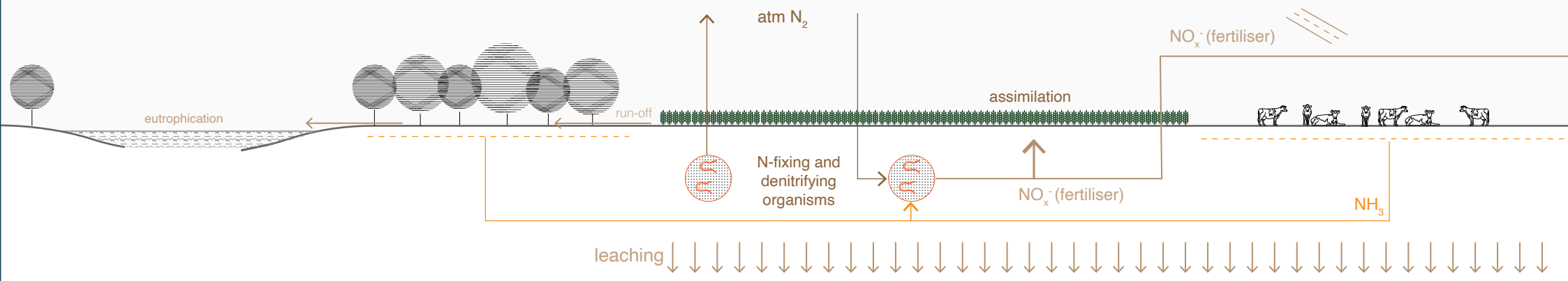
Pipelines

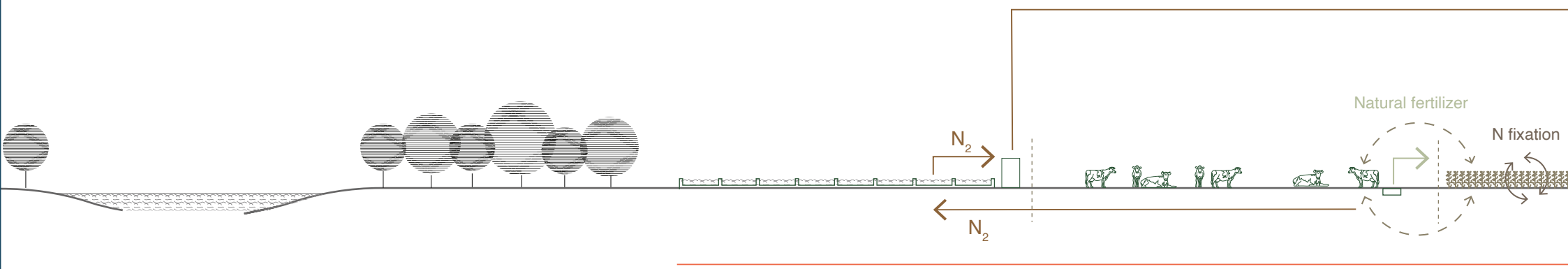
The potential of the common ground to interact with different landscapes can be investigated when projected at the scale of the Randstad metropolitan area. The network here interacts with several biotopes, including dunescapes, intertidal zones, inland marshes, and other naturally vegetated places. The Common ground's capacity to engage with the urban fabric to generate a public platform and grounds for innovation is at its highest at this interface. The new environmental landscape also makes it possible to change the patterns and flows. By diversifying the crops grown, nitrogen and food flows can be brought closer to local production. Instead of being shielded from humans, the naturally vegetated areas are protected against nitrogen runoff by human interventions like algae farming and agroforestry. The common ground network serves as a platform for the exchange of information and resources at the second level. The intervention switches farmers from using chemical fertilisers made from petroleum to using biobased green ammonia. The intervention proposes the change of the port and industrial landscapes to accommodate new spatial typologies, such as bioenergy and green ammonia plants.

Integration

On Circularity

Apart from reducing and pushing towards localising production, the proposed nitrogen flows also rethink the systemic section where the source and destination of nitrogen are localised by the implementation of land rotation. Nitrogen fixation from the leguminous plants and the deposition of ammonia increase the nitrogen content in the soil. The consequent food crop cultivation absorbs and assimilates the nitrogen in the soil and reduces its nitrogen content. If there is a nitrogen deficit, the stored organic manure from the local cattle is mixed in the soil to increase the fertility. The nitrogen runoff captured by the algae can be recycled in the production of green ammonia, which can be used in greenhouses. The biowaste from the crops can be used to create energy, and the released carbon dioxide can be captured and repurposed for use in the greenhouses, where it is later used for photosynthesis by the plants. Through these processes, the vision reflects on the R ladder (Potting et al., 2017) in regenerating and recovering soil and natural systems.

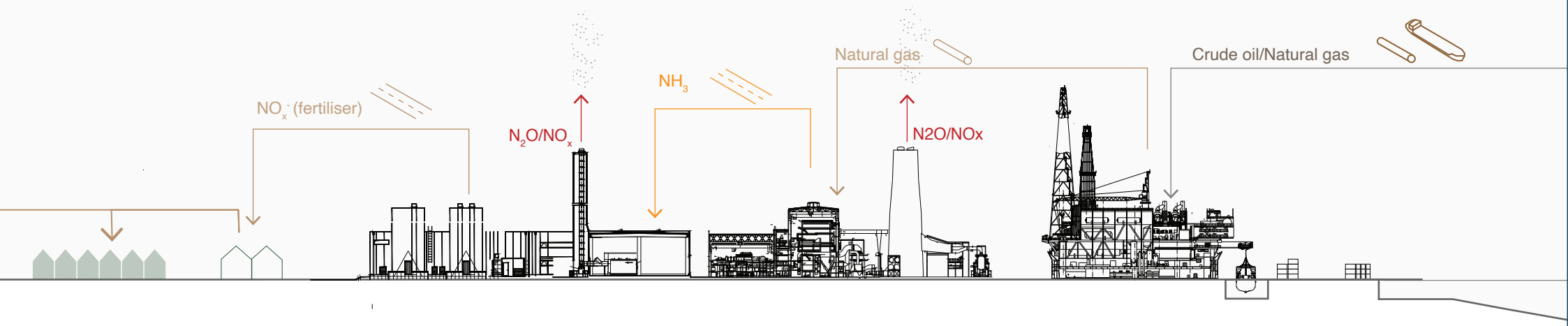




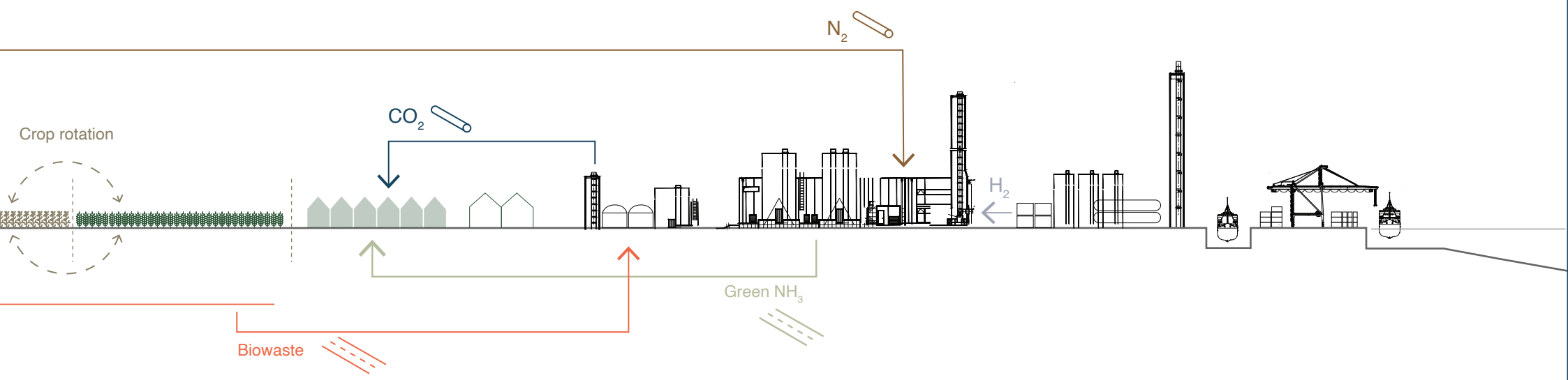
Revision of the systemic section towards nitrogen circular flows

atm N_2	Atmospheric dinotrogen
NH_3	Green ammonia
NO_x^-	Nitrates / nitrites (fertilisers)
N_2O / NO_x	Nitrogen oxides
CO_2	Carbon dioxide

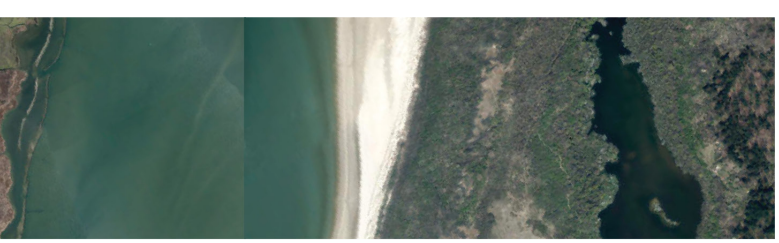
Ground transport
Freight / sea transport
Pipelines

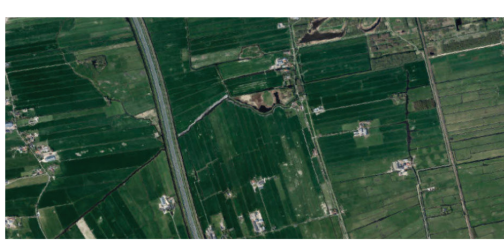


Greenhouse | Distribution centre | Fertiliser industry | Inorganic chemical industry | Oil / gas refinery | Port

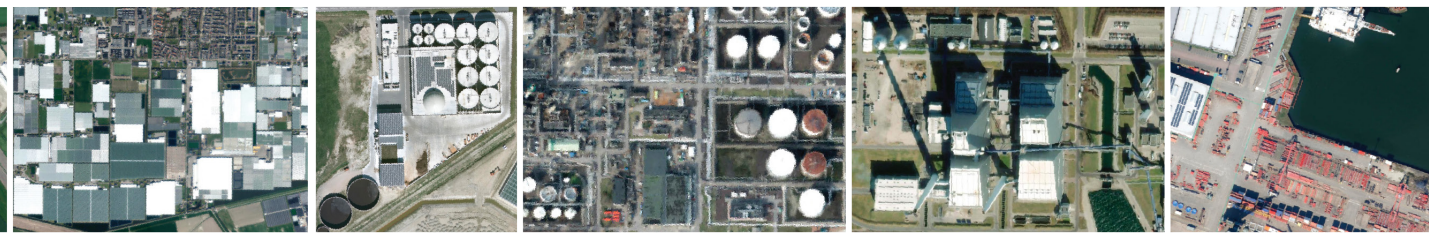


Food crops | Greenhouses | Biogas plant | Green ammonia plant | Hydrogen plant | Port






Change in landscape characteristics to form dynamic polycultural patterns



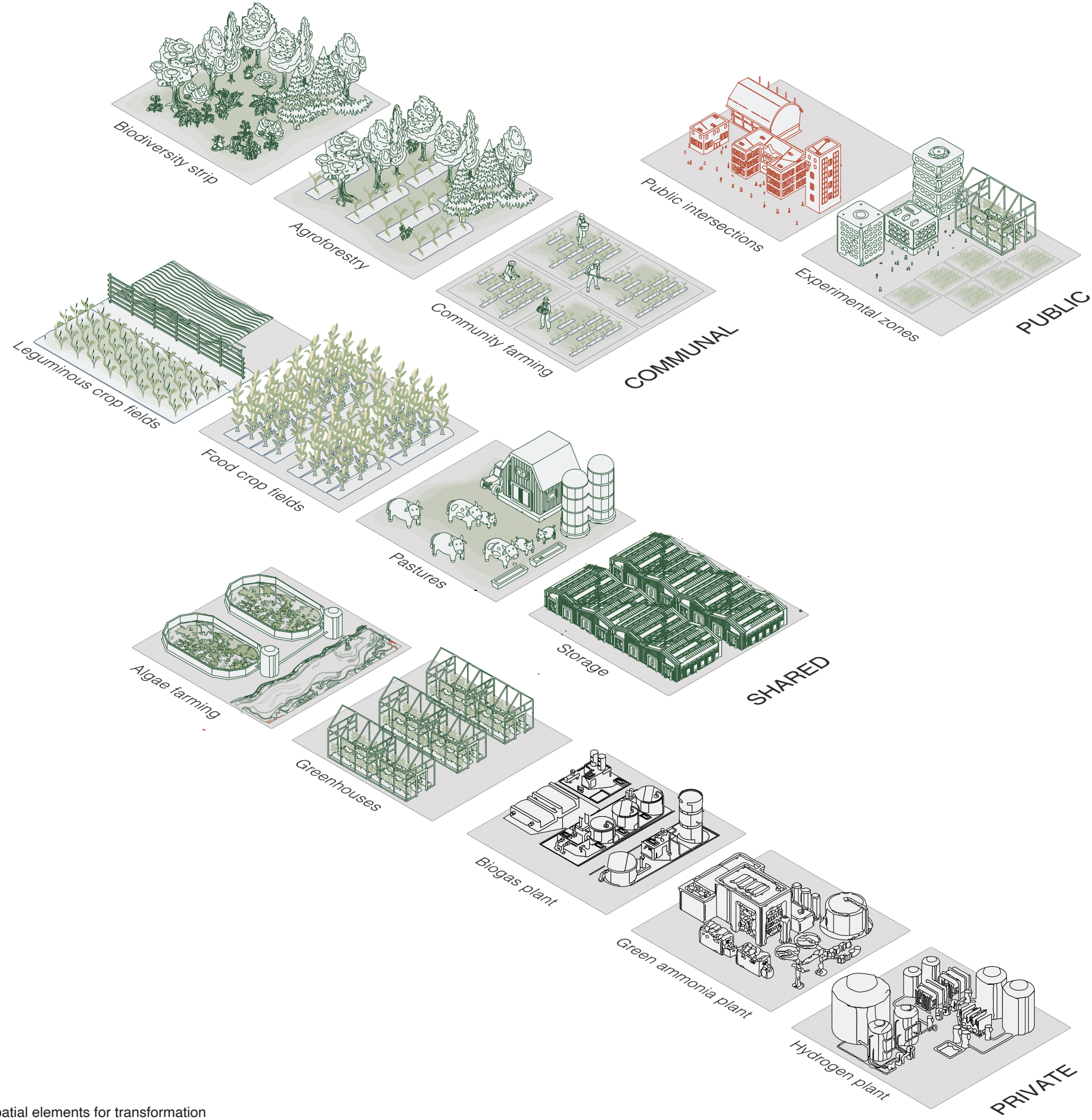
On sustainable land use

The proposed four year cycle for agricultural use based on the soil nitrogen content creates a new way of cultivating the land, and thus the land use is a function of the soil characteristics. Based on this, the character of the landscape is temporal and dynamic. This revises the current methods of large, intensive monocultures based on artificial fertilisers that degrade the soil. The Common Grounds also creates a foundation for multifunctional land uses that increase the diversity of cultivation and reduce the over-extraction of selective minerals from the soil. The planning and land management principles include the periodic assessment of the soil and the revision of the activities and cultivation in the parcel. This land is therefore engineered for the regeneration of soil while harnessing productivity in a sustainable way.

On Decentralisation

Based on Ostrum's principle of nested networks from Governing the Commons, the realignment of agricultural practices through the Common Ground network can be decentralised (Ostrum,1990). Multiple, self-organized local networks at the provincial level are nested within the larger national network, which is a component of the European network. While this establishes the institutional framework for governance, the corresponding spatial elements can be decentralised at various dimensions in order to localise the network. This affords numerous decision-making platforms at lesser levels. The structure then strives to achieve a balance between the top-down and bottom-up approaches to decision-making. The localised forums and land banks produce the conditions at these dimensions for improved accessibility and convenience. Together with forest officers, provincial governments, and other stakeholders, the members of self-organised cooperatives can establish their own regulations for forming the commons.

Cartographic references
Satellite imagery from ESRI-2022



Spatial elements for transformation of agricultural practices

Elements for Transformation

Components for the alteration of several spatial components can facilitate the transformation of the landscape towards sustainable land use. The primary components consist of the Common ground network and agricultural fields that practise land rotation between food crops, leguminous crops, and pastures. The biodiversity strips in the common ground network create different biotopes at a larger scale.

The practise of agroforestry in the commons maintains the productivity of the land while facilitating ecosystem services such as enhancing biodiversity and connecting biotopes. The introduction of algae farming as a buffer prevents nitrogen runoff into the natural zones.

The common grounds can also create conditions for innovative agricultural practices. In these experimental areas, sophisticated techniques like precision farming and pixel farming can be tested out. Programmes like RnD and innovation hubs and knowledge centres support these activities while also setting standards for the new agricultural practices.

The common ground can also be programmed with urban agriculture, where it interacts with the urban fabric and thus encourages community farming and uses the potential to localise production. These can also be programmed with innovative spatial functions like greenhouses and vertical farming using hydroponics to explore advanced technologies for production.

Public intersections include the elements necessary for the functioning of the common grounds and land rotation to ensure the fundamental setup of the landscapes.

While the land bank institutionally creates a space for the land transactions to function, the forums at the public intersections create a platform for the interactions of the stakeholders in discussing the policies, resolving local disputes, exhibiting innovation, etc. This institutional setup also provides the potential for the farmers to form cooperatives on a local scale within the provinces, which in turn integrate to form larger networks. Additionally, the public intersections form zones for public engagement in the form of educational visits, recreational functions in the form of architectural interventions like observation decks.

Resource sharing capabilities require spaces to store the shared machinery in the form of resource banks. These resource banks can be connected to the land banks, and the sharing of these resources is also on a local scale. The shared resources also include shared storage solutions to store the produce, seeds, machinery, etc.

Energy landscapes can be integrated into the common ground when they interact with port landscapes, where the potential for the transformation of industries based on fossil fuels is harnessed. It creates space for bio-based energy structures based on biowaste. This creates the space for the introduction of green ammonia plants, which create fertilisers based on hydrogen and extracted atmospheric nitrogen. This process is spatially translated into hydrogen plants, nitrogen extractors, and green ammonia plants.

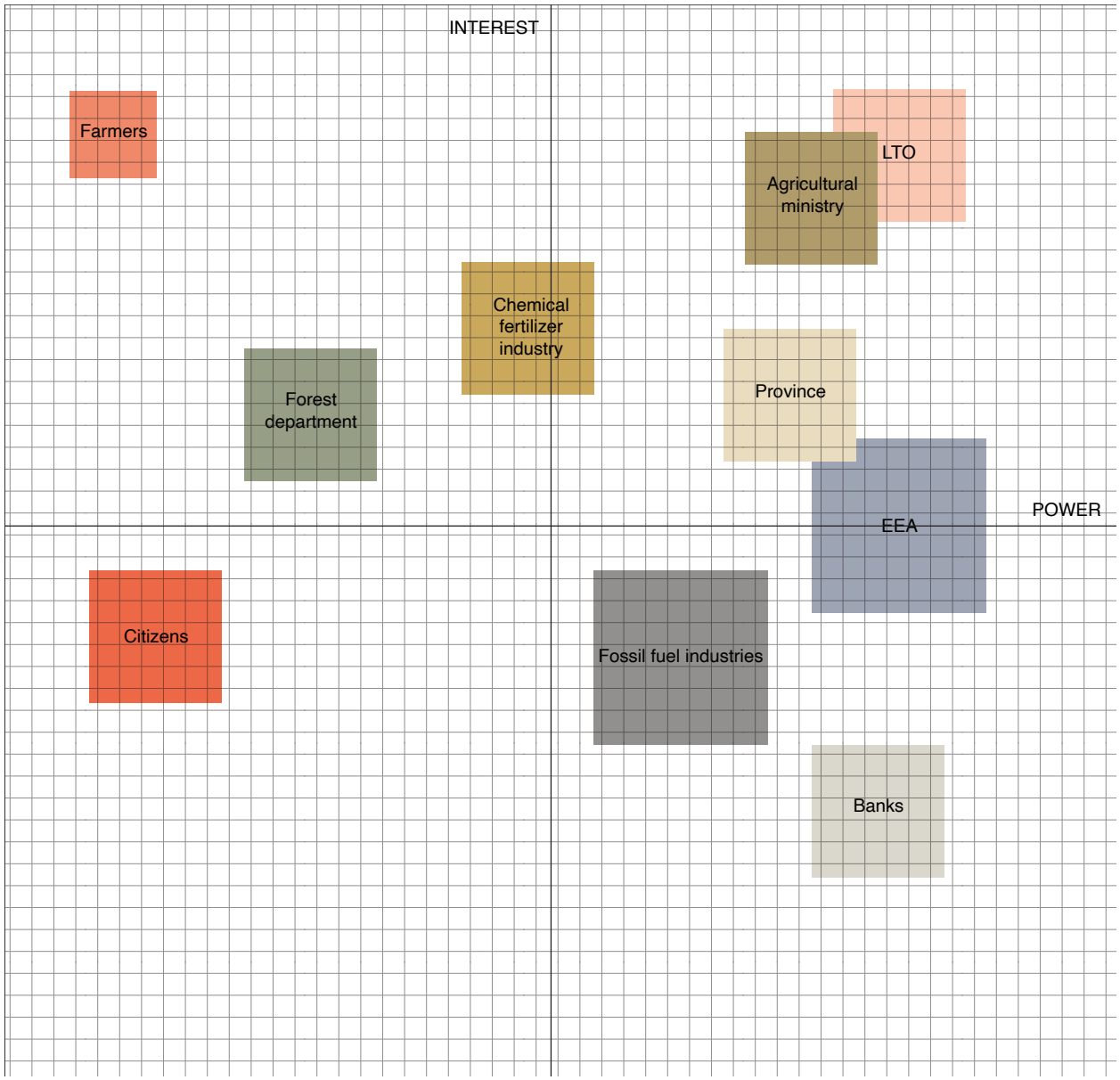
Strategy

Stakeholder and Spatial Relations
Governance System
Operative Strategy
Emerging Landscapes
Implementation Timeline and Trends
Reflecting on Socio-spatial Justice
Integral policies

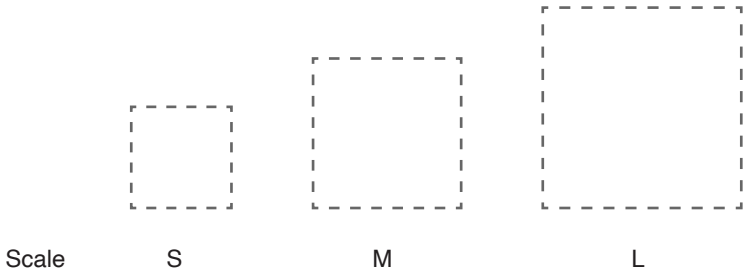
5

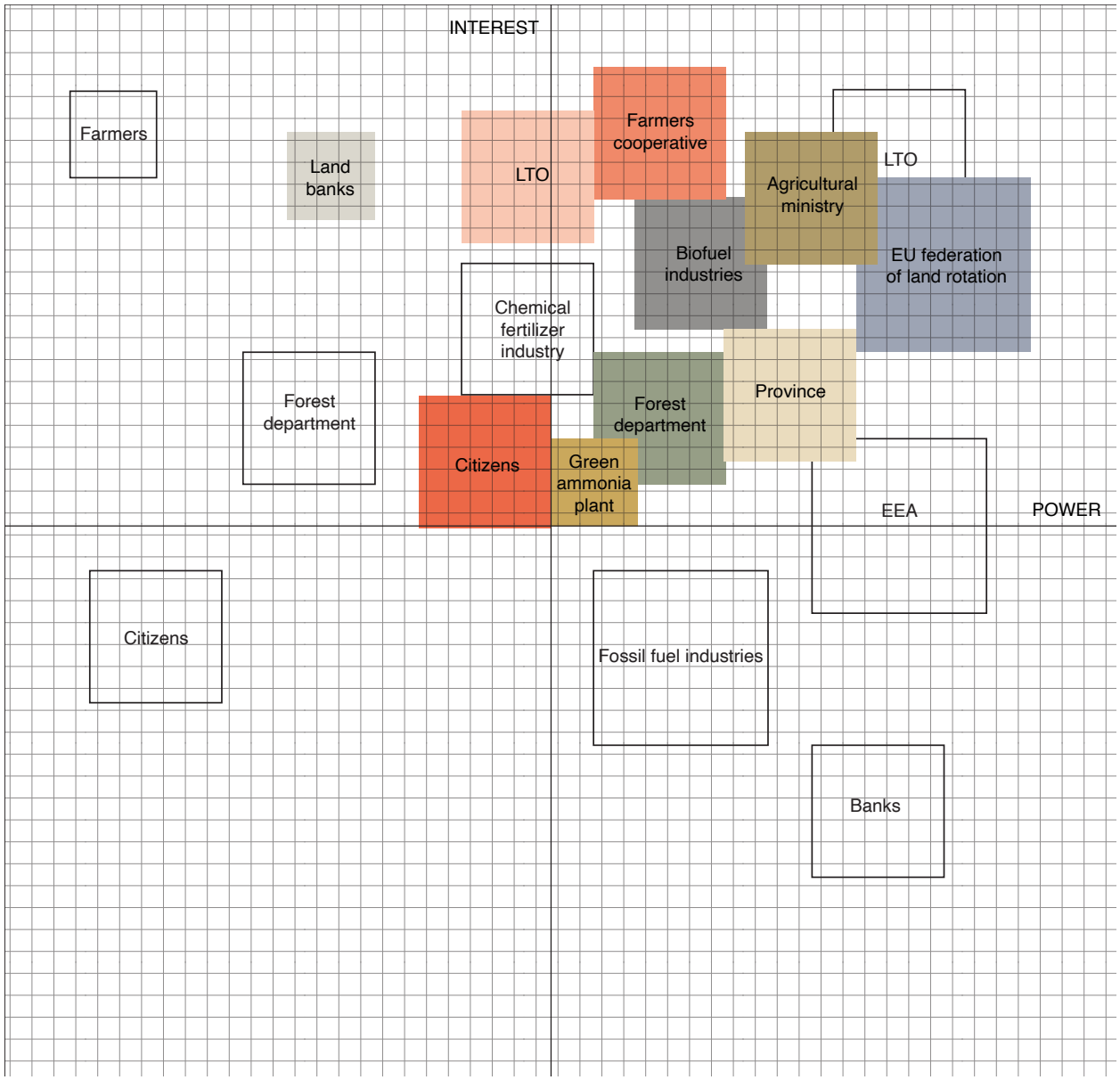
Stakeholder and Spatial Relations

Involving stakeholders throughout the implementation and the use of the project is important in achieving the set objectives as later set in the timeline.



Mapping the current positions of the main stakeholders in power interest matrix

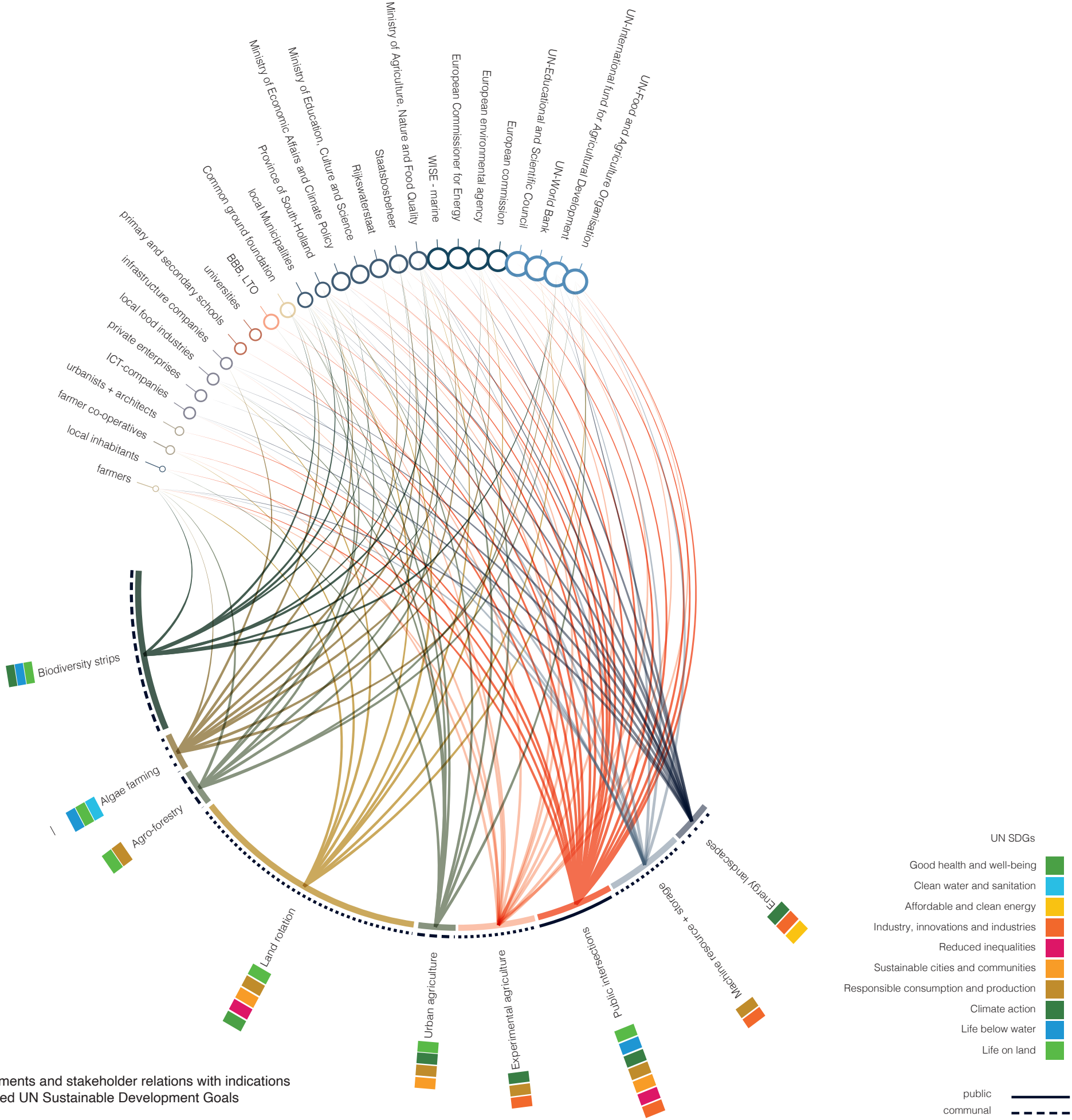




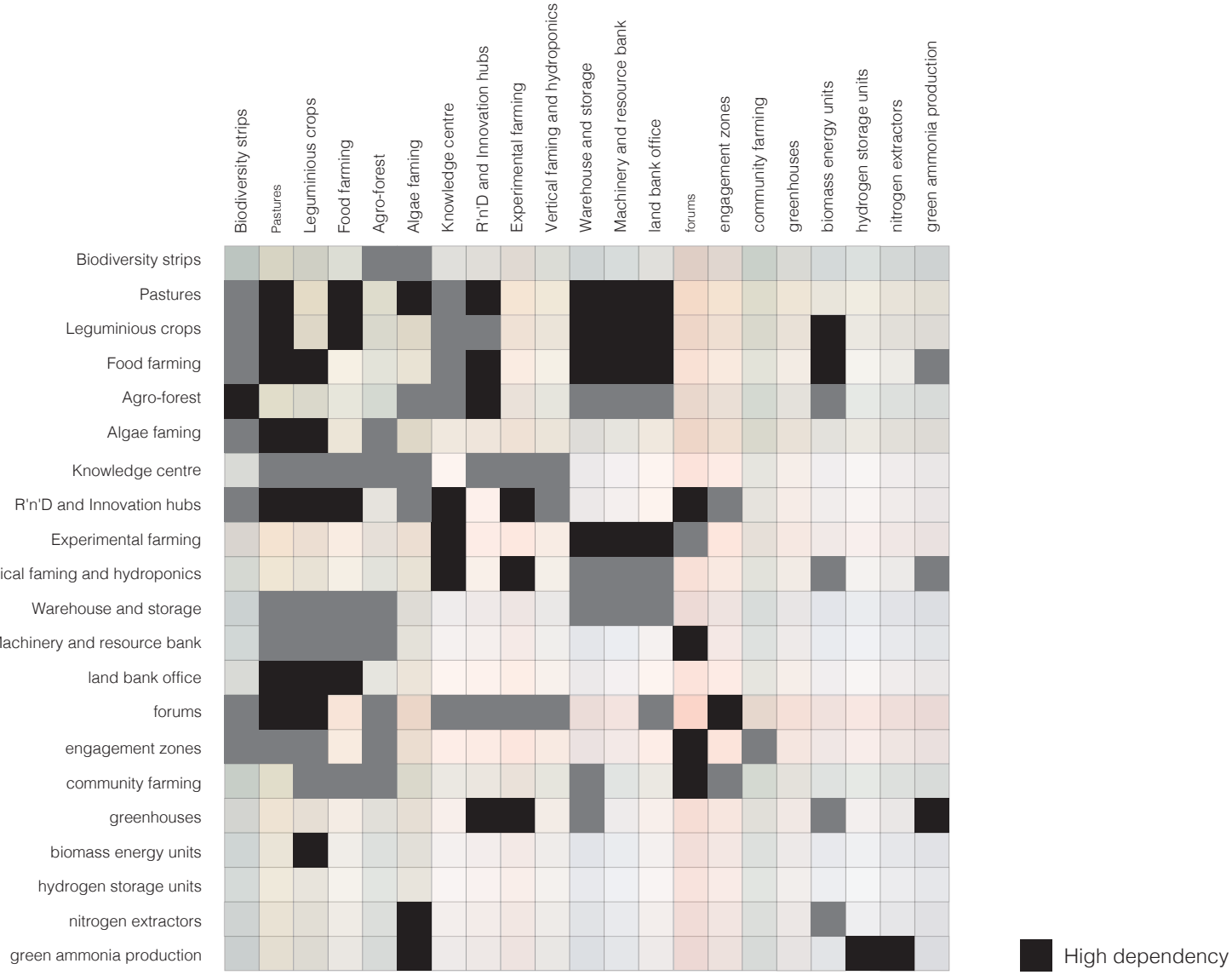
Mapping the prospective positions of the main stakeholders in power interest matrix

As an instrument for stakeholder analysis, Mendelow's (1991) power-interest matrix is utilised. It organises the stakeholders based on the influence they have over the process and the importance of the issue for each stakeholder. A selection of essential stakeholders has been made for this diagram. An essential stakeholder is a person with the relevant political, regulatory, functional, or financial authority and expertise in relation to the issue at hand (Bryson, 2004).

For this project, both the current and prospective stakeholders are mapped in order to determine which stakeholders must be included in different periods of the project and to identify potential synergies between the various actors. Next, it demonstrates how the essence of their function may become redundant or alter over time. Current stakeholder analysis reveals that stakeholders are dispersed across the field; future stakeholder analysis envisions incorporating all pertinent stakeholders into the project.



Spatial elements and stakeholder relations with indications of associated UN Sustainable Development Goals



Functional dependencies of the spatial elements with each other

To give an indication of the spatial relations of the different stakeholders and how they relate to the different newly introduced zones within the project, this circular relationship matrix is made. This diagram includes a broader array of stakeholders, who are linked to the spatial zones they have an influence on through coloured lines. These are exactly the different zones that have a role within the common ground. These functions within the common ground are also related to the corresponding Sustainable Development Goals (SDG) as formulated by the UN. These goals exist to steer the whole of the UN towards an end of poverty and inequality, protection of the planet and ensuring health, justice and prosperity for everyone (United Nations, 2015).

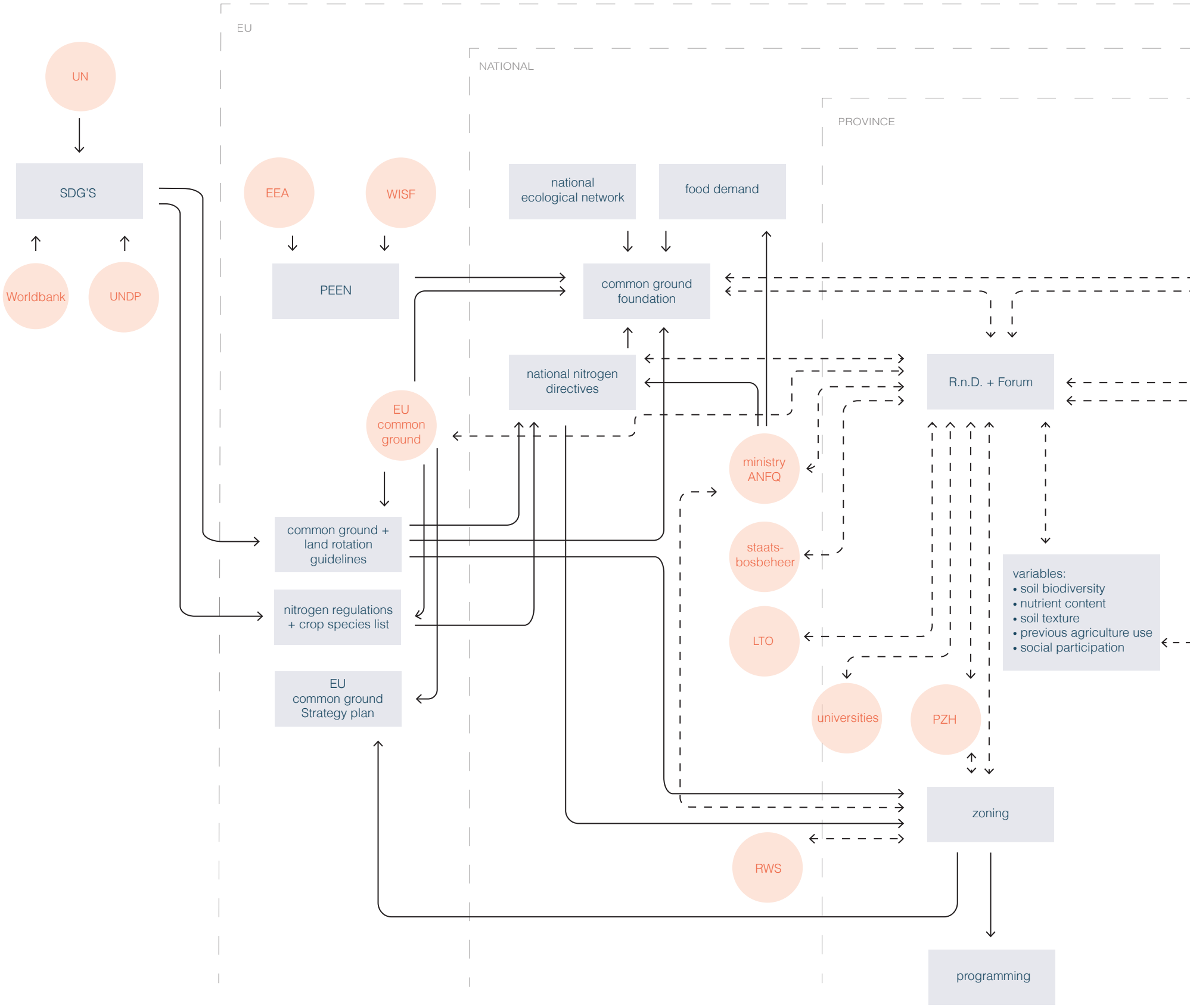
What is learned from this diagram is that certain zones and functions play a very connecting role within the big scheme of the different functions. The public intersection for example is a place that involves almost all stakeholders. This information is then used to decide upon where the public forums should be placed, this is also a place where different stakeholders have the opportunity to meet, exchange ideas and collaborate with the policy makers to have an influence on the course of action of the common ground.

This matrix shows the different spatial elements that make up the project and indicates how they depend on each other. It thus helps in setting the sequence in which certain spatial elements have to be realized. What can be seen is that many of the different spatial elements rely on the development of the public intersections and the RnD centres within the experimental zones.

Governance System

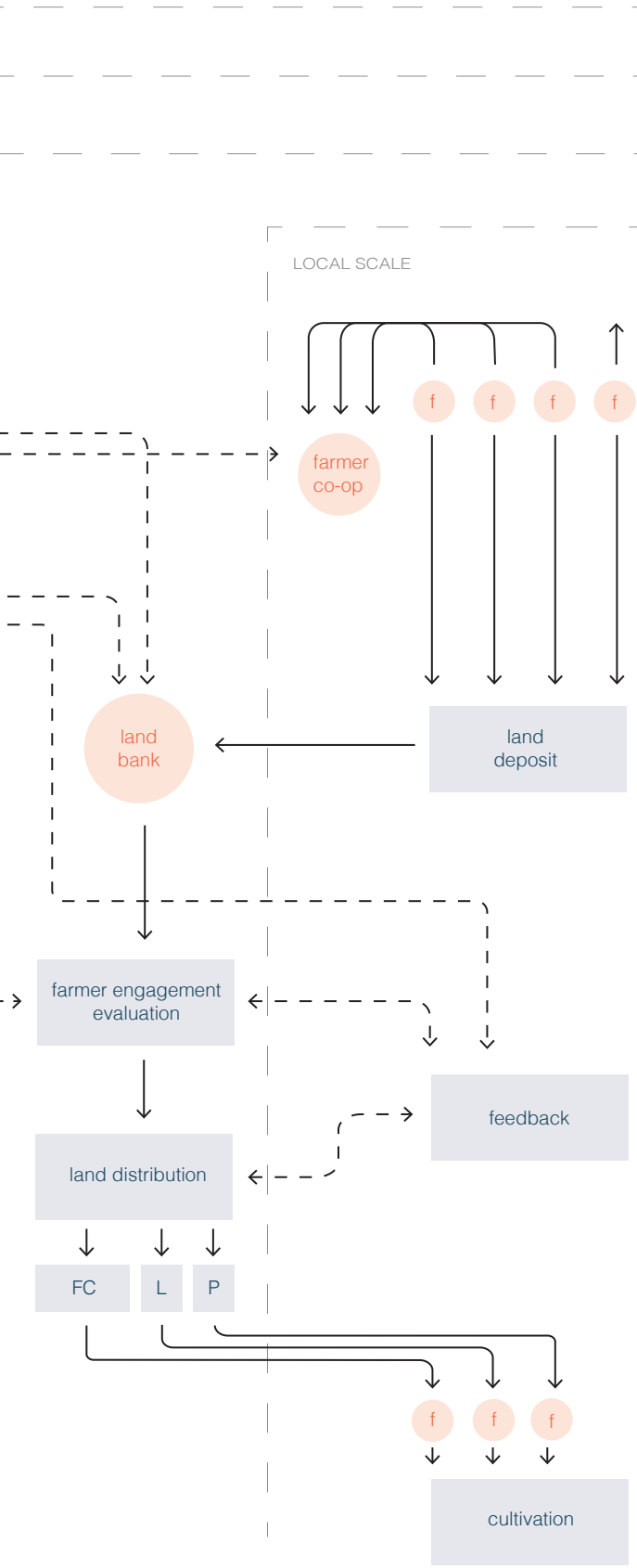
Starting at the largest scale, the focus lies on the Sustainable Development Goals (SDG) established by the United Nations. As explained later in the chapter on comprehensive policies, the transition of current agricultural practices towards a solution that reduces nitrogen pollution and biodiversity fragmentation is highly compatible with these objectives. The SDGs also play an essential role in the formation of EU policies. Here, a more specific policy is outlined for the reduction of nitrogen contamination by 50 percent by 2030 and the reduction of artificial fertilizers by 20 percent on EU agricultural land (European Commission, 2015). Within the scope of the EU, the beginnings of the common ground network are established, based on the existing Pan European Ecological Network (PEEN). In addition, an EU federation for land rotation will be established, not only to signal the desire for this to become an EU-wide practice but also to optimally coordinate land rotation processes. This is not just a solution for South Holland but, ideally, for all of Northwest Europe.

On a national scale, the national directives are set, meaning that the goal of reducing nitrogen runoff and artificial fertilizer use is set by the EU, but each individual country can devise its own way on how to do this. Politics and the government system within the Netherlands will have a big role in setting these directives. Also an initial plan for the common ground network is made based on the Ecologische hoofdstructuur (EHS), a network akin to PEEN but more specific to its natural context. This will serve as the primary guideline for provincial-level planning of common ground, together with the surface area the production of the local food demand needs. The intended future is one where food is produced and consumed locally, and this thus forms the indicator on how much space agriculture can take up. Farmers, Staatsbosbeheer, and universities conducting research pertinent to the development of the agricultural sector and biodiversity are involved in the participatory planning of the common ground structure and allocation of the relevant zones. The R&D center has the role of conducting soil research to determine the soil quality and to distribute the lands for land rotation accordingly, FC, plot is meant for food crops, L, plot is meant for leguminous crops, P, plot is meant for pastures. The RnD center and the Forum together are also places to engage different stakeholders and establish a level playing field, which is particularly crucial in multi-level governance where all stakeholders are of equal significance within the discussion (Mazur, 2011). It is crucial to include all of these stakeholders in the first stage of collaborative planning, as they are the ones who can make or break the success of the project during the implementation phase. As indicated by the dashed lines, the governance system will continue to be an iterative process with planned reflection moments involving all stakeholders.



Spatial elements and stakeholder relations with indications of associated UN Sustainable Development Goals

Stakeholders
Activities
Linear flows
Iterative flows

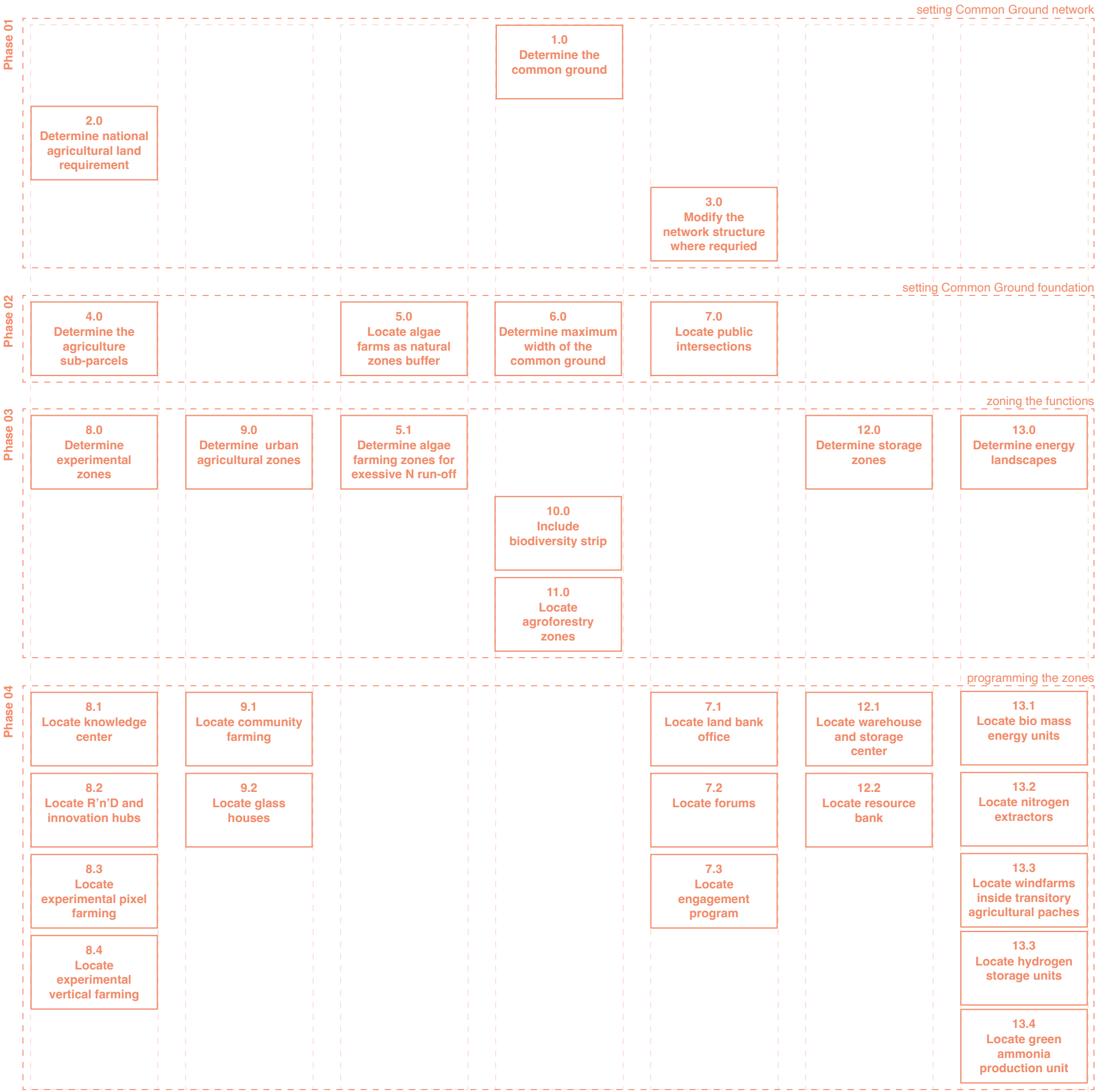


The province takes on the role of zoning and programming the common ground in more detail, these functions are very context dependent, but it is also important to keep an overview of the different facilities along the whole network. Functions such as depositing land for the landbank, is also done on the province scale to ensure that it has a clear overview of the soil's trends and thus which type of cultivation the soil needs. The objective is to distribute farmers for land rotation near their residences so they do not have to travel far to cultivate the land. In a way the province takes over the historical role the Rabobank, the bank by and for farmers, used to have.

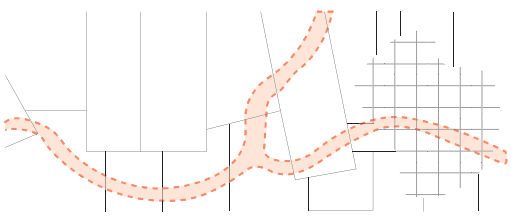
The local scale is very much the domain of the farmers, and thus they are frequently engaged to participate on this level through biannual reflection moments. This is where the land is cultivated and the farmers' cooperative is established, which contributes actively to discussion in the R&D center. This is a municipal-level group of farmers who constitute the land rotation circles. Local land rotation is important not only because it is more convenient for producers to travel short distances, but also because cows that use pastures should be able to return to their quarters at night. The division of land over several years is dependent on an evaluation of how farmers have treated their lands throughout the previous year. Consequently, democracy is reflected in the quantity of input stakeholders have in urban space. This governance system provides an overall framework for how land rotation is intended to function and how the various stakeholders are involved in shaping this process. Farmers will be required to make the greatest adjustments to their working methods and are therefore well-represented at all levels of the governance system. Feeling the endeavour of a decentralised governance system that includes farmers will ideally restore the farmers' faith in government collaboration. This trust is required to realise a successful project that contributes to achieving the UN's SDG objectives and preserving the agricultural practices that make up such a significant portion of Northwest Europe.

Operative Strategy

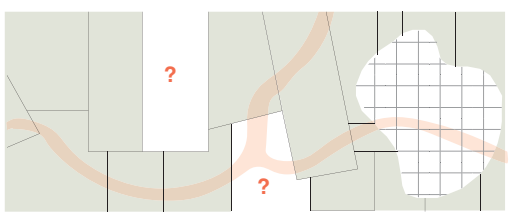
In order to establish the eco-agricultural network, the following operational strategy is designed to generate a shared understanding of the Common Ground Network and to establish a corridor that supports local agricultural practices while connecting various natural zones. Here, the PEEN-network serves as a crucial backbone to which essential local and public programmes that foster a regenerative agricultural landscape are attached.


Phase 01
setting Common Ground network
1.0
Determine the common ground
2.0
Determine national agricultural land requirement
3.0
Modify the network structure where requried
Phase 02
setting Common Ground foundation
4.0
Determine the agriculture sub-parcels
5.0
Locate algae farms as natural zones buffer
6.0
Determine maximum width of the common ground
7.0
Locate public intersections
Phase 03
zoning the functions
8.0
Determine experimental zones
9.0
Determine urban agricultural zones
5.1
Determine algae farming zones for exessive N run-off
10.0
Include biodiversity strip
11.0
Locate agroforestry zones
12.0
Determine storage zones
13.0
Determine energy landscapes
Phase 04
programming the zones
8.1
Locate knowledge center
8.2
Locate R'n'D and innovation hubs
8.3
Locate experimental pixel farming
8.4
Locate experimental vertical farming
9.1
Locate community farming
9.2
Locate glass houses
7.1
Locate land bank office
7.2
Locate forums
7.3
Locate engagement program
12.1
Locate warehouse and storage center
12.2
Locate resource bank
13.1
Locate bio mass energy units
13.2
Locate nitrogen extractors
13.3
Locate windfarms inside transitory agricultural paches
13.3
Locate hydrogen storage units
13.4
Locate green ammonia production unit

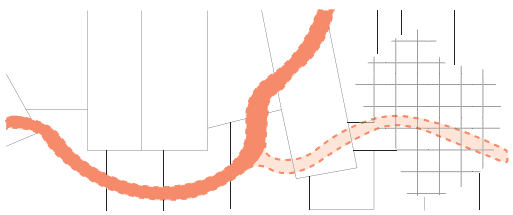
1.0 step
Determine the common ground
by using the PEEN network as a backbone



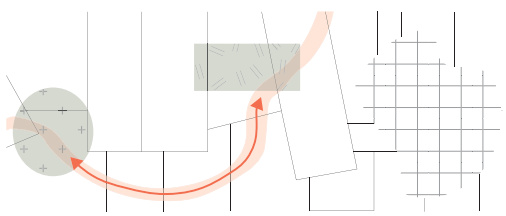
2.0 step
Determine national agricultural land requirement
by calculating future food trends



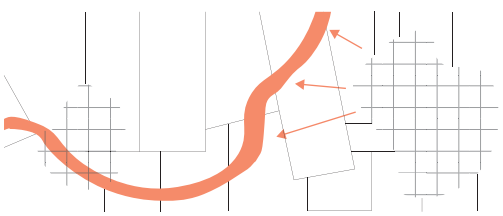
3.0 step
Modify the network structure where requried
minimize intersections with urban fabric



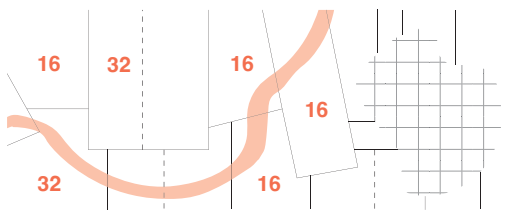
3.1 step
Modify the network structure where requried
maximize intersections with (different) biotopes



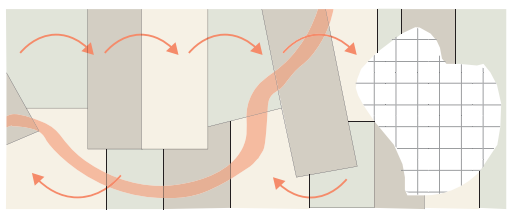
3.2 step
Modify the network structure where requried
maximize the interaction with different landcovers



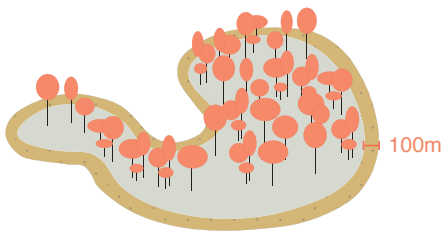
4.0 step
Determine the agriculture sub-parcels
in existing agricultural landscapes and based on the multiplex of 16 ha



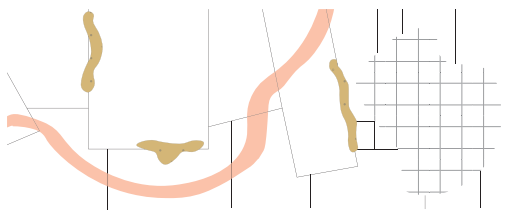
4.1 step
Determine the land rotation sequence
located on current agricultural land and based on soil texture.
25% legumes, 25% pastures, 50% food crops



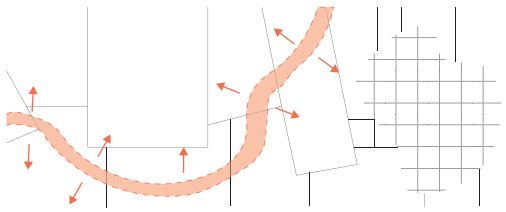
5.0 step
Locate algae farms as natural zones buffer
in natural water around natural areas as remidation buffer zones. Minimum width of 100m and maximum width of 1 parcel



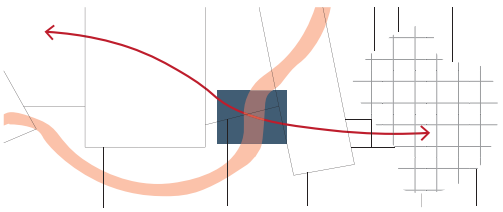
5.1 step
Locate algae farm buffers
dispersed in the common grounds near existing infrastructure and agricultural fields. Based on periodical soil tests that are above the critical limits of 25kg/ha-1 per year



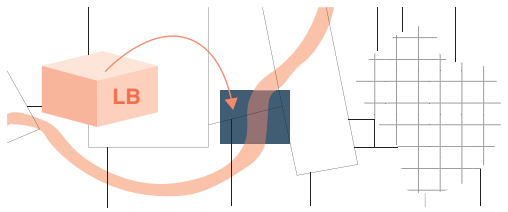
6.0 step
Determine maximum width of the Common Ground
by determining maximum area of agricultural lands, nationinally and provincially distributed



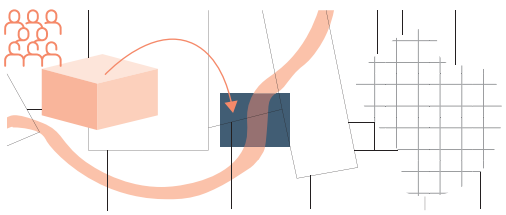
7.0 step
Locate public intersections
intersection of local roads and different landcovers with common ground while interacting with local public life and agriculture



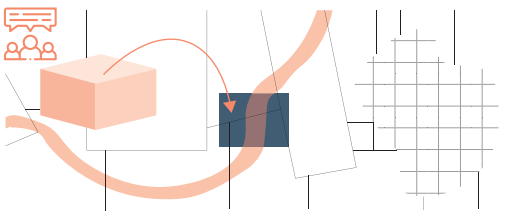
7.1 step
Locate land bank office



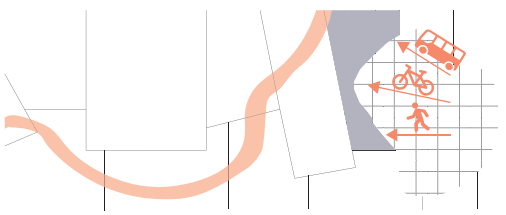
7.2 step | **Locate engagement program**



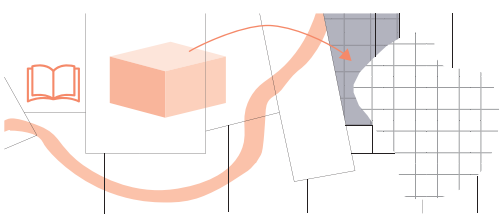
7.3 step | **Locate forums**



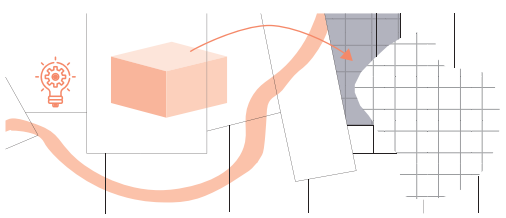
8.0 step | **Determine experimental zones**
close to urban fabric and easily accessible by foot, bike or public transportation



8.1 step | **Locate knowledge center**
1. proximity urban area for better accessibility and need for human resources
2. easily accessible by foot, bike or public transportation

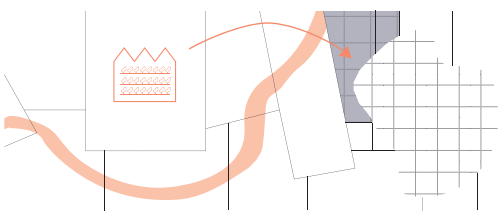


8.2 step | **Locate R'n'D and innovation hubs**
proximity to the urban area for its connections to universities and collaboration with government agencies

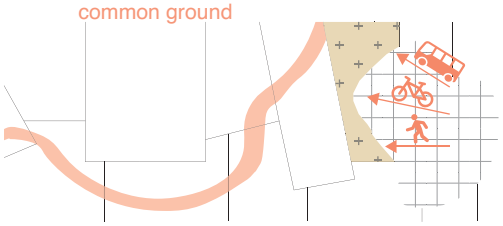


8.2 step | **Locate experimental pixel farming**
1. in the common grounds
2. closer to RnD and innovation hubs and agricultural lands
3. one experimental plot per hundred transitory agriculture plots as a start.

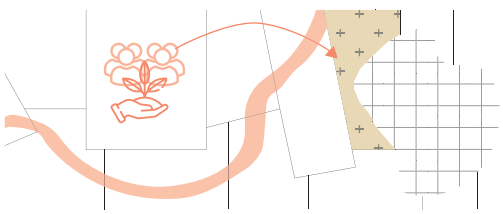
8.3 step | **Locate experimental vertical farming and hydroponics**
proximity to urban fabric or existing artificial farming techniques like greenhouses



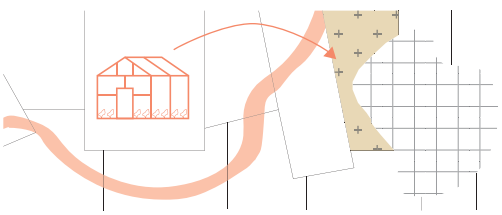
9.0 step | **Determine urban agricultural zones**
1. easily accessible by bike and public transport
2. maximum of 1km away from the city edge
3. connector between urban patch and common ground



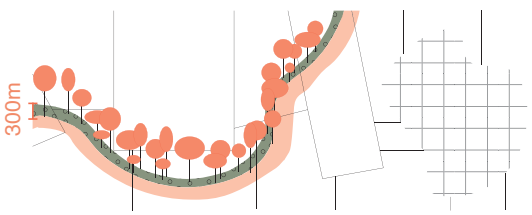
9.1 step | **Locate community farming**
1. interaction with local community
2. maximum of 1km away from the city edge
3. easily accessible by bike and public transport



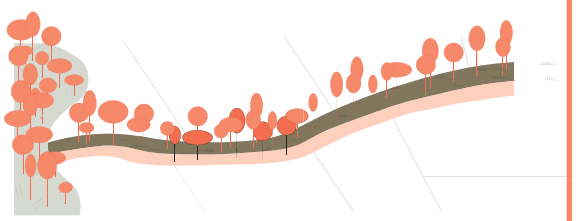
9.2 step | **Locate glass houses**
with a close proximity to urban fabric



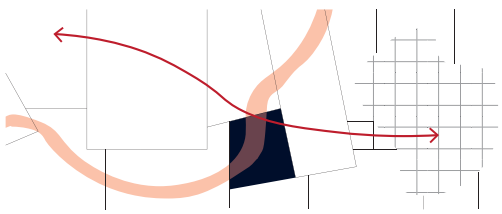
10.0 step | **Include biodiversity strip**
as a continuous element inside the common ground, connecting biotopes based on soil patterns. Minimum width of 300m



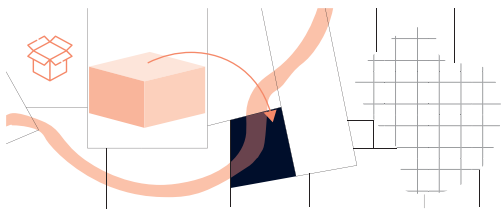
11.0 step | **Locate agroforestry zones**
inside the common ground, closer to naturally vegetated areas while maintaining the continuous biodiversity strip



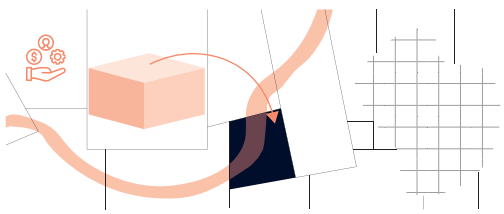
12.0 step
Determine storage zones
1. closer to highways
2. easily accessible to users (farmers) - central location



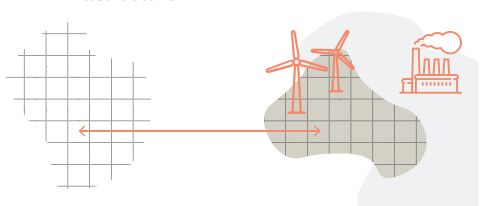
12.1 step
Locate warehouse and storage center
1. closer to highways
2. easily accessible to users (farmers) - central location



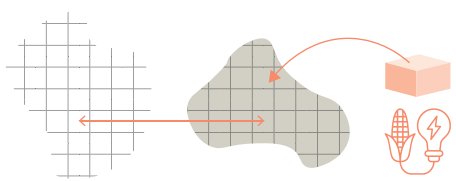
12.2 step
Locate resource bank
1. closer to highways
2. easily accessible to users (farmers) - central location



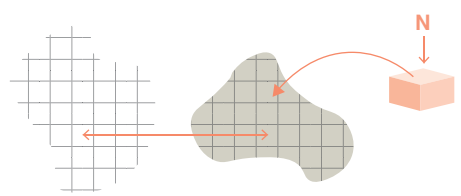
12.0 step
Determine energy landscapes
1. using potential transformable landscapes to energy infrastructure - industrial use
2. closer to urban fabric for the use of energy to minimise transmission losses
3. making use of existing energy infrastructure



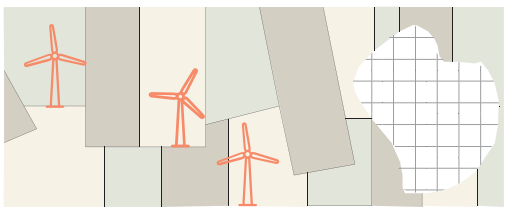
13.1 step
Locate bio mass energy units
1. closer to urban fabric for the use of energy to minimise transmission losses
2. making use of existing energy infrastructure



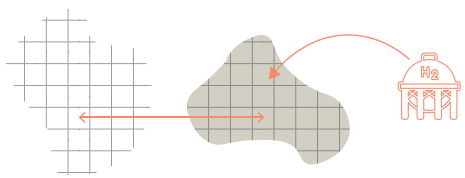
13.2 step
Locate nitrogen extractors
1. closer to urban fabric for the use of energy to minimise transmission losses
2. making use of existing energy infrastructure



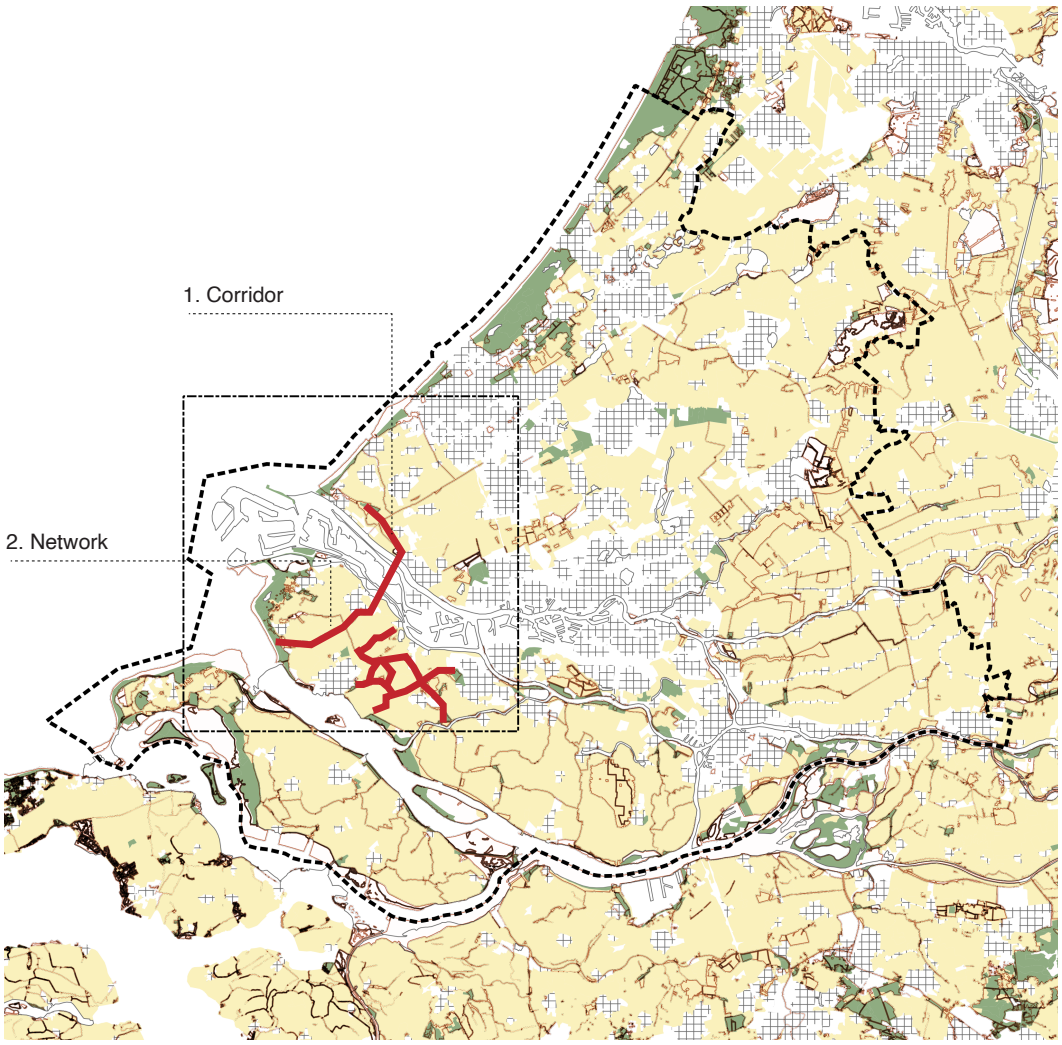
13.3 step
Locate windfarms
inside transitory agricultural patches



13.3 step
Locate hydrogen storage units
1. closer to urban fabric for the use of energy to minimise transmission losses
2. making use of existing energy infrastructure



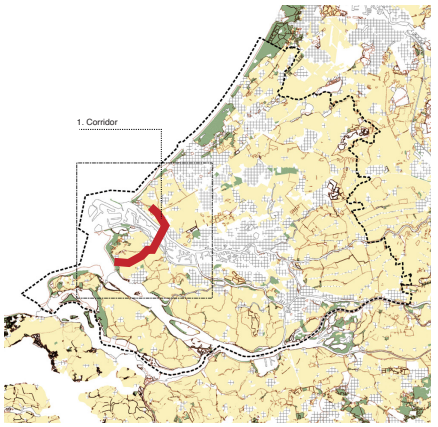
13.4 step
Locate green ammonia production units
1. closer to urban fabric for the use of energy to minimise transmission losses
2. making use of existing energy infrastructure



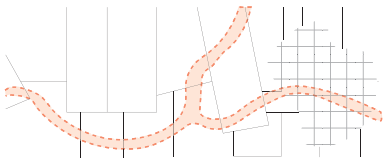
Map of Randstad highlighting the areas for demonstration

Demonstration

The two maps below illustrate a potential outcome of the Operative Strategy for the S-scale of Voorne-Putten, South Holland. Here is the design outcome for two distinct forms - a corridor and a networks. The first map depicts the Proof of Concept for a significant corridor linking two larger natural zones over a greater distance. Here, the port landscape is transformed into a renewable energy landscape that provides space for ecological connections and connects to the Common Ground. The second map illustrates the Proof of Concept when multiple corridors form a network. Here, it becomes clear how programmes are located and distributed across various locations and how the corridor progressively transforms from multi-use to ecological and vice versa.

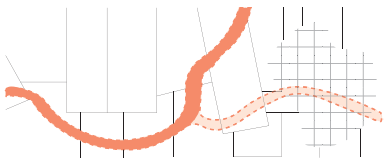


1.0 step | **Determine the common ground**
by using the PEEN network as a backbone

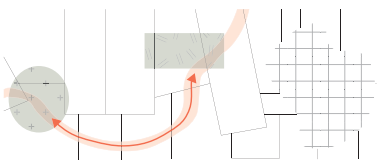


2.0 step | **Determine national agricultural land requirement**
by calculating future food trends

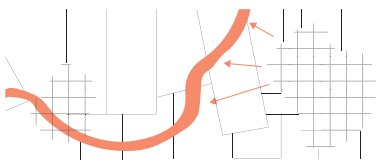
3.0 step | **Modify the network structure where requried**
minimize intersections with urban fabric



3.1 step | **Modify the network structure where requried**
maximize intersections with (different) biotopes



3.2 step | **Modify the network structure where requried**
maximize the interaction with different landcovers



N

0

1

2 km

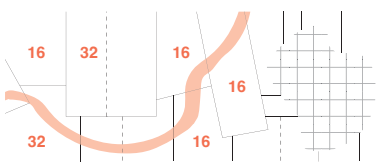
- PEEN network
- common ground
- biodiversity strip
- forest
- grassland
- water
- agro forestry
- algae buffer
- pastures
- leguminous crops
- food crops
- experimental zone
- public intersections
- urban fabric
- urban farming
- energy landscape
- storage zone

Demonstration of the operative strategy on a corridor in Voorne-Putten area

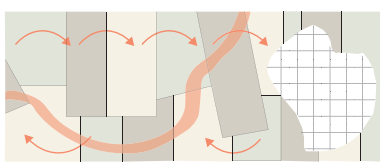
Phase 1
Setting Common ground network

Cartographic and data references
Natuurnetwerk Nederland, 2022
Natura2000, European Environment Agency, 2022
Eurocrop, D'Andrimont, Verhegghen et al., 2021
Corine Land Cover data: Copernicus programme 2018

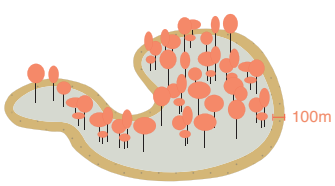
4.0 step — **Determine the agriculture sub-parcels**
in existing agricultural landscapes and based on the multiplex of 16 ha



4.1 step — **Determine the land rotation sequence**
located on current agricultural land and based on soil texture.
25% legumes, 25% pastures, 50% food crops



5.0 step — **Locate algae farms as natural zones buffer**
in natural water around natural areas as remidation buffer zones. Minimum width of 100m and maximum width of 1 parcel



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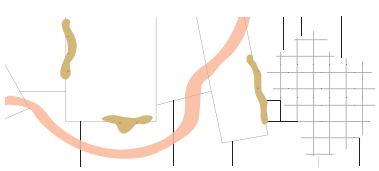
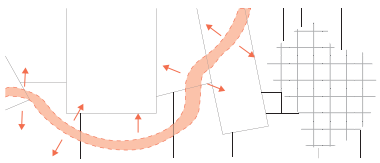
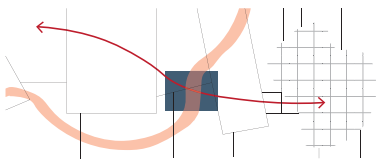


6.0 step — **Determine maximum width of the Common Ground**
by determining maximum area of agricultural lands, nationinally and provincially distributed



7.0 step — **Locate public intersections**
intersection of local roads and different landcovers with common ground while interacting with local public life and agriculture



N

0
2.5
5.0 km

- PEEN network
- common ground
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- forest
- grassland
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Phase 2
Setting the Common ground foundation

Cartographic and data references
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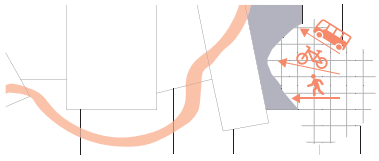
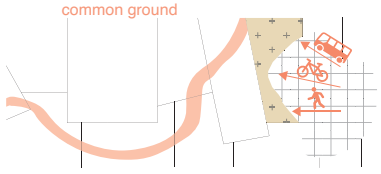
Natura2000, European Environment Agency, 2022
Eurocrop, D'Andrimont, Verhegghen et al., 2021
Corine Land Cover data: Copernicus programme 2018

8.0 step — **Determine experimental zones**
close to urban fabric and easily accessible by foot, bike or public transportation



9.0 step — **Determine urban agricultural zones**
1. easily accessible by bike and public transport
2. maximum of 1km away from the city edge
3. connector between urban patch and common ground



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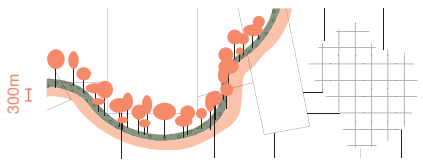
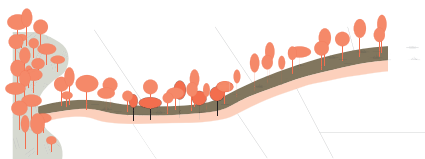
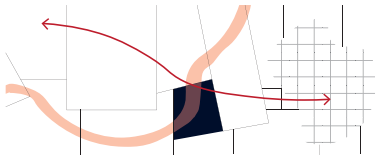
as a continuous element inside the common ground, connecting biotopes based on soil patterns. Minimum width of 300m



11.0 step — **Locate agroforestry zones**
inside the common ground, closer to naturally vegetated areas while maintaining the continuous biodiversity strip



12.0 step — **Determine storage zones**
1. closer to highways
2. easily accessible to users (farmers) - central location



13.1 step — **Locate bio mass energy units**
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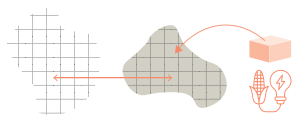

N

0

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Phase 3
Zoning the functions

Cartographic and data references
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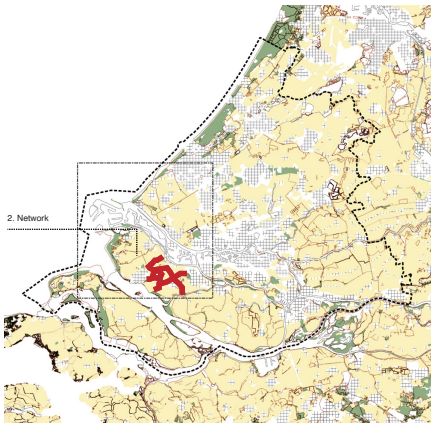

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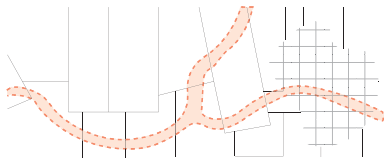

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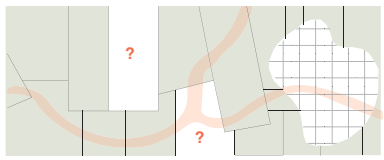

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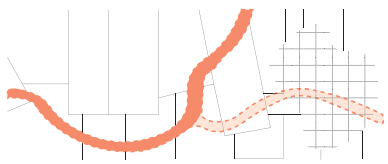

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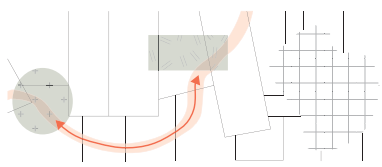

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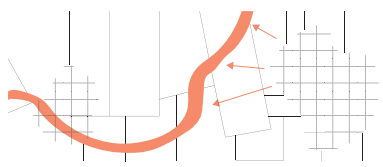

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Demonstration of the operative strategy on a corridor in Voorne-Putten area

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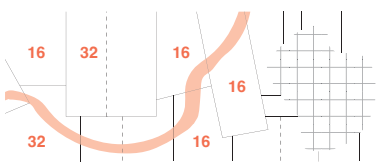

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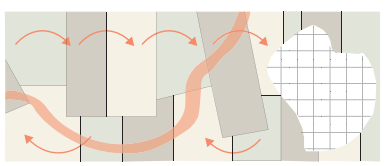

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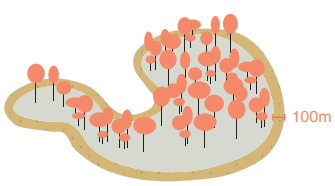

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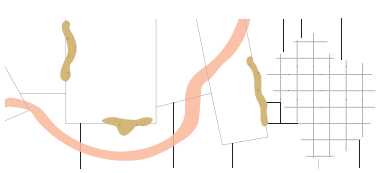

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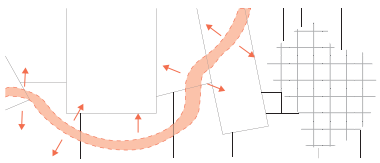

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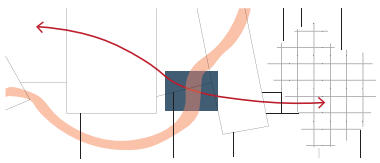

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Demonstration of the operative strategy on a corridor in Voorne-Putten area

Phase 2
Setting the Common ground foundation

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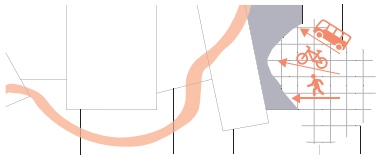

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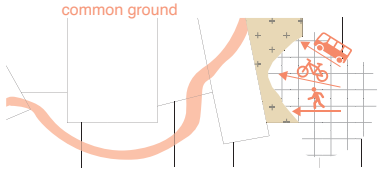

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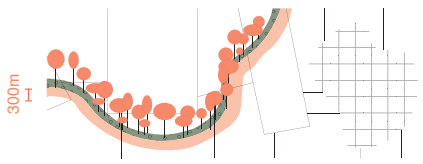

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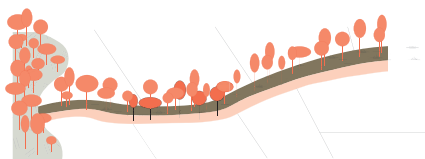

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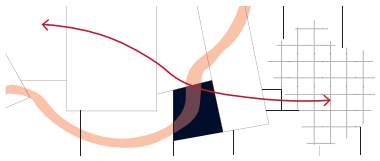

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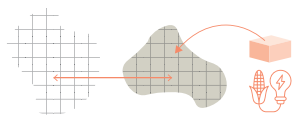

N

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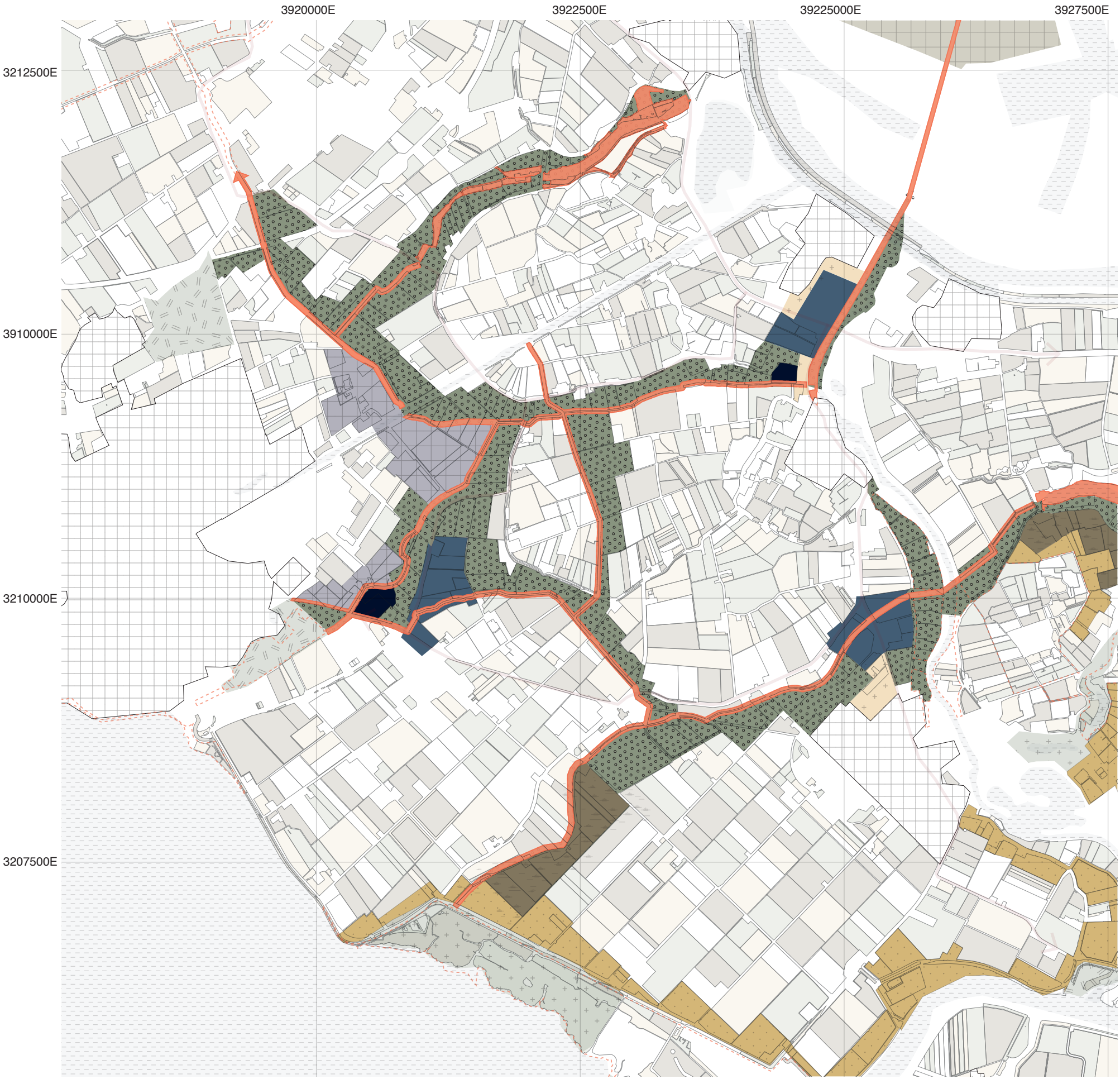
Demonstration of the operative strategy on a corridor in Voorne-Putten area



Phase 3
Zoning the functions

Cartographic and data references
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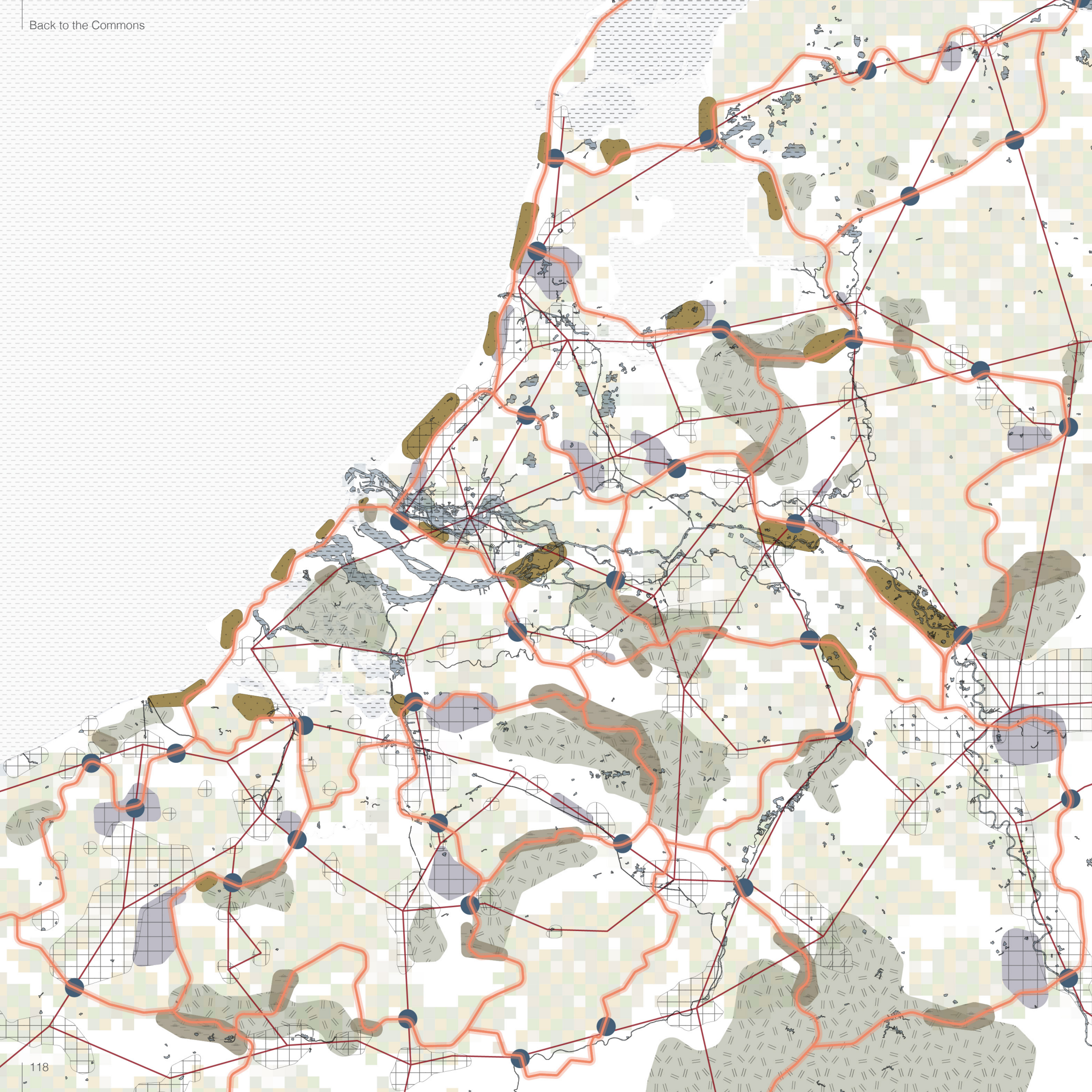
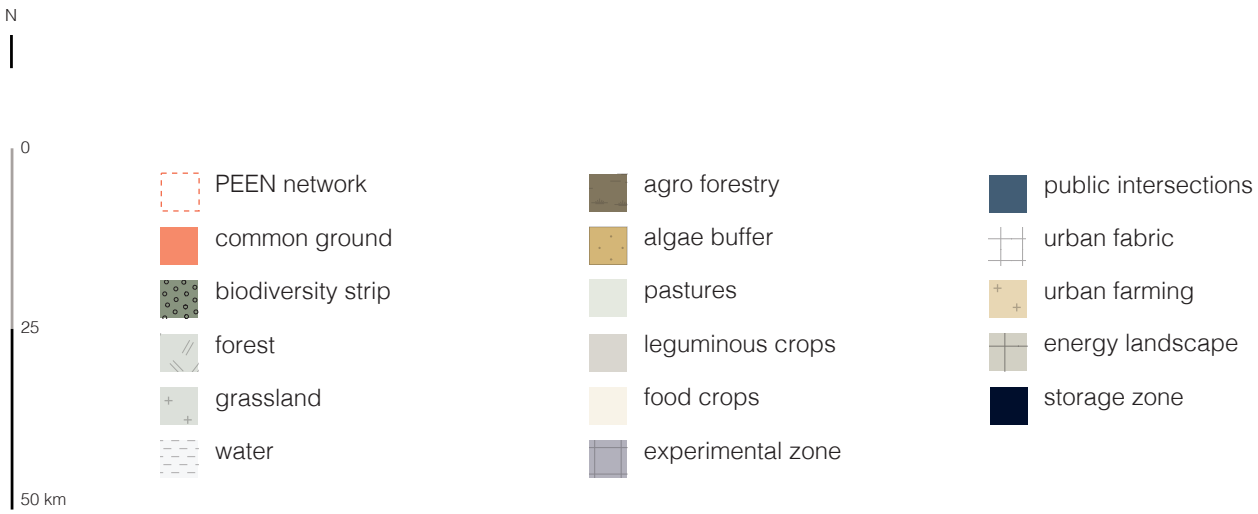


Implication in the Eurodelta

The multiple inventions at the local scales interact with the common grounds nested in the larger network creating a new structure with intersecting patches of different landscapes. The seasonal land rotation practices create a dynamic agricultural landscape. Since the process of planning is iterative and momentary with respect to discussions between the stakeholders in the local scale, the changes will also manifest on the larger scale with the common ground network forming the basis for the transformation. The result of these reactions form the new ever-transforming emerging landscapes.



Emerging landscape patterns
in the Eurodelta scale

Cartographic and data references
Openstreetmaps, 2023
Corine Land Cover data: Copernicus programme 2018

Emerging Landscapes

These images illustrate the potential landscapes that can be created by introducing the Common Ground with its various zones and land rotation. The appearance and functionality of agricultural practices will not change, but the configuration of the various forms of cultivation will adapt to the required land rotation. In addition, the network of biodiversity crossing the current agricultural fields will create a new typology of emergent landscapes. The biodiversity will be very dependent on the progression of succession to shape the appearance of each phase.

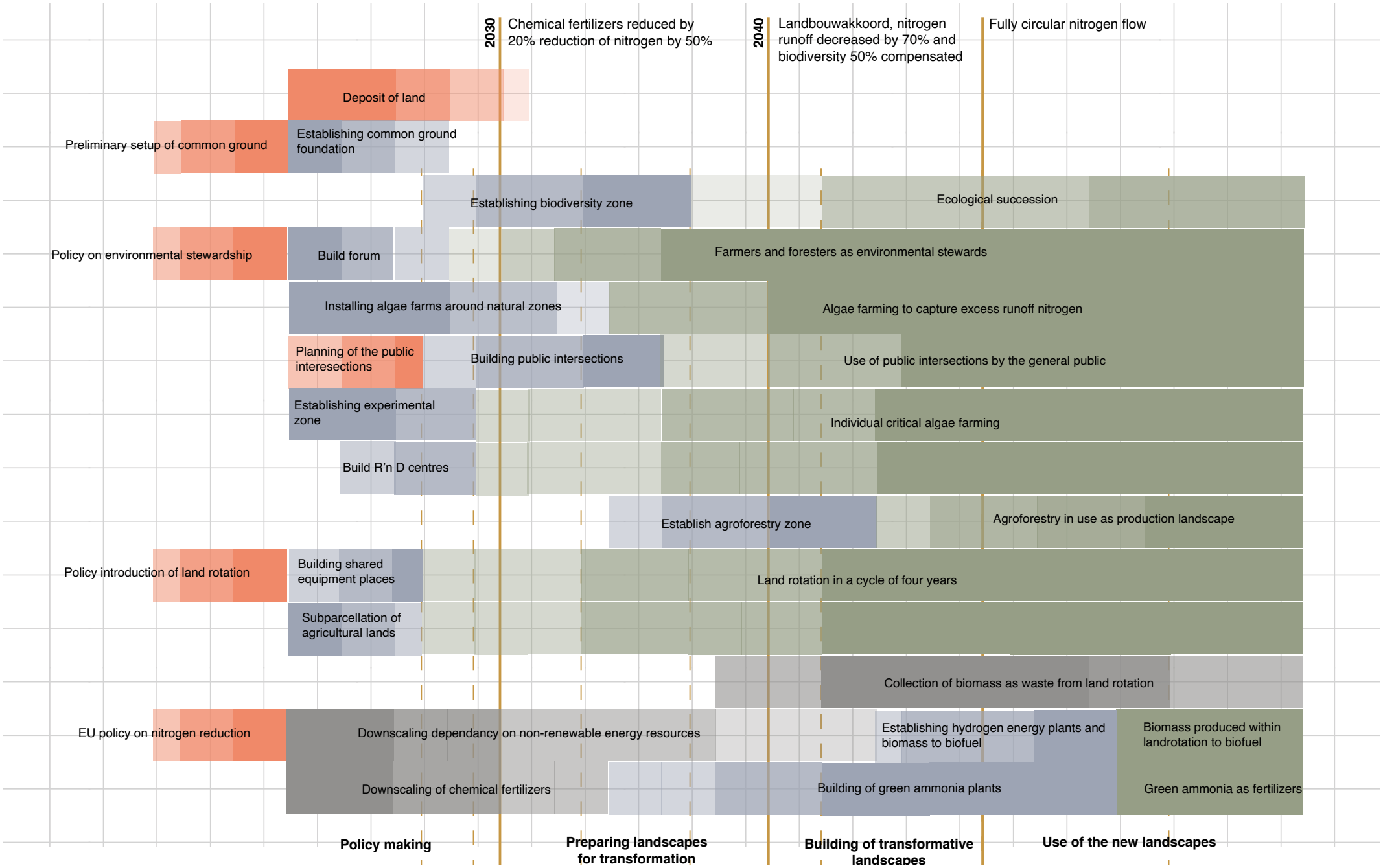

FORUM
PUBLIC INTERSECTION
STORAGE
URBAN FARM
CITY
R.n.D
TRANSITORY AGRICULTURE
BIODIVERSITY STRIP
EXPERIMENTAL FARM

Image references
Daubigny, 2023; Chystiakov, 2020; Sluijsmans, 2022;
Studio Marco Vermeulen, 2015; The green ark Bostanie, 2020


BIODIVERSITY STRIP
AGROFORESTRY
ALGAE FARM
NATURAL ZONE

Image references
Daubigny, 2023; Farr,2018; Meyers, 2019; Overgoor, 2019

Implementation Timeline and Trends

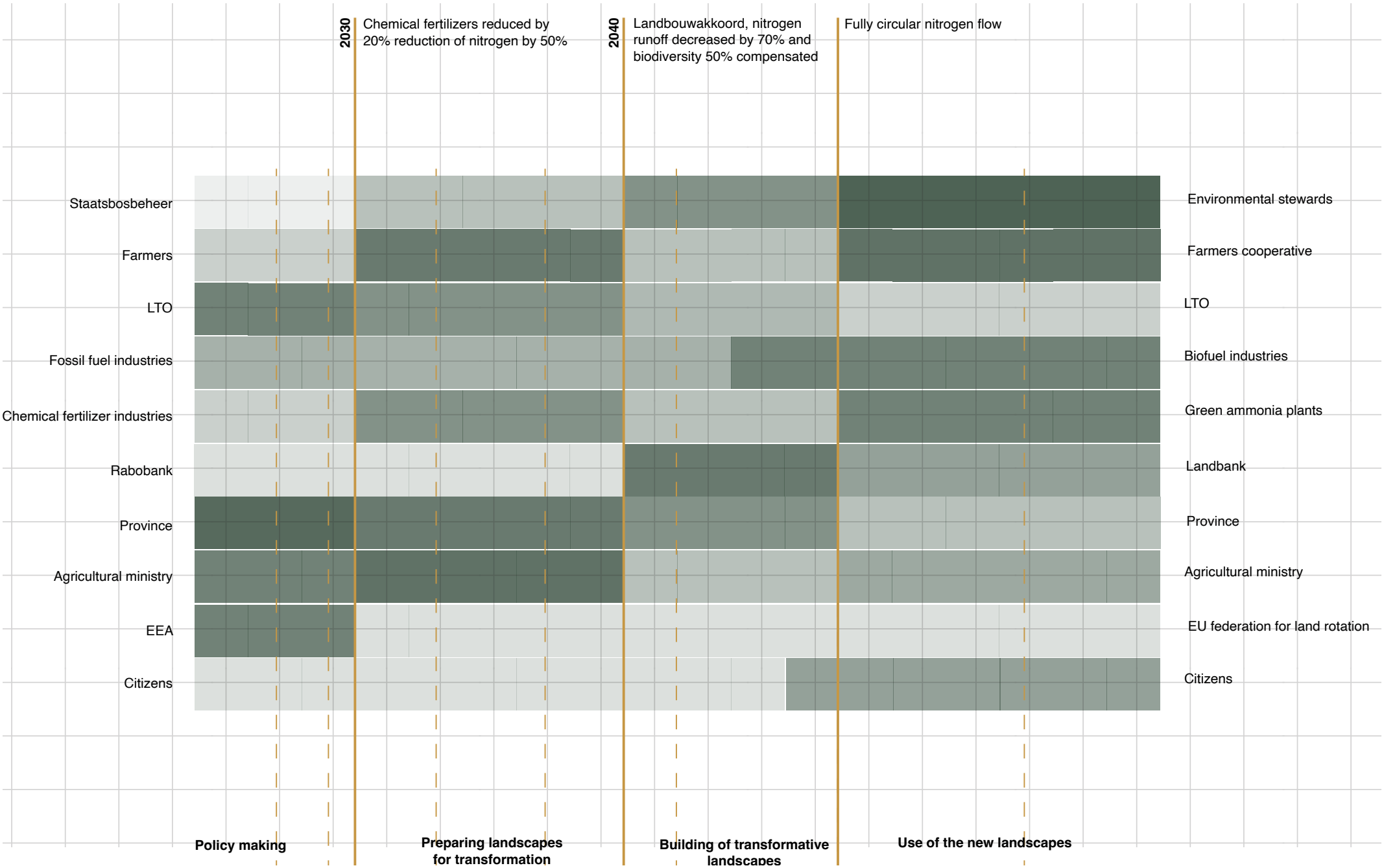


Dynamic project impementation sequence and milestones

Initially, it is essential to recognise that the development process is dynamic and iterative throughout its entirety. This is achieved by continuously involving diverse stakeholders in reflecting on the development and its implementation. The dashed line indicates planned reflection moments that are spaced further apart as the project progresses. The forum, which will be located at public crossroads, will become a place where the public can learn about the new method of agricultural practices and have input on the project. Thus, the project's policies and milestones are determined in advance, but there is ample space for collaboration within this framework.

Secondly, the different colours correspond to the different general actions within the project. To get the whole project started it is important to first open up the necessary space for implementation. Before anything can be built for the common ground, this has to happen. Simultaneously the different zones of the common ground can be planned (red), before being able to build them (blue) and finally being able to use them in the way they are meant to (green).

Thirdly, the timeline indicates when certain project steps should be concluded as milestones. These are the result of a 2022 EU directive mandating a 50% reduction in nitrogen emissions by 2030 and a 20% reduction in chemical fertiliser use. The objective of the initiative is to establish a fully circular nitrogen cycle in which there is no harmful excess nitrogen from agriculture. The Netherlands is currently working on a nationwide agricultural agreement focused on how to tackle the future challenges of agriculture, keeping in mind climate change, biodiversity loss etc (Ministerie van landbouw, natuur en voedselkwaliteit, 2023). Since no goals have been specified yet, the liberty has been taken to formulate a few in line with the timeline, a decrease in nitrogen runoff of 70% and a compensation of the current rate of biodiversity loss by 50%, both by 2040. The final goal of the project, and thus the end of the timeline will be the fully circular nitrogen flow, resulting in only a small amount of nitrogen runoff caused by agricultural practices, that can be countered by the critical algae toolkits that farmers will be able to use to extract excess nitrogen out of the waters. Also, fragmented biotopes will be reconnected after 50 years of secondary succession, which is the re-establishment of biodiversity following a natural or anthropogenic disturbance (Discovery education science, 2010)



Comparison between the timeline and stakeholder involvement and transitions

The comparative timeline concentrates on connecting the pertinent actions to the milestones and displays the required sequence of these actions. The purpose of creating this map of stakeholder involvement is to determine the function of the stakeholders. This demonstrates not only the changing responsibilities of the stakeholders, as shown in the stakeholder analysis, but also the changing relevance and involvement over time. For optimal comparison, the same landmarks are used as on the timeline.

Initially, this diagram demonstrates that government institutions are heavily involved in the earliest phases of project development. They possess the authority to make policy decisions and the means to initiate the project. As the project progresses, however, the farmers, foresters, and other individuals who will utilise the common ground and land rotation will become more involved.

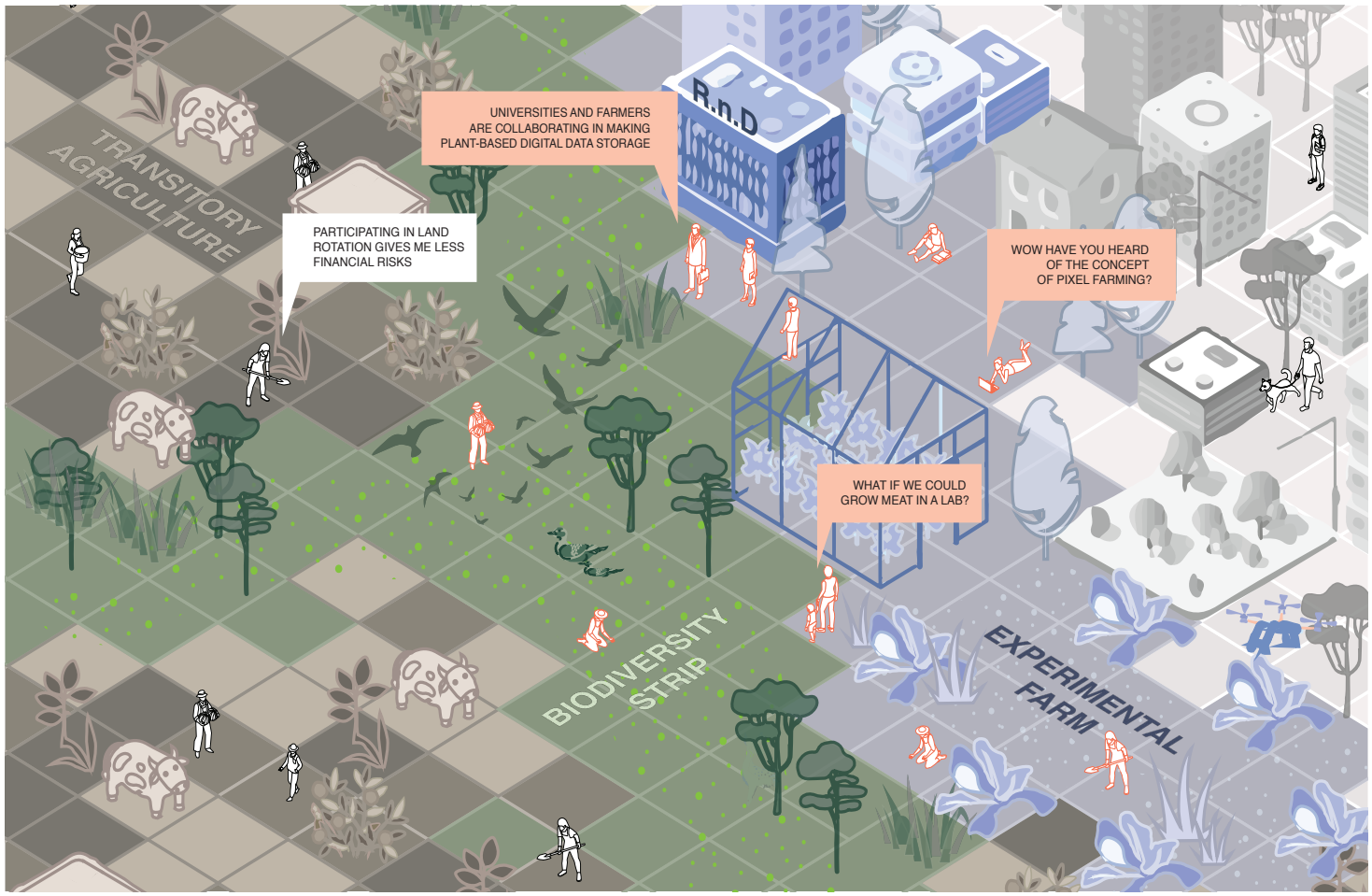
Another trend that can be observed from this diagram is how agriculture is decentralised over the course of the project. Meaning to say that stakeholders who hold a lot of power in a centralised way will decrease in power once local production and consumption are more stimulated through the new way of agriculture. That means that the LTO, the farmers union, will have a lot of influence in the beginning phases of setting the new rules and regulations, but as production becomes more local, their involvement will decrease.

On the other hand, farmers will organise into the smaller cooperatives needed for effective land rotation.

A final observation pertains to the stakeholder who is not a key stakeholder in the beginning but turns out to be one over the course of time. These are the citizens. At the start, the whole project was still focused on reshaping agriculture and thus mostly included the production side of agriculture and not the consumption side. As the project progresses, though, citizens become an increasingly important component. They will be responsible for urban farming, obtaining employment in the experimental farming zone, and strolling through the common grounds over public intersections. It is important for them to understand what is occurring in agriculture, how their local food is produced, and how they can participate. Through forums, the involvement of citizen participation as part of the development of the Common Ground is established as part of the public sphere.

Reflecting on Socio-spatial Justice


AS A FARMER I FEEL HEARD THANKS TO THE FORUM
FORUM
PUBLIC INTERSECTION
LUCKILY I CAN GET SOME EQUIPMENT FROM THE RESOURCE BANK TO START GROWING BEANS
LETS GET A VIEW OF THE COMMON GROUND KID
STORAGE
URBAN FARM
I HAVE LEARNED SO MUCH ABOUT THE SOIL WHILE MAKING NEW FRIENDS
WE WILL VISIT THE EDUCATION CENTER IN THE COMMON GROUND LATER KIMBERLY
CITY


TRANSITORY AGRICULTURE
PARTICIPATING IN LAND ROTATION GIVES ME LESS FINANCIAL RISKS
UNIVERSITIES AND FARMERS ARE COLLABORATING IN MAKING PLANT-BASED DIGITAL DATA STORAGE
R.n.D
WOW HAVE YOU HEARD OF THE CONCEPT OF PIXEL FARMING?
WHAT IF WE COULD GROW MEAT IN A LAB?
BIODIVERSITY STRIP
EXPERIMENTAL FARM

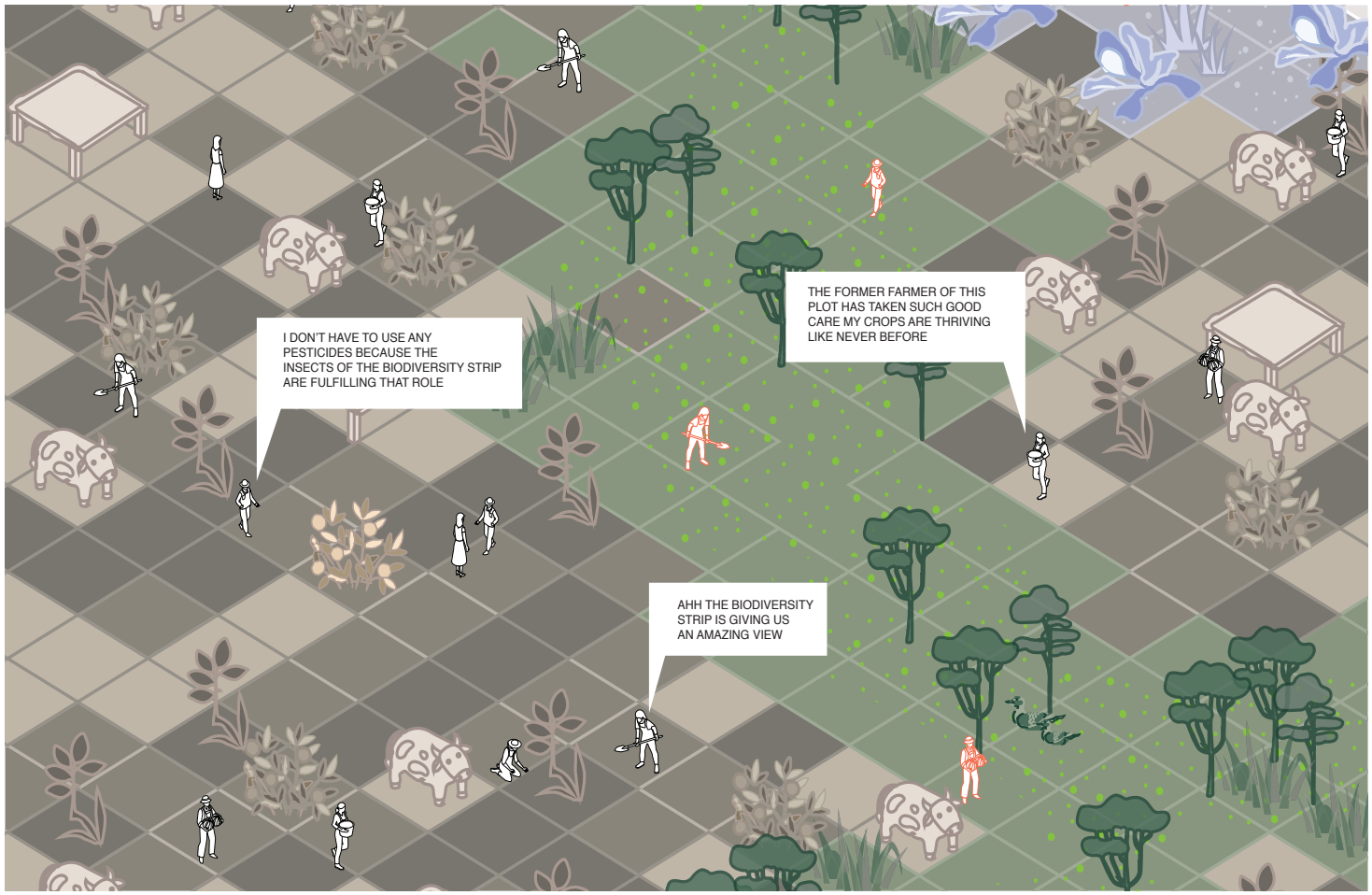
Public goods what we create are something the society as a whole builds on transforms around. We find that creating land as a common good as it was working in the past is a sustainable way to address the key issues related to pollution, respect for nature and thus climate change. We find that in transitioning to a more sustainable future, the idea of the non-urban is also as important as the urban. There is not a single space in the world where humans haven't set foot to.

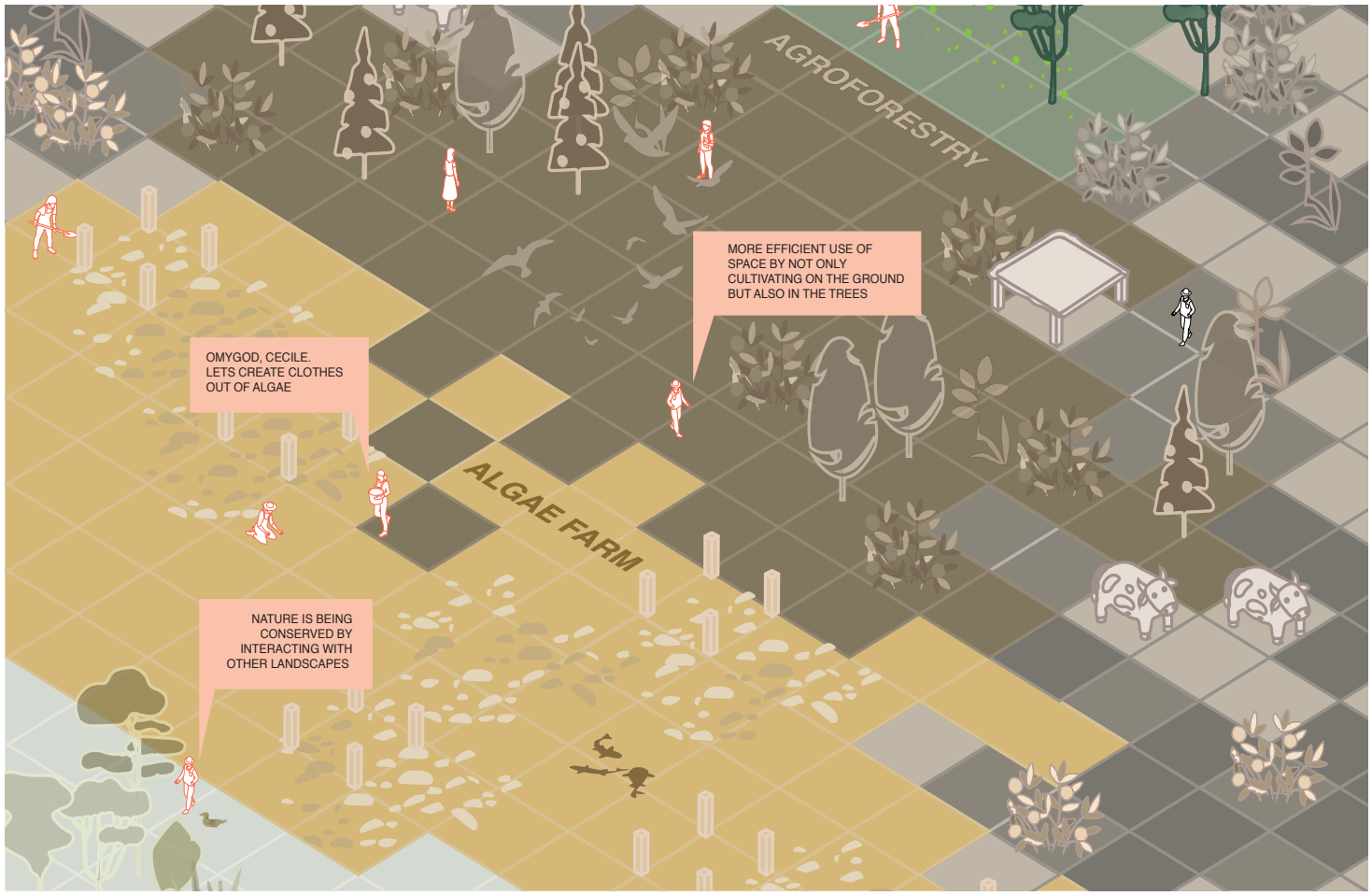
Agriculture practices are, aside from the industries, contributing the most to excessive nitrogen pollution, resulting in homogeneous fragmented landscapes all throughout Europe. They are the biggest polluters of nitrogen causing biodiversity loss and monocultures. As seen in many news articles of the Netherlands over the past year this has led to a big revolt from the farmers side, clearly portraying a conflict in planning, design and implementation process. The problem being that the different stakeholders that would have to work together for a successful collaboration were not involved in the process and thus did not have the opportunity to align their interests. The result of these single handed, top-down decisions was a social spatial injustice, depriving a large part of the agricultural sector.

The introduction of the common ground foundation with its forum, and the formation of farmers cooperatives will create a way for all directly involved stakeholders to get together and discuss. This might naturally still lead to conflict possibly used to help bring the discussion to another level. It polishes the idea at hand so to say, making the result more fitting to all the different interests and creating a more intrinsic motivation of the stakeholders to cooperate within the realisation of the plan.

The transition of agriculture is necessary to be able to maintain this way of cultivation in the long term. As seen earlier, agriculture takes up a lot of land, and this in combination with the pollution and fragmentation it is causing, it is under a lot of stress. This project on the introduction of common ground and land rotation provides a possible solution, but it is one that requires the cooperation of the farmers. The incentives for farmers to join are the need for change, and the intrinsic motivation to act as an environmental steward. Also the introduction of common grounds, and thus the idea of the commons together with the land bank and farmers cooperatives, decreases the overall risk one farmer carries. Farming turns into the much more social practice that it once was. Farmers cooperatives can also be used for farmers to meet each other and exchange ideas.

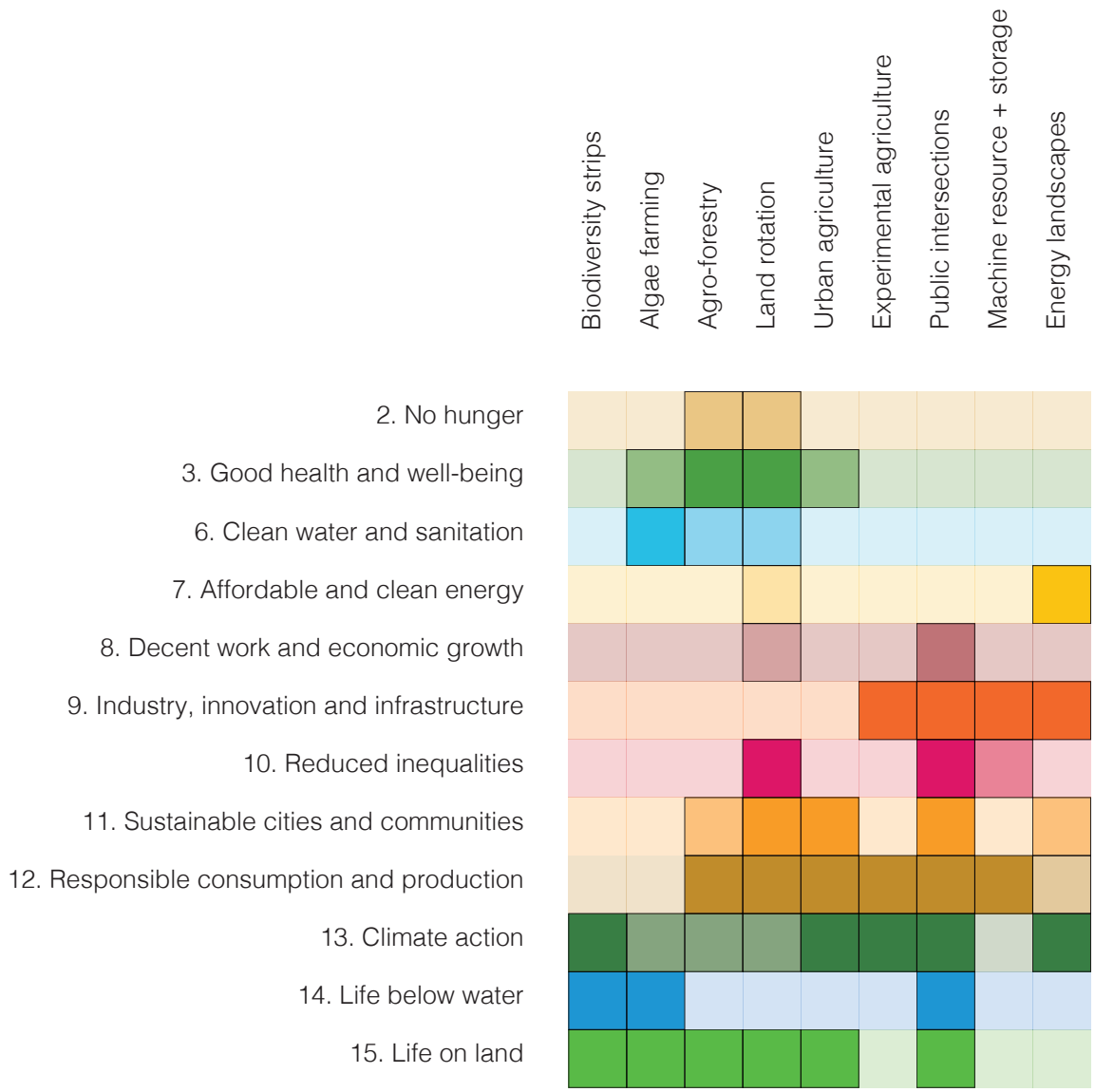
The focus governance within this project should provide directly involved stakeholders with a motivation to collaborate and work towards a solution for the biodiversity loss and nitrogen pollution through agriculture in a socially just way.


I DON'T HAVE TO USE ANY PESTICIDES BECAUSE THE INSECTS OF THE BIODIVERSITY STRIP ARE FULFILLING THAT ROLE
THE FORMER FARMER OF THIS PLOT HAS TAKEN SUCH GOOD CARE MY CROPS ARE THRIVING LIKE NEVER BEFORE
AHH THE BIODIVERSITY STRIP IS GIVING US AN AMAZING VIEW


AGROFORESTRY
MORE EFFICIENT USE OF SPACE BY NOT ONLY CULTIVATING ON THE GROUND BUT ALSO IN THE TREES
OMYGOD, CECILE. LETS CREATE CLOTHES OUT OF ALGAE
ALGAE FARM
NATURE IS BEING CONSERVED BY INTERACTING WITH OTHER LANDSCAPES

Integral Policies

The combination of existing EU and national policies, as well as some suggestions for policies concerning the establishment of a common ground and the introduction of land rotation, will serve as the framework for reforming the agricultural sector and contributing to the achievement of the sustainable development goals.



Spatial elements adressing
United Nations SDGs

Current Policies

Agricultural subsidies are one of the largest cost items of the European Union, with 66% of the total European Union budget spent to agricultural practices in 1980 and 31% in 2023 (European Parliament, 2023). This part of the budget is meant for the Common Agricultural Policy (CAP), which is mainly focused on supporting farmers in having a steady income they can live off and simultaneously tackling climate change and the sustainable management of natural resources (European Commission, 2015). With current agricultural practices contributing largely to nitrogen pollution, the reasoning behind these subsidies is something that can be critically questioned.

Through the introduction of a new way of farming, sustainable, circular, local and socially just ways are incorporated that align with the principles of the CAP.

On a national level there is the policy "*Wet natuurbescherming en de omgevingswet (stikstofreductie en natuurverbetering)"* on nitrogen reduction for agricultural fields threatening an excess of nitrogen around the Natura2000 areas (Staatsblad van het Koninkrijk der Nederlanden. 2021). This policy, as seen at the beginning of this report, caused a lot of anger. The problem that this policy causes is that it requires the agricultural sector to reduce nitrogen with an almost impossible amount. The option left for farmers is to agree to be bought out of their farm. In essence this policy is in line with the project, where a complementary way of the reduction of nitrogen is found to maintain the practice of intensive farming but to also stick to the goals the government has set for the reduction of nitrogen.

Future policies

To guarantee a successful project a few new policies will have to be introduced. Ideally the boundaries for these policies are set in collaboration with the key stakeholders. The main structure of the suggested policies will be set on a bigger scale, but must be specified locally.

First it is important to gradually reduce the production fitting the more local requirements of the Netherlands. A lot of produce is exported at the moment, the goal would be to produce local and consume local. Policy will have to create incentives for the agricultural sector to do this, by for example increasing tariffs on export outside of the European Union.

Secondly, the introduction of the land bank system should be guided through policy to start the process of land rotation. Similar policy should also provide incentives (maybe through subsidies) for farmers to act as environmental stewards and take responsibility for increasing and maintaining diversity within the newly established common grounds. This will be one of the policies made where it is important to include the people that will take an active role in maintaining the common grounds. These will be the farmers and the foresters.

Lastly, the policy of creating a land bank should be assisted by a policy on spatially rotating function of land to reduce monocultures. This should include plants that on the one hand take nitrogen out of the soil alternated with plants that fixate nitrogen within the soil. This way a more natural balance of nitrogen within the soil can be found, and the nitrogen run-off can be reduced. This policy could be set in the reduction of nitrogen in numbers, in combination with establishing the way the different types of cultivation of land should be rotated.

The impact of this project will touch upon the following SDG goals:

- 2. No hunger
- 3. Good health
- 6. Clean water and sanitation
- 7. Renewable energy
- 8. Good jobs and economic growth
- 9. Innovation and infrastructure
- 10. Reduced inequalities
- 11. Sustainable cities and communities
- 12. Responsible consumption
- 13. Climate action
- 14. Life below water
- 15. Life on land

The following image shows the relevance of the SDG's linked to the spatial elements of the common ground network. This project is a very broad one. Not only focusing on mitigating the physical issues of biodiversity loss and nitrogen pollution, that touch upon points 3 (good health), 6, (clean water and sanitation), 13(climate action) and 14 (life below water), but also focus on the social spatial injustice caused by top-down enforced policies, which is touching upon the points 8 (good jobs and economic growth), 10 (reduced inequalities) and 16 (peace and justice). Simultaneously touches agriculture upon the entire food chain, where it is an important part in the production of food, and thus is very relevant for point 2, no hunger, but also point 12, responsible consumption. The introduction of the common ground, especially the public intersections created touch upon the point of 9, innovation and infrastructure. Lastly, the creation of a circular nitrogen flow touches upon the points of 7, renewable energy and 11, sustainable cities and communities.

Some SDG goals carry more weight within the project than others. Some are more clearly integrated within the project such as point 9, innovation and infrastructure, point 13, climate action and point 14, life below water and 15, life on land. Other goals are more touched upon within this project and were not the main goal of improvement. What is interesting when looking at the sub-goals of each SDG is that a lot of subgoals seem to align with point 12, responsible consumption, which is not really the focus of our project but does seem to be a welcome outcome, and point 15, life on land, which is one of our main objectives.

A more in depth reflection upon the SDG's is included within the appendix.

Conclusions

Recommendations for Upscaling
Providing Answers
Suggested Policies for EU and PZH
Limitations of the Project

6

Concluding, the in-depth research on current agricultural practices causing biodiversity loss and nitrogen pollution led us to an integrated approach to reform both agricultural practices and the way this is governed. The following part will recap the conclusive answers on the main research question and its sub questions.

Recommendations for upscaling

Several suggestions are available for expanding the project to combat nitrogen pollution and biodiversity loss. These ideas are meant to increase the project's overall efficiency, impact, and significance:

Collaboration and partnerships: Establish robust collaborations and partnerships between relevant stakeholders such as governments, businesses, academic institutions, NGOs, and local communities.

Knowledge sharing: facilitate the exchange of information, research results, and novel approaches to addressing nitrogen pollution and the loss of biodiversity by creating forums and channels for doing so.

Integrated Policies: Collaborate with policymakers to ensure that the project's recommendations are incorporated into relevant environmental, agricultural, and land-use policies at multiple levels (local, regional, and national).

Financial support: Receive public and private funding to scale up the project's recommendations. Encourage stakeholders to adopt sustainable practices and technologies that address nitrogen pollution and biodiversity fragmentation by offering subsidies or tax breaks.

Monitoring and evaluation: Create thorough systems for monitoring and evaluating the project's status, outcomes, and strengths and weaknesses. Keep tabs on the project's progress and results.

Public awareness and engagement: Engaging the public can build support and create a sense of shared responsibility for addressing the dual crises.

Technological innovation and research: Encourage research and development of innovative solutions to address nitrogen pollution and biodiversity fragmentation and support the scaling-up of successful pilot projects.

If these suggestions are implemented, the project will be able to scale up effectively, making a bigger dent in the global, national, and regional crises of nitrogen pollution and biodiversity fragmentation.

Providing answers

When it comes to answering the main research question and the sub-questions of this report, the answers can be summarized as following:

Answering the Main Research question:

"How to transition agricultural practices to revitalise biodiversity in a socially just way?"

Through the establishment of agro-ecological networks that spread throughout Northwestern Europe, a Common Ground is erected that finds synergies in enlarging ecological connectivities and establishing sustainable modes of agriculture. By making use of existing agricultural land plots that account for the majority of Europe's land cover, multi-functional land uses are introduced that transform current homogeneous and monofunctional landscapes into regenerative ones and contribute to the enrichment of biodiversity. Simultaneously, current agricultural practises are radically transformed through the extension of the farmer's role to that of environmental steward, sharing responsibility in ecological connectivity with the forestry, while land- and crop rotation, agroforestry, and the sharing of resources, knowledge, and financial risks contribute to a sustainable palette of agricultural practices while safeguarding important underlying social and cultural structures.

By utilising active citizen participation throughout the development and implementation of public engagement zones, a transparent and democratic mode of governance is established that supports and encourages a diverse array of stakeholders to actively participate in decision-making. In this way, horizontally-functioning multilevel governance can facilitate spatial justice.

Answering Research Sub-question(s)

"Which land covers contribute the most to nitrogen pollution?"

Erected maps clearly visualized how atmospheric nitrogen pollution was most evident at petrochemical, industrial landscapes while nitrogen pollution leaching into groundwater as well as nitrogen runoff into water was most evident at agricultural- and pasture landscapes.

"Which parts of Northwestern Europe contribute mostly to nitrogen pollution?"

The Netherlands, Germany, Belgium and large parts of France and the United Kingdom contribute the most when it comes to nitrogen pollution of Northwestern Europe.

"What are the nitrogen polluting processes that are happening in the current landscape?"

In the current landscapes of the Eurodelta area that is under investigation in this report, the nitrogen polluted processes that are happening are mainly connected with activities from the industrial and agricultural sector such as fertiliser production, keeping cattle and the waste that they produce and energy production.

"What are the socio-spatial implications of nitrogen pollution in the current landscapes?"

Current policies regarding the handling of the nitrogen pollution crisis are unequally distributed among the variety of emitters, focusing largely on agricultural practices. Here, important industries and the critical questioning of existing (international) flows and food demands are overseen. Current agricultural practices are the result of policies, high economic competition, and high competition for land. This, coupled with indecisive and non-inclusive decision-making throughout history, has led to tension and frustration among farmers. A complete, inclusive, and critically reflective holistic view is currently missing that includes the complex underlying social and cultural structures that are linked to agricultural practices and needed to find solutions for the existing nitrogen crisis.

"How can you make the nitrogen landscapes circular?"

The nitrogen cycle has been made circular through reduction, localization of production, application of nitrogen through land rotation, and utilization of crop biowaste for energy production. Nitrogen can be kept in a local cycle by using nitrogen fixation and nitrogen-absorbing cultivations in land rotation. The nitrogen runoff captured by algae can be recycled for green ammonia that can be used as fertilizer by greenhouses. Additionally, the carbon dioxide that is released during the production of bioenergy can be caught and used in greenhouses as well.

"How does the role of the farmer change within a circular nitrogen landscape?"

To tackle the social spatial injustice for farmers created by nitrogen reduction policies, the concepts of land rotation and common ground network have been introduced. This will change the way current agriculture works, but ensures a more valued position within society for farmers. Agriculture will transform into a cooperative where land is rotated to diminish the necessary amount of nitrogen fertilisers. To reduce the impact of fragmentation, the common ground network is introduced, creating an additional role for farmers as environmental stewards. Another addition to the expertise of farmers will be the critical algae farming toolkits, to be able to create a circular nitrogen flow farmers will contribute to this by checking the waters around their fields for excess nitrogen and making use of algae farming when deemed necessary. This way, all the nitrogen introduced to the nitrogen flow, is recycled in the end.

Suggested policies for EU and PZH

EU Policies:

a. Provide financial resources and research, by establishing a fund to support the implementation of the Common Ground network and regenerative agricultural practices.

b. Increase access to agro-ecological learning opportunities like workshops, and field trips.

c. Reward farmers who work towards conservation and environmental degradation by revising agricultural subsidies to encourage the adoption of regenerative agricultural practices and the establishment of Common Ground networks.

d. Encourage cooperation between EU nations so that information about regenerative agriculture and the Common Ground alliance can be shared more efficiently.

National Directives Policies:

Maintain focus on local food supply- and demand by introducing tariffs policy on the export and import of agricultural products in Europe.

Extending responsibilities of local farmers to contribute to a balanced ecological network and re-establishing a rich biodiversity through the introduction of policy regulating the responsibilities and distribution of environmental stewards

Policy introducing a four year cycle of agricultural land rotation

Maintaining a horizontal, multi-level governance by introducing policy on the grouping of farmers in farming cooperatives

Policy on formal and informal evaluation moments

Province of South Holland Policies:

a. Connect biotopes for multiple purposes by giving local Common Ground networks technical and financial support.

b. Create opportunities for local farmers to come together and talk about their experiences with regenerative agriculture and the Common Ground network.

c. Create land-use policies that will help prioritise and sustain the Common Ground network's development.

d. Establish a system for tracking the progress and effectiveness of the Common Ground network and related policies in South Holland by establishing a monitoring and evaluation system.

e. Improve regenerative farming methods and the Common Ground network idea through joint research with academic institutions.

In conclusion, the recommendations made for the European Union and the Province of South Holland aim to promote the establishment of a regenerative agro-ecological network to address the problems of landscape fragmentation, biodiversity loss, and social injustice among farmers. By providing incentives for regenerative agricultural practices, encouraging collaboration, and placing a premium on the conservation of biodiversity, these suggestions aim to create a sustainable, environmentally responsible, and socially just agricultural landscape. By adopting these measures, the European Union and the Dutch province of South Holland will help create a landscape that is better able to withstand environmental and social stresses.

Limitations of the project

Complex societal concerns are addressed by networked/multi-level governance. It factors in a wide variety of players, objectives, and potential partnerships. Nonetheless, this situation may create tensions between the various stakeholders and actors involved. As a result, it is more challenging to align these interests and reach conclusions that can be put into action. Communication across the many parts of government is another issue raised by networked/multi-level governance. Due to their decentralized approach to problem solving, many components can evolve at their own rates. This could make it harder to uphold the government's core values as a whole, while also benefiting some groups at the expense of others. Another potential issue is citizens not knowing where to direct their complaints. With a clear chain of command in place, everyone knows who to go to with any issues or queries. This may be more challenging in a system of networked, multi-level governance.

Methodological challenges include the possibility that a comprehensive framework to combat nitrogen pollution and biodiversity loss may require the merging of formerly distinct disciplines of study, methodologies, and models. Using an interdisciplinary approach may make it difficult to ensure that the project's results are consistent and well-founded.

Engaging stakeholders: For the project to be successful, many various groups, including governments, businesses, farmers, and communities, will need to provide input and support. It can be challenging and time-consuming to ensure that everyone's concerns and suggestions are considered. Even if the project's vision and framework are well-developed, implementing the intended solutions may present obstacles. Potential impediments include inadequate resources, a lack of political will, opposition from stakeholders, financial risks and regulatory constraints.

Some proposed solutions may have unintended consequences, such as unfavorable societal repercussions or trade-offs between diverse environmental objectives. To ensure the long-term success of the endeavor, it is essential to identify and mitigate these potential negative effects.

Future changes and uncertainties: The project may need to prepare for future changes in areas like climate, technology, and social and economic conditions. These unknowns may influence how well the proposed solutions work, necessitating regular adjustments and reviews. For the project to be successful and have a lasting impact on reducing nitrogen pollution and biodiversity fragmentation, it is essential that these constraints be recognized and dealt with throughout its duration.

Land rotation: In this project, the idea of land rotation lacks a comprehensive chemical theoretical foundation. More details about the precise amounts of nitrogen added or absorbed by each agricultural practice are required. It is conceivable that in the system as it is currently designed, some agricultural practices will add more nitrogen than would be absorbed the following year. Since, in practice nitrogen fixation and absorption is a very context and time specific matter. Furthermore, this chemical theoretical framework would also give an insight on other agricultural practices that can be used, since the current system is only limited to four different types. Another point to take into account is that land rotation is only possible if multiple agricultural practices can cultivate on the same soil texture. This might not be applicable in every location. And lastly land rotation also provides opportunities to include other nutritional values than just nitrogen to ensure soil quality.

Future food consumption: This project is stimulating the consumption of local and seasonal goods. Nevertheless, this project has not taken into account the effects of consumption. Future food demands for the Netherlands have been predicted, but more investigation is required. Moreover, it is plausible to say that in this system farmers must find a balance between the demand of consumers while finding the right crop that can perform its nitrogen balancing task. Customers may need to change their diets, one that is most likely high in legumes. A consumer diet shift that triggers controversy may make things difficult for farmers because they become limited in the goods they can produce.

Future policies: Suggested policies are made that fit and accompany final spatial design solutions to accomplish a more circular, sustainable and socially-just answer to the nitrogen crisis. However, as spatial designers, this is not our area of specialization. The proposed policies must therefore be seen as suggestions that need critical reflection and adjustments. Important aspects such as citizen-participation, multi-level governance and horizontal policy making should remain central when defining future policies.

Reflections

Collective Reflection
Individual Reflections
Kirthan Shekar
Nancy Nguyen
Stefania Saridou
Raven van der Steen
Willemjin Hoogland

7

Collective reflection

Existing attitudes of exploiting natural resources for human goods have resulted in a disruption of balance in ecosystems on various scales. In this project, we tried to assemble a way to find solutions for the existing nitrogen crisis. However, throughout the course of our project, we came to understand how multifaceted and intricate this issue is and how it should involve not only politics, spatial planning, and European objectives but also a significant social and cultural framework which is underrepresented in current policies. We came to understand how social (in)justice can be manifested in spatial justice through a thorough exploration of landscape elements as a result of political agendas.

In order to transition from current to future landscapes, whether urban or non-urban, that serve a wide variety of stakeholders while preserving essential ecological networks, it is crucial for a spatial designer to comprehend their position within this complex web of interdependent requirements. An active civil society that participates and lets their voice be heard in a planning and design process is therefore beneficial because it creates a more nuanced understanding of the issue at hand. It can address the needs of different communities while offering expertise in cultural and historical elements that in turn can result in a more inclusive and considerate design strategy. Furthermore, an active civil society can ensure transparency about the planning and design process that holds designers and governmental institutions accountable for their actions. This transparency strengthens symmetrical communication streams and citizen-participation which positively contribute to the general trust in democratic institutions. In general, an active civil society can make the planning and design process more democratic and responsive to the demands of communities in the interest of the common good.

Throughout this course we as a group have faced many challenges, both in our personal lives as in the development of the project. It was challenging in ways where our form of communication and expectations were not always aligned and how it was difficult to not be able to see each other. Long and intense discussions rooting from a desire for a good project is how we spend most of our time as a group. However, after sharing with each other our experience with the group dynamic and jumping through several hoops to find our direction, we found the common ground within our project: tackling the current social-spatial injustice in the agricultural sector through introducing agro-ecological corridors, land rotation systems and the concept of environmental stewardship.

We honestly enjoyed our theoretical lectures and tutoring sessions a lot (!!) and would like to use this medium to thank our tutors N. Katsikis and R.O.V. Cardoso for their open, critical and reflective attitude towards our work. We would also really like to thank our tutors R.C. Rocco and M. Dabrowski who gave very meaningful, important lectures and workshops with much enthusiasm. We truly looked forward to and enjoyed both the lecture and the tutoring sessions.

Kirthan Shekar

The project reflects on the Dutch tradition of engineering landscapes in their physical form, but the main studio problem questions the social aspect of an environmental problem. For a person from the global south, where the main issues to be tackled are mostly in the social context, like questions on density, the Q3 studio setting taught me the tools to understand how an environmental problem has greater social implications.

Addressing social problems tends to get subjective at times and lead to intense discussions, which in turn lead to diverse conclusions. But the challenge of the studio was to then spatialise these diverse problems by understanding what causes socio-spatial injustice. The design of the course structure, integrating the studio with the methodology course, further opened a series of questions on ethical issues and value systems.
This integrated setup also provided the fundamentals of design research.

Although the main structure of our argument required design through research, the project also created many instances where research can also be used as a design tool. The intensive SDS and Capita Selecta lectures provided the fundamentals for the design research. Understanding the domains of circularity and decentralisation in parallel with the question of nitrogen through critical mapping of the flows provided a systemic understanding of the landscapes. Being apart of an agricultural family myself, I could relate to the ways of farming, and the studio gave me a platform to critically look at the problem objectively. The studio also created a setting for working in teams. While there were certain compromises to be made collectively along the way, as a group we tried to push each other to think about and reflect on every decision we made. This might sometimes be a hindrance to the process as it is energy- and time-consuming.

The studio also provided a platform to understand how to design for uncertainties. The aspect of integrating policy and directive making to reflect on the SDGs creates a platform to understand design as a way of creating conditions for development rather than the product itself. Our vision also tried to understand the theoretical premise and the aspects of governance rather than provide a fixed solution to a problem.

Nancy Nguyen

The design solutions of this project have been based on scientific research. To come up with a new future for agricultural practices that would address the nitrogen crisis, research has been done to understand the processes in the current system. In order to then introduce a shift to a more sustainable system, different theories and existing practices had to be found that could offer a design solution for our case study. During this course this relationship between design and research was an ongoing iterative process since we always found new problems, potentials or processes that we did not understand. In a course of ten weeks, it is plausible that assumptions also had to be made to be able to come up with quick design proposals.

Stefania Saridou

Having studied urban and regional planning throughout my integrated master's, I was really excited to work on such a big scale again, after working for two quarters on city and neighborhood scale. I never thought that addressing the nitrogen pollution problem would be such a challenge. Starting the course by researching the topic of the nitrogen crisis, it was clear from the beginning that the problem is much bigger than a chemical reaction that has a negative impact on the environment and human health.

Over the last decades, there have been several attempts to manage the nitrogen crisis not only from the side of the European Union but also from the side of the Dutch government. Most of these attempts were mainly regulation/policy related. Our team quickly realized that this crisis of nitrogen pollution should have a more design-based solution, with policies and regulation on provincial, national, and European level, supporting the regional design proposal.

Having created all necessary products that support our analysis research outcome, the development of our vision came easily: a common ground, where farmers can come together, put effort and knowledge to restore biodiversity but also change the way the agricultural sector has been working up to this day.

Throughout the SDS and Capita Selecta lectures and workshops, we gained the theoretical background and all the necessary tools on how to properly convert our vision into a product and later into a strategy that could be implemented in South Holland. Furthermore, the Methodology course helped us understand how important the social layer is when it comes to designing. Being able to tackle problems like social injustice and provide public goods to people throughout our vision and strategy made me realize how important the role nowadays of an urban designer is.

The transition from vision to strategy was smooth, but also difficult. On one hand we already knew what kind of common grounds we wanted to introduce and where, but everything else like policies that would support this design, implementation of the different phases of the design and details like crop rotations required a lot more research and detailed designing. After a lot of healthy debates, we finalized our vision and created our strategy step by step.

I would like to thank our course coordinators and professors of this quarter, who took time and effort providing us insightful lectures and discussions during these 10 weeks. Learning from experts and professionals that were invited during our lectures as guest lecturers was really beneficial for the whole team.

I hope that our vision can become the first stepping stone for the Netherlands to tackle the nitrogen crisis through a design that not only regenerates the existing agricultural lands but also addresses the problem in a social just way, navigating us back to the commons.

Raven van der Steen

For this self-reflection I will be reflecting on the guiding question: “In which way is the governance aspect embedded in the planning and design proposal of your group project and what are the reasons for this embedding?”

The main focus of this project was the current agricultural practices and how to transition them to future ones, with the goal of decreasing nitrogen pollution and biodiversity loss. What I learned from this, is that a project initially focused on spatial elements also touches upon the lives of people. In other words, spatial design is closely linked to social impact, and it is important to be aware of this whilst designing. One of the main topics addressed in our report, aside from nitrogen pollution and biodiversity loss, was social spatial injustice of farmers. Our vision is a socio-spatial answer to this injustice, by linking newly introduced spatial elements such as the common ground and land rotation, to newly introduced social frameworks such as environmental stewardship, land banks and farmers cooperatives. Our strategy provides a framework actively including farmers and other relevant stakeholders to contribute to the iterative process of transition to future agricultural practices.

I think the above discussed social layer adds a lot of value to the final design, and definitely taught us as a group some essential skills as a regional planner and even outside of the field of urbanism. Even though the goal of a plan can be decreasing nitrogen pollution, or protection of biodiversity, it is important to be aware of the social impact these proposed regulation changes can have, and how these two aspects can be integrated together. To be able to effectively do this, our group used a wide variety of methods, such as conducting interviews with farmers, going out into the fields to observe, reading policy documents and using our creativity to come up with innovative ‘What if…?’ scenarios.

To link the newly introduced spatial and social concepts a governance system was needed. Our strategy of mitigating the social spatial injustice is by creating a platform that does not only implement top down policy, but opens up the discussion to other stakeholders. This way they can contribute equally, and from their own field of expertise to how EU milestones can be accomplished. Farmers can thus for example act as experts on practical knowledge about agriculture. This discussion between stakeholders has its own physical space within the design, the R&D centres, that form a neutral zone where every stakeholder has the same weight within discussion.

Our group included people with various backgrounds such as urban planning, architecture, urbanism and public administration (myself). Through a lot of discussion, this variety of knowledge was combined to design an integral plan for the transition to the future of agriculture, which does not rely on a static, top-down implementation, but introduces a dynamic design and iterative involvement of especially farmers but also many more stakeholders. The most obvious influence of stakeholders will be on the local scale of the project. If participation is successful it might be able to influence policies on national, EU and maybe even global scale. In this way the governance really integrates both planning and designing. What is certain,, in my opinion, is that an integrated and open design like the one we propose, shows a lot of potential for the future of design in general and can be a pioneer in reshaping the future of governance.

Willemijn Hoogland

As a former architecture student, working on the XL scale of Northwestern Europe was a challenge for me. With the means of this project, I realized more than ever how spatial configurations can be the results of political agendas; therefore, our role as spatial designers needs to be taken seriously, for they can strongly affect trust in democratic institutions and structures. This in-depth understanding is the result of thorough theoretical research that offered me ways to understand the current paradigm and link this project to existing theories. In addition, it made me realize how complex practical dilemmas can be and how existing spatial structures are the result of neo-liberal agendas, globalization, and changes in local (food) demands that evolved over time.

I would like to highlight my honest and intrinsic gratitude towards my tutors, for they inspired and energized me to critically reflect on my personal role as a spatial designer. I am thankful for many meaningful insights and the always-existing space to question concepts and ask questions. Our discussions helped me in my process of understanding the complexity of the urban profession.

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Appendix

1. Interview Transcripts
2. Cultivation Parameters
3. Spatial Elements Criteria Matrix
4. UN Sustainable Development Goal Indicators

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Appendix 1 / Interview Transcripts

Interview 1

Jorden Oostdam

Farmer,

Oostdam livestock farm

Bodegraven, South Holland

3 March 2022

Nancy Nguyen

Well nice of you to do this interview with us. Maybe just a quick round of introductions. I'm Nancy. I'm a first-year master's student at TU Delft, the master of urbanism, and we are doing research on how nitrogen is causing social and spatial implications in today's society. And to better understand that, we would like to better understand the processes behind nitrogen. And since agriculture is one of the key stakeholders, we are very happy to have a conversation with someone who is directly dealing with this issue. So thank you very much first of all.

Jorden Oostdam

Well I'm Jorden Oostdam, home dairy farmer. I'm also an agricultural broker, so nitrogen has a lot to do with that as well.

Nancy Nguyen

I've been reading a lot. There was a lot about dairy farm Oostdam. For example, I had read that the farm started with Yvonne as a family business and that's how you got into it.

Jorden Oostdam

Yes, that's slightly different. It comes from my family. Yvonne is also a farmer's daughter, so she also has a dairy farm. So we were both interested in farming.

Nancy Nguyen

Was it a natural process that you took over the farm?

Jorden Oostdam

Yes, I have a younger brother and an older sister. My sister does not have a direct affinity for agriculture. My youngest brother does, but not to farm himself. So he also went to Wageningen and went to work in the secondary agricultural sector. But for me that was actually so obvious from childhood.

Nancy Nguyen

And then you have been farming from the beginning? Or have you walked other life paths?

Jorden Oostdam

Yes, that's from the beginning though. I also always did something in addition to it. I first started working at the NIJK and then I started studying. I am a steward, broker, appraiser, court expert, so with all the competent papers. So I've always been doing things in addition to it.

Nancy Nguyen

And why? Do you have so many things next to being a farmer?

Jorden Oostdam

It broadens you. I find many things fun and interesting. So I work. But I can't really miss the farm.

Nancy Nguyen

And so what do you value most about being a farmer?

Jorden Oostdam

That you are one with nature. It's wonderful to make a beautiful healthy food product. To take good care of your animals. That gives a lot. You have to do that, too. Otherwise you don't become a farmer. Because if you think of it all as work, you're working for a hundred hours a week. Nobody keeps that up. But if you like it, then it's not a big deal. And also that it is family farming. A family business has a vision that is much longer than a few years. A family farm has a vision and that is to sustain the family farm. And if opportunities arise, maybe you can expand or enlarge it. But because the family business automatically makes sure that you don't go for the short gain, but always for the long lasting. And that is for example, I just compare it to retail or shareholders. Aholt will do quite well to be sustainable. But if there is no dividend for the shareholders, then they also abandon it. And that differentiates. That's why the Netherlands needs to be more careful with its family businesses. Those have a long-term vision.

Nancy Nguyen

Yes and what is that vision then? The long-term vision of farm Oostdam?

Jorden Oostdam

Well, that is that you can continue to produce high-quality food for humans. And for that you need healthy soil and healthy soil and healthy animals. Yes, and then I draw it more broadly even. Look, the livestock industry also processes mountains of enormous waste, so to speak. So what is in the human industry as waste is still converted by animals into high-quality products. And that's cycles, thinking actually.

Nancy Nguyen

Yes. And do you have any other animals besides cows?

Jorden Oostdam

Yes, we have another pair of sheep. And we have so many chickens. Yes, that's mainly because, well, also because, we especially like that, because that's a hobby or that's still money. But the chickens, our kids grew up with that and then they sell the eggs down the road. And you just have to ask Jeroen about that.

Nancy Nguyen

And then what kind of resources do you need, especially for dairy farming?

Jorden Oostdam

Yes, knowledge. And nutrition, of course. That, of course, is a very important aspect. Actually a lot of things come together in that, say, of things, well, also marketing, machinery.

Nancy Nguyen

Yes. And then could you maybe explain a little bit more about how you deal with the cows? Because I had read that you let them walk freely, they get to choose when to be milked and to eat.

Jorden Oostdam

Yes, well they walk in a, we call it greenhouse barn, which is basically just a roof. The side is actually open. So it's, the climate is already outside, it just doesn't rain inside and the sun doesn't come in either. Because those are things that cows hate, rain and sun, distant sun. They can choose whether to stay in the barn or go outside. And there are indeed 24 hours a day, they can eat, lie down, drink milk, and drink. Yes, see if you take good care of your cows, it pays off. So we built our barn in as well, really on a cow feed basis, as we call it. So yeah, wide aisles, good light bubbles. Yeah, so a cow actually lies down for an average of 14 hours a day to re-fold.

Nancy Nguyen

And is this kind of the norm how the Netherlands does it? Are there other farmers who also do it this way?

Jorden Oostdam

Well, it is a norm. If you don't do it this way, then you have different outcomes, you could say. Or your cattle are less healthy. In the end, it's also kind of important that there's bread on the plan already. You're not trying to find anything in there, of course. Things could maybe be even nicer. But yes, if that costs money and nothing else and nobody has anything to show for it, then that doesn't make sense either. Yes. But this is how the Netherlands treats cows. Broadly speaking, the Netherlands treat their animals fantastically. Very much due to norms and values, but also due to legislation of course. Things are no longer allowed and things are no longer possible. And that is, according to my understanding, quite a lot to be said for that. But, say, the Netherlands really treats its livestock very well, the Dutch farmer.

Nancy Nguyen

And why is that? That the Netherlands treats its cows so well?

Jorden Oostdam

Well, I think also because of the progress and the technical possibilities and laws and regulations and

the wishes or demands of the consumer. These are all in line, so to speak. Yes, well, some things. But look, the point is, we have to comply with certain things. We don't mind that at all, either. That's cost-prohibitive. And, of course, you have trade treaties with free world trade. And in the rest of the world those are generally, of course I don't know all the arrangements exactly, but they are generally the requirements and the standards tend to be a little bit lower. Yes, so those also have a lower cost. And that's then also in the supermarkets, for example. That's unfair competition actually. And that's why there's not so much resistance to it. The farmer doesn't mind at all, so to speak, if they had to milk fever cows. But that is less efficient. But if that is then paid for by the product, that's good. Only if that product is then much more expensive in the store compared to foreign products, then you don't make it. That is also why organic farming is slow to take off. Because people think, yes, I'll still choose the non-organic, so to speak. Yes and it is not possible to work more efficiently with technical progress in order to have a product. Working in the Netherlands was super efficient. But technical progress also just means costs. Yes and if foreign countries don't have those costs or have less or have them differently, then you get an unfair playing field actually.

Nancy Nguyen

And that's the thing that you don't agree with at the moment: concerning the nitrogen policy, so to speak?

Jorden Oostdam

Well, the nitrogen policy, what I was talking about now, was animal welfare actually. The nitrogen policy is another whole other issue. Just everything just comes together, so to speak. You can't separate one from the other. That also has to do with CO2. Yes, the nitrogen policy, that is, try to say something about it very briefly. Europe ordered the countries in the eighties, I think in the nineties, to designate nature areas and map what kind of nature there is. And those are the Nature 2000 areas, I think we've heard before. So those are, that's only too right. And Europe also says that nature must not deteriorate. You have to maintain it or improve it. But at least maintain it. Well, you can do that in different ways. You can say, every year, or every five years, I go into the field and look at what kind of nature I find. The Netherlands has chosen to do that on the basis of nitrogen, emission and deposition. Only that emission and deposition of that nitrogen, that's a model calculation, the ARIES model. I don't know if you've heard of it either. That's the ARIES model. But that's purely an arithmetic model. Well, you can use that to map it for a country, maybe a region, but for individual companies, actually, you can't. Because that model actually says, if I relate it to our farm, well, we have so many cows, those cows put out so much ammonia. And that ammonia, it stays somewhere, some of it sits on, stays in the manure, but some of it also goes into the air. And then they say, yes, the air, that's the emission. And then that settles again somewhere, so to speak. It settles again somewhere and that's a deposition. And then that's a theoretical model. They say okay, with that wind, normally, there's so much wind, those tall buildings, those bushes are nearby, so you as a company, your ammonia is depositing that much there. Only, that ammonia is not authenticated, so you can never, there will be ammonia coming down, but whether that comes from our company or from another company or from the industry, is not traceable actually. The overall outline. And there are such limit values being set, that because of that even now construction is just locked up. The Netherlands has a limit value, which is a whole technical chemistry thing, that may not precipitate more than 0.05 mol per hectare. In Germany that limit is also 20 mol, so to speak. So if that limit is also applied here, then basically everything can just go on. The Netherlands has chosen to do this. So it's not necessarily what Europe says, you have to maintain your nature. And the Netherlands has chosen to do that through nitrogen, and because of that they are now stuck with the cake.

Nancy Nguyen

And how does your company itself deal with that?

Jorden Oostdam

Well, we have to have your permits in order, the nature permit, the environmental permit and the conservation law permit. We have that, but it says how many animals we are allowed to keep, so we are not allowed to keep more than those animals. And now if we want more, it says because of the nitrogen policy, that's not allowed, that's not possible. So everyone can also live with that. There are also companies that have applied for a Nature Conservation Act permit, and then he said, on a principle that he joined authority, yes, you only emit so little, then you don't need a permit for that.

Nancy

Yes, but you have to, don't you?

Jorden Oostdam

No, you don't have to. Those are those so-called pass detectors, you may have heard about those in the news reports as well, but that's what was shot down by the State Council, so to speak, that passed the law. So those companies did their best and they applied for a permit, but they didn't get it because the government said, you don't need it. And now with rainback, the government says, no, you do need it. But if they took the question, there is no nitrogen space, so to speak. So that pinches tremendously, that those farmers don't have a permit. That's not because of those farmers, because they did apply for it, but that's because of the government, because they didn't apply for it. So how do we deal with that? We are in the middle of the green heart. It's, well, the people, the consumers or people, also no longer think it's desirable to have more cattle there as well. So we don't actually have the strategy to relate more cows, but we have started to look and look to relate our product, so to speak. So normally all the milk goes to the dairy, but we have invested in our own dairy on the farm, so we are trying to bring that short chain, say, and transparency to the people. So that's how we deal with it, so to speak.

Nancy Nguyen

So you're just looking for solutions for your farm to come?

Jorden Oostdam

Yes, some kind of broadening or other activities, yes. But I've always done something besides it, so then you look and then you look too. But there are also farmers who say, well I'm just a farmer and that's what I want to be, so I'm not going to do other things. But yes, those are also free choices.

Nancy

But do you find the foundation's policy too restrictive at the moment?

Jorden Oostdam

Yes, yes, foundations policy is, but well, you also indicate yourself of, it's so complex. No one goes into depth, so to speak, accepts things that they find agreeable or where they think, yes, that will do. Of course I go there myself, nothing good can come over me there either, but I must say, I do know a little more about it of course, because it touches me more. Especially also in the, I always hate to say it, but in the media, if there is someone there with a little more background information about it, it is very often cut short. But about the foundation policy, well, people are now trying to halve the livestock, say, or do, or reduce, somehow, but we know nature well enough for that. Nature is not going to recover from that, so to speak, because so many more people are coming, so many more people are building, so many more roads, flight movements, things like that. That's where nature goes, of course, because those fewer cows or pigs, that nature isn't going to refurbish in the end. Yes, that's the way, at least that's the way we look at it. And then ten years from now and we say, no, nature hasn't actually improved at all. What are we going to do now?

Nancy Nguyen

Then do you feel that the media, maybe politics, then puts too much blame on the agricultural sector? In relation to the nitrogen crisis?

Jorden Oostdam

Yes, well, I think the solution that's being sought, well first, I think the problem is not, the problem statement is already not good, so to speak, but that's what the Netherlands has chosen to do for a while. The Netherlands has chosen nitrogen and people stick to that, while I think that is an incorrect starting or starting point. Because we are often at the most nitrogen sensitive locations, but we do see certain species grow which according to the model, wouldn't be possible. But so those models sometimes assume something, but you could also say, we're going to see if it's correct. And then we're going to try to adjust the model. You always have

to be open for improvements or adjustments and not get stuck in that one model. So I think that the point of departure is actually already wrong and then I think that if that is your point of departure, then the solution is too often sought only in agriculture. And that stings and that doesn't solve the problem.

Nancy Nguyen

And how would... How do you see the future of agriculture? What would you like to change about the current agriculture industry?

Jorden Oostdam

Say, they have already achieved a huge reduction in emissions in the last 20, 30 years. There's already a lot more there's being emitted. So those are already very well on their way. And I think when we talk about the problem of nature, environment or climate, the Netherlands is very much inclined to think in cities or villages, provincial borders, national borders. But that draws on nature, environment or climate, that doesn't have anything to do with borders at all. And you have to see it this way, in terms of animal welfare, but also in terms of efficiency. If we get rid of one cow in the Netherlands, then somewhere in the rest of the world we have to add three cows to produce the same food. If we get rid of one hectare of farmland here, somewhere else in the world we have to add about three hectares of farmland to produce as efficiently. That's because technological progress in the Netherlands is very great. And also the climatic conditions. And the soil, the sweeping soil, the small soil, is also just very suitable for production. If we stop with one cow in the Netherlands, we have to have three elsewhere in the world. But I do blame some political parties for that. It's kind of the same thing too with electric driving. I'm not against electric driving at all, but 70% of electric driving, that energy is generated by fossil fuel. Just not at a station, but elsewhere in the world. You're shifting the problem, so globally the climate doesn't benefit from that, let's be clear. So the problem is much more complex.

Nancy Nguyen

So do you feel that you as a farmer should be more involved with the policy?

Jorden Oostdam

Yes, I think so. Farmers, again, are professionals, hard workers. Who have a down-to-earth view, farmer's common sense. That is very often the truth, just substantiated or scientific. That takes a lot of time and that is difficult. Those observations from the farmer's mind didn't just come from there. That is centuries old. There is updating and adjusting that. I think the farmers are not listened to enough. They have to solve that problem for all of the Netherlands. That's where it chafes. It is often said in an interview that farmers have been here for four or five generations. I personally don't think that's an argument, that you just have to stay there. I don't have much with that. That's emotion. You have to see what is happening and what is possible in a place like this and then it is indeed better if you are close to nature. But 99 out of 100 farmers don't find that a problem either. If they are treated decently, but that hardly happens. That doesn't feel nice.

Nancy Nguyen

And are you trying to keep your cycle in the Netherlands as much as possible? So for example, cattle feed is also all from the Netherlands?

Jorden Oostdam

We try to get as much feed as possible from our own land. But some things don't escape having to come from abroad. But you try to keep that as close as possible,

Nancy Nguyen

And also with fertilisers?

Jorden Oostdam

Yes, we are limited in the amount of manure we can use ourselves and the rest has to be removed. There's a twist in the system there, too, because animal nitrogen is limited. That gets less and less. And what it becomes less, we are allowed to do more with artificial fertiliser. That's actually another very energy-guzzling system to make fertiliser. So that's also something that goes against the circular idea, as it were. And that's also government-related, European-related, that's not allowed. The amount of fertiliser you put in the soil. Yes, and actually animal manure as well.

Nancy Nguyen

But the mix, even if you use part animal fertiliser and part artificial fertiliser, you still come to the same amount of nitrogen, right?

Jorden Oostdam

Yes, there is a nitrogen ceiling and that was allowed to be two-thirds animal manure and one-third artificial fertiliser. Animal manure is reduced from two-thirds to eleven, so to speak. And fertiliser you're then allowed to put down. And yes, that's.. Well, that gives a lot of transportation movements, because we have to dispose of most of it and bring in the fertiliser. But it also gives that fertiliser production, which is huge natural gas sequestration. So yeah, we honestly don't understand that.

Nancy Nguyen

No, but that way it's easier to protect biodiversity say?

Jorden Oostdam

No, not actually.

Nancy Nguyen

Yes and then in what ways do you try not to do that or take that into account?

Jorden Oostdam

Yes, that's difficult, because that's legislation and that's also legislation. So you can't do that then. I can say, I want to fertilise that soil more, say, with animal manure. Because there's not only nitrogen in it, but there's a lot of nutrients in it. But yes, if you do that, that's an economic crime. So then it doesn't go well.

Nancy Nguyen

So in that way you are also restricted to kind of exercise your knowledge or protect the neighbourhood there all the time?

Jorden Oostdam

Yes, to take advantage of the opportunities, yes, that's true. And it can be done differently, but then again it becomes much more expensive. Well, and so then the product is much more expensive. Yes, there is no outlet for that. Because then there will be, and then we are back to the beginning, there will be a cheaper product from the other parts of the world.

Nancy Nguyen

Yes, but with the circular farming that you practise and the kind of freedom that you give to the cows, that's how you maintain biodiversity or nature?

Jorden Oostdam

Yes, biodiversity is just fine, I would say with us. Because well, we also participate in agricultural nature management. So there are plenty of opportunities to get that together.

Interview 2

Richard Hartensveld

Partner

Schenkeveld

Westland, South Holland

26 February 2022

Raven van der Steen, Nancy Nguyen

In the Netherlands, nitrogen is a very socio-spatial case study, which is what our project is about. The focus is now on agriculture. We therefore desired to gain a much deeper understanding of the landscape. How does it appear, and what impact does policy have on it?

Richard Hartensveld

We as horticulture have to deal with economic affairs and also the Ministry of Agriculture. We sometimes feel like we are literally falling in between horticulture and agriculture. Because on the one hand we feel very connected to agriculture, to fisheries, since they are also in the primary sector. On the other hand, if we look at the average farm, then we see that compared to greenhouse horticulture very little innovation has been done in recent years. We are constantly developing and innovating. So that does make it difficult, also in the discussion with politicians. Where we belong, where we do not belong. In our case, we only bring up the subject of pure nitrogen when we are planning to build a new business or greenhouse. You must show that there is no increase in nitrogen emissions as soon as a new greenhouse is built. So the only time we actually have to deal with nitrogen is in those nitrogen permits for new construction. It isn't really a topic at all when speaking only in terms of our operations in practice. We recycle all of our water and fertilizers because we don't discharge anything underground. Therefore, we are essentially cultivating away from the soil. And in that regard, we do not experience any negative effects from the nitrogen rules.

Raven van der Steen, Nancy Nguyen

And then what about the fertilisers you use? Those are natural fertilisers or synthetic fertilisers?

Richard Hartensveld

Only synthetic fertilizer is used here. We have ten acres of greenhouses here, and when you talk about water flows, for example, on the greenhouse cover, water flows on all of those greenhouses, but there are gutters in between them. A catch basin that leads to a sizable water boss is located at the end of the greenhouse. We collect all of the water that lands on the greenhouse. Consider that waterbasin because it is so sizable. Every greenhouse has a water collection, water is also very limited. For example, we don't want to pump water out of a ditch to water our plants because that could introduce disease and pests. Therefore, we want to prevent diseases and viruses from spreading as muchas we can. Therefore, using only rainwater is ideal. Therefore, we save that rainwater. In fact, it eventually makes its way back to the greenhouse from that water basin, but first it goes to a water room. There, fertilizer is incorporated into the rainwater. After that, the fertilized water returns to the cabinet, where it is given to the plants. We water our plants in the greenhouse itself, which I do have a picture of as well. Let me try to explain it clearly here. This is a partial image of the cucumber greenhouse; on our 80 acres, we grow tomatoes as well as cucumbers in a greenhouse. We have gutters in that greenhouse, and on those gutters are stone gol, which are mats. I don't think I got it right, but you can see one of those white mats here, hidden behind a leaf. And glass wool and rock wool are both types of insulation materials. On that subject, I am aware. The tomatoes and papayas grow on two plants that are attached to it and are growing in that greenhouse.

Raven van der Steen, Nancy Nguyen

So there will be no soil at all? No, nothing. And why is the rockwool on a gutter? Yes, it lies on a gutter. And that gutter, so what we do, we have that rainwater, we have the manure added to it and then we give that via pressure. So if you look at a gutter like that, the one from the side, that mat is on that and on that is a pot with that plant. And with that we have a drip tray and with that we give that water with that fertiliser in it. So each plant has its own drip tray with which it can.... Let me see if I can zoom that somewhere. And at least that's where it gets the water. Here you can see the plug and a tube attached to it. Through this hose it receives water with fertilisers. Is too much water given, because every plant must get enough. And there are a hundred thousand plants in such a greenhouse. And then the one that steps through the most must still get enough, but that also means that some get too much. Excess water and fertilizer runs out of that mat back at the bottom and that's collected in a gutter. And that gets recirculated again. So if we give one hundred percent water to that greenhouse, often about thirty percent comes back. We collect that in a large silo, which are round tanks. We disinfect those again. Because you don't want if there are sick plants among them that you're discussing diseases. So we're going to disinfect that. And then we're going to mix it with rainwater. And then we're going to add fertilizer to that again. And so that circle goes around and not one drop of water holes is actually lost. How cool! Is this what is the norm in the Netherlands? Yes, in greenhouse farming this is the norm for tomatoes, cucumbers, peppers, eggplant, greenhouse vegetables. For example grisants, lettuce, you also have other types of cultivation, those are still grown in the ground. And organic, then you have to grow in the ground. So if you buy organic tomatoes or organic cucumbers, they are grown in the ground.

Raven van der Steen, Nancy Nguyen

So why is that organic? Is that better?

Richard Hartensveld

The law requires that if you want to have organic label, then you have to grow in the ground. Because that's the way it is in nature. It won't necessarily always be better for your tomato, right? It's not better for your tomato and it's not more sustainable. With this system we get, for example, it's very dependent per variety, because you have very productive varieties and some less productive ones. But suppose we get 60 kilos from a square meter, an organic garden gets 40 kilos per square meter of the same. But they also have to put in gas and they also have to put in all kinds of energy. And all the fertilizer they use goes back into the soil and of course they wash it out. So you keep that within your own system.

Raven van der Steen, Nancy Nguyen

And the fertilizer, does that come from the Netherlands or do you import it? We have a supplier, Van Yperen. And van Yperen gets that from all over the world. Israel I know, in the past it also came from Russia, but now they have it in other places.

Raven van der Steen, Nancy Nguyen

And why do you choose to use fertilizer instead of animal manure?

Richard Hartensveld

Yes it's actually just bad to process in the systems the way we work. Because of blockages, but also again viruses, diseases. We work so sterile that we also want to keep out as much as possible all kinds of entrances of diseases and pests. What is applied is vegetable fertilizers. But that is actually more in, you have to see, such a stone worm mat that has just been laid down is so sterile at the beginning. Then you actually want to create some kind of soil life in it and then by adding plant fertilizers. So that are made so controlled that we know that there is no, how do I say that net, woes from outside coming into the farm. That we know that they are controlled plant fertilizers where there can't be any more diseases or viruses. Then sometimes we want to add that to get soil life going. That's good for the resilience of the roots again, so that plant grows better again. So animal fertilizer is not controlled like that? That doesn't seem to be possible. Besides, if you want to run that through that kind of tubing and you get blockages in that system. Because this is also liquid? Yes, it's given along with that rainwater and that sanitized water back from the greenhouse. That all gets dissolved and animal fertilizers dissolve worse than vegetable and fertilizers.

Raven van der Steen, Nancy Nguyen

I had read that fertilizer can also cause plants to grow too fast. Or by making them grow too fast, fast and susceptible to disease. But then that is not the case.

Richard Hartensveld

I have no experience with that. You're mainly trying to keep the diseases out of here. That it doesn't get that chance. That it doesn't get in. You already see that with us. It seems to me like a kind of laboratory that we are doing. So sterile and exciting. People have also been working with company clothes for about three or four years now. So every morning they come to work in their regular clothes. But get from us their own, clean, clothes washed every day. So that we can also keep out that outside angle in terms of disease pressure. We have the most nasty in tomatoes. And for that matter, so does cucumber. Cucumber you have cucumber union virus. In tomatoes you have Tobamo virus. And then our parts just die. Then if one plant gets... Then you can spread it. And we all want to keep that as small as possible or as manageable as possible.

Raven van der Steen, Nancy Nguyen

And so how does Schenkenveld differentiate itself from other tomato farms?

Richard Hartensveld

We try to do it by maximizing productions. And minimizing inputs. That way we are as sustainable as possible. So with as little fertilizer as possible, we can make as many tomatoes as possible. On the other hand, of course, you have to do that in such a way. That there is enough flavor. If you only water, then you are very sustainable. But then that plant is not going to grow well. And eventually there is no flavor in those tomatoes either. So you have to do that well with as little energy input as possible. We have a total of eight varieties of tomatoes. And now also cucumbers. And with our association that we have, TELUS Prominent. We are members of TELUS Association Prominent. And together, we can supply all retailers in Europe with tomatoes in a good way and in a sustainable way. But also of cucumbers, eggplants and peppers. What a great collaboration. With all growers selling tomatoes. Yes, that's Grow is United.

Raven van der Steen, Nancy Nguyen

And then your tomatoes and cucumbers are just sold in the supermarket? Or is it often for processing as well?

Richard Hartensveld

We actually supply with Grow is United, we are a prominent tomato. Do we supply 95% of our tomatoes go to supermarkets. Throughout Europe. And 5% ends up in major trade markets. And also food service, so at restaurants, caterers. But our biggest customers are the supermarkets of Europe. But not the tomato sauce and all that you see in the supermarket? No, the sauce comes mostly from Italy. In Florida, America, we do have a lot of areas where outside... So all Italy is outdoor growing. In Florida is outdoor growing and in China there's also a lot of outdoor growing of tomatoes. Those are all used for purees and jars and things like that. We really only do fresh. And we're also way too expensive here. If you have a jar of puree like that, it costs a quarter or so. We can't manage that here in our cupboard.

Raven van der Steen, Nancy Nguyen

And how do you envision the future of Schenkenveld?

Richard Hartensveld

That we just keep growing nicely. Our goal is for people to be able to enjoy healthy food grown in a sustainable way. And we have also really thought about growing organically. Only so far we feel that organic does not offer enough added value compared to our method of cultivation. So we believe in it less. So you have to do what you feel good about. And what the consumer ultimately feels best with. Everyone can make their own choice whether they go for traditional or organic or a jar or a packet. But we support this. We are looking at how we can take this further. For example, we have now started with cowpeas for the first time. That's another piece of broadening. We are looking at whether we can grow tomatoes with Schenkenveld in Spain or Morocco, for example, as well as in the Netherlands. Because there energy is just a very hot issue at the moment. And there you can with much copier labor. And a lot actually in Spain and Morocco almost without energy input you can grow tomatoes. Only there is then you have solved the one and then water is again a problem. They're short of water again. So then you have to go back to doing other things to still get it done. So those are the things that we are focusing on. How we don't necessarily have to get bigger, but how we constantly keep developing. And further sustainability, further improving production methods. To keep our place on the shelf.

Raven van der Steen, Nancy Nguyen

And then about sustainability. Because you have now explained how the process actually works. And that that is the standard for the Netherlands and for cultivation. What about innovation then? For our company?

We are looking at LED lighting. We have a greenhouse at Schiphol Airport. There, instead of one energy screen, we now have two energy screens. So you start saving energy even further. We have air handling units there. Normally when you have a greenhouse. There are vents in there. If it gets too hot then the vents open. But at this time, for example, it's not so much too hot. But if those plants are growing in there and they evaporate then it can get too humid. Then we have to open the windows to let that moisture go out. Only then is the moisture going to be able to be there, but so is the energy. We are now working on air handling units that allow us to keep the windows closed. And still be able to remove the moisture in a controlled way. Again, those are investments. On the one hand, you make an investment and it costs a lot of money. On the other hand, you can save energy. So what wasn't possible five years ago financially is now coming into the picture. Heat pump in houses was a few years ago, you couldn't calculate it around. And now you can. LED lighting a couple of years ago was not calculable for us. And is now becoming interesting again. We're now constantly looking at how we can put solar panels, all of our processing room roofs we're going to put solar panels on. So every time you try to take all kinds of steps in terms of sustainability. That LED lighting, last time I noticed that one cabinet was lit all pink. That's LED lighting. We had that orange light before. And that was, I do have pictures of that again. Because that's also that the plants grow more efficiently then? I don't know though. Let's see, this kind of light, this is actually traditional lighting. Oh yes, I can do it that way indeed. And then, look, normally in a growing season in the Netherlands we can't deliver tomatoes in the winter. Then we plant in January. Then that plant, which is such a small plant, comes into the greenhouse, it starts to grow. And then it also gets more and more light, because in January you go towards the light, as we call it. Every day the day gets a little bit longer and on average it gets a little bit sunnier. And then around March, April, we have the first tomatoes. That's a traditional season and then you can grow tomatoes from March, April through November in the Netherlands. If you want to grow tomatoes December through March as well, you have to light. Otherwise there's just not enough light outside to grow that well. This was the way we did it in the past, only this requires a lot of energy. And now, let's see, in one greenhouse we've installed LED lighting. And then you actually get, well here you see a combination, you get that pink light. And the plant gets just as much light as the other lamps, only it costs 50% of the electricity. So that's actually the advantage.And that investment in those bulbs is so high that before that was not calculable. Only now with those high energy prices, your series sum becomes different.

Raven van der Steen, Nancy Nguyen

And how do you deal with pesticides?

Richard Hartensveld

We have pesticides, fungicides, both for orphans and for fungi. We always want to ensure a biological balance in the greenhouse. You just saw with those cucumbers maybe already. Just a quick look. You can see it right

there. Every pest in the greenhouse has a natural enemy. For example, we hang up a kind of card with parasitic wasps in it. And these parasitic wasps lay their eggs in the eggs of the whitefly. And the white fly is a pest that can bother us. And we put the critter in there, which actually fights it again in a natural way. I can imagine, if we create that kind of critters, so a whole biological balance, if we then start spraying pesticides, then those good critters are also going to die. So we want to spray as little as possible. Besides, the moment we spray, the plant is going to grow less well. So preferably we don't do it at all. Sometimes, if you wake up on Sunday morning and you had a very nice Saturday night, you do have a little headache, then you take paracetamol, which is chemical. But yeah, you can't solve that with green tea for a while. Sometimes we also have something that we have in a certain section or a few paths in the greenhouse, that a pest, even though we're trying to balance it, that that doesn't go well. And then we use, a biological part may not intervene then, for example. We can intervene. We don't like to do it, but we can. And with that we can sometimes save an entire crop in a greenhouse by intervening spot by spot. We then do that intervention and then we go again, because in the rest of the greenhouse we leave that balance intact and then you see that it often does recover. So we do use, we may use, but we do it as little as possible. We call that maximum organic ourselves. To take it that way.

Raven van der Steen, Nancy Nguyen

And maybe a little bit more about Schenkenveld. How did such a big company come about, grow, where did it start?

Richard Hartensveld

1937 Leo Schenkenveld started it. You can read about that on our site. But at least in 1937, the grandfather of one of the current executives and owners, who started. Richard Schenkenveld, Pieter van der Wel and Joost Barelsen, the four of us, we do the business at the moment. They have the management of the company and the owners. But one of the four, Richard Schenkenveld, who is his father and his uncle and before that, so his grandfather, he started the company. So it went from grandfather, father and uncle, and then to Richard. Richard wanted to grow further, but he also saw that if I'm going to do that on my own, it's going to have to be a big deal. He merged with Nursery De Kabel, and Joost Barelsen and I had Nursery De Kabel, so we merged with Schenkenveld. Because we had only been around for 11 or 12 years at that point, I think, and the company Schenkenveld, now 85 years old, we were like, well that name is so well known, we'll keep it. And then we're going to continue to bunk on that name. And later, in 2019 or 20, Pieter van der Wel, who is ten years younger than we are, also joined the company. So again towards the future, that we also have more young recruits.

Raven van der Steen, Nancy Nguyen

And how did you get into it yourself? Because you just said you had a nursery yourself.

Richard Hartensveld

Yes, I came out of college in 1997. That's when I was born. Then I first worked at Brinkman, which is a supplier of horticultural products. They sell fertilizer, plant protection products, all kinds of accessories for horticulture. Then I ended up at Hovendoorn Automatisering. They sell climate computers for greenhouse farming. So I've actually always been in the horticultural sector, I grew up in Westland, so I was actually born between the greenhouses, more or less. Joining Hovendoorn I worked from 2000 to 2007. For seven years I sold climate computers. And then some of my customers wanted to start a new company. I had heard that and then I got into that together with Joost.

Raven van der Steen, Nancy Nguyen

I'm curious though as you grew up here and have been working here for so long now, whether you've seen Westland change very much in that time. And in what ways that? Maybe it's a very abstract question.

Richard Hartensveld

Of course you see things change anyway in terms of infrastructure, like in a lot of areas in the world, in the Netherlands. The roads are getting bigger, the traffic circles are getting bigger. You do see the greenhouse horticulture itself, where there used to be ten small farms, I already call that daddy-mommy farms, where mom and daddy worked together. Maybe with one or two employees. You actually see that less and less. And those old greenhouses that are being demolished and then larger new companies are coming in return. Or you also see housing developments, so the cores that are growing, so some parts of the greenhouse industry, being sacrificed, so to speak, for housing developments. Or for the growth of housing or industrial sites. Because there are a hundred land, there is a big industrial area with mazdij. Yes, there used to be all greenhouses there. And it is now industrial heard. And with that you see again that we ourselves have chosen, for example, to go to Reissenau, near the longest A4 near Schiphol Airport, because there was still a large area available there for further growth. But the companies we see in front of us now are almost impossible to establish in the Westland, because of the space available. A company of 44 hectares that we have built there, you can't really put that in the Westland. There is no more room for it. And suppose the space was there, it might also have been unaffordable, almost. Yes, the land prices are a little more expensive here, but otherwise that in itself.... If there was room then. Yes, if there was room then it could be. So we did consciously choose to.... You also see that one part, the head of North Holland, there you also have quite a lot of glass thumb track. That's from here, with us it's so, if I get on the highway here and there's no traffic jam more than half an hour, I'm on the other company. So that's convenient. Yes, that is convenient. But if you're really to North Holland, an hour and a half away, you have to pass Amsterdam. And then you also see that a lot, that the people who then put their business there, that they also go and live there. And we were like, we want family, friends, our whole social life is here, so we were like, we want to stay in the neighborhood.

Raven van der Steen, Nancy Nguyen

And how could policy help you with that? How would you like the government to steer on that or not?

Richard Hartensveld

Yes, for us it is important from the government how they look at energy taxes. The moment they start imposing our very heavy tax on energy, it does become very difficult for us. I would rather have a clear, steady government that makes choices, that I can anticipate.... than every four years after elections that it's all sides again.... same with the municipal, we have municipality, province, national, Brussels. If you become an entrepreneur there, it does scare you that at different levels, different decisions ... everybody has to think something about it. For example Koppard is our supplier of that biological control. Koppard... We recently had a whole discussion with them together with the government. They supply our bumblebees, but they... I just like it a little bit. Yes, the bumblebee supplier. Yes, a bumblebee supplier. And you can tell you, very funny what all these have developed over the years. These are all critters that we can buy their. And the moment you... We work with Enamix. Crypto bug. These are all... And for cake bowls you need something different again than in your Swirsky. These were those bags that we use in those cake bowls. And in the tomatoes we use different ones. So you have different critters for everything. Only the moment they... They also have resources. You should see here. Let's see if they have any here.... Oh, yes. These are organic pesticides made from natural substances. We can also spray these when we have problems. That's in the form of a soap, for example. Or a... Which makes the wings of harmful insects stick together. A very simple toep. Only, if they want to introduce this into the market.... They've discovered something new and they want to introduce it. Then they have to go through all the legislation. And before we can use it, it's five years down the road sometimes. Yes. And so then it's on the shelf. It's ready. It's developed. And then we do become thinking, yes, what do I need from the government? That they understand of this is not something chemical that we use. It's a nature's own substance. We want to apply it in that cultivation. Now make that a different process than when.... Bayer or BASEF enter the market with a chemical. Then we understand that you first want to test it on all kinds of things before applying it.

Raven van der Steen, Nancy Nguyen

And as a board member, are you very involved with cultivation or more with the entrepreneurship of the company?

Richard Hartensveld

I am more with entrepreneurship. Joost is my companion with us. He is responsible for cultivation. Ries is a bit in between. So we made a division of labour with each other. But in the end, we all depend on that cultivation. Cultivation is Schenkeveld's core business.

Raven van der Steen, Nancy Nguyen

I would still be curious, but I don't know if it's necessarily the right question to ask you. But because obviously lately, I can see from here also those flags down below. It's kind of provoked by the nitrogen anyway. So on your farm then it doesn't necessarily affect you directly. How do you kind of get that into the take?

Richard Hartensveld

What I do see is that Westland is to a certain extent an agricultural area. Because people do feel connected to the agricultural sector. Whether it's agriculture, animal husbandry, greenhouse farming, fishing. The primary sector feels connected. I think a lot of those flags are more like a protest vote than actually about nitrogen. Because I also see colleagues in greenhouse farming who hang this flag upside down. But we said, we're not going to do that, it doesn't suit us. We want to be innovative, we want to be progressive. We do not want to associate ourselves too much with a livestock farmer who still works the way he worked in 1950. And doesn't want to change. Anyway, that's everybody's choice. But then maybe it's also just because they want to be listened to. That's just very important. That's a good insight, though I also do see homes in the Westland also all of a sudden have a flag upside down. Maybe that one has an uncle who has a farm or it is more that some have something against the government anyway. I don't have much with that. I find it irritating that we in Westland are full of those things.

Appendix 2 / Cultivation Parameters

	Leguminous crops	Food crops
How it works; Science behind it	ground-nuts, peas, beans, lupine Family: Fabaceae Legumes - pods of the plant Pulses - seeds of the plant The roots of the leguminous plants contain rhizomatous bacteria which absorb atmospheric nitrogen and assimilate to the plant. This process is called Nitrogen fixation. The nitrogen is stored as plant proteins. The plant residues when decomposed forms absorb-able mineral nitreogen (ammonia, nitrates & nitrites) as fertilisers increasing the nitrogen content in the soil without the use of fertilisers	
Soil requirements	Sandy soil to sandy clay loam to sandy loam The ecosystem service functions of leguminous plants ais to increase the nitrogen content in the soil and increase its fertility. So they are grown in less fertile soils as a way to increase the fertility.	Loamy soil - fertile with high organic content Monocultures reduce the fertility of the soil by selectively absorbing minerals. It is necessary to find the crop rotation scheme based on their ecosystem services
Space requirements	8-16 hec per crop cultivation based on the efficiency of machinery use. 2.5 TO 3 TN/HA	8-16 hec acres per crop cultivation based on the efficiency of machinery use Barley - 8.9 Potatos - 42.6 Sugar beet - 88.8
Resource requirements	seed bank irrigation knowledge bank agricultural machinery warehouses percision agriculture (big data centres, GPS & soil sensors & computers)	seed bank irrigation knowledge bank agricultural machinery warehouses percision agriculture (big data centres, GPS & soil sensors & computers)
Stakeholders	Farmers Markets Governments Energy producers Fertilizer industry Food corporations & companies	Farmers Markets Governments Energy producers Fertilizer industry Food corporations & companies
Time of cultivation	Sowing season - dry (April-May) Harvest season - wet (August-September) Rest season - cover crops	Barley (Spring) - APR -- OCT Barley (Winter) - SEP -- AUG Potatoes - MAR -- OCT Sugar Beet - MID MAR - MID APR -- NOV-DEC Onions - MID MAR - MID APR -- MID JUL MID SEP Wheat (Winter)- MID SEP - MID OCT -- JUL-AUG Wheat (Spring) - MIDMAR -MID APR -- AUG-SEP Rye -MID SEP - MID OCT -- JUL-AUG Oats - MID MAR-MID APR--JUL -AUG Maize - MID APR - MID MAY --SEP-OCT(Food)/AUG-SEP(Feed)
Product by product	Food Feed waste - manure (natural fertiliser) Waste - biofuel	Food Feed waste - manure (natural fertiliser) Waste - biofuel

Algae	Cattle	Pigs
Different organisms that produce oxygen through photosynthesis. Light: Algae needs light energy to grow. The more sunlight that penetrates the area, the higher the chance for algae to sustain life. Nutrients: Nutrients, like nitrogen and phosphorus, fuel algae growth. Temperature: Warmer water leads to increased algae growth. Turbidity (water clarity): Particles suspended in water affect how light travels. The clearer the water, the more sunlight will penetrate. Stable Conditions: Most algae prefer stable water conditions with minimal turbulence.	Activity During the summer you will see cows grazing in the fields. In the winter they are kept indoors. Milking And cows are typically milked twice a day – once in the early morning, and again about 12 hours later. Eating Cows are diurnal mammals, which means they are up during the day and asleep at night. Age Cows naturally can turn 20 years old, but averagely they get slaughtered at the age of 6	Pigs function Field pigs do what machines and other animals cannot; churn the soil naturally, freeing up space for amphibians, insects, plants and trees. In addition, pigs can play a useful role in controlling invasive exotic species such as Giant hogweed. Age Fattening pigs are slaughtered after only 6-8 months and sows are often slaughtered after 2 years, as they are no longer economically viable by then. In the wild, however, pigs easily live to be 10-15 years and cases of 20-25 years are known.
Water These organisms can thrive in freshwater lakes or in saltwater oceans. They can also endure a range of temperatures, oxygen or carbon dioxide concentrations, acidity and turbidity, does not have to be still water	Clay and clay loam soils will have a greater propensity to hold water and nutrients than sandy loams and sand at the other end of the scale. To maintain good ground cover and root growth, different soil types under different environmental conditions will require different fertiliser and grazing regimes.	
Natural way : The most natural method of growing algae for biodiesel production is through open-pond growing. Using open ponds, we can grow algae in hot, sunny areas of the world to get maximum production. While this is the least invasive of all the growing techniques, it has some drawbacks.	- Barn - Water source - Plot of land 1 acre (4046.85 m2) grazing land per cow	
Natural Requirements Threads, sticks, water Technological Requirements Raceway ponds can vary in width, but are generally 1-5 meters (3-16 feet) wide. The length of a raceway pond can vary depending on the available space and the scale of the operation. Smaller ponds may be 10-20 meters		
Farmers Markets Energy producers Governments	Farmers Markets Energy producers Governments	Farmers Markets Energy producers Governments
Above 8 degrees celcius		
	milk, beef, manure, animal remains	

Appendix 3 / Spatial Elements Criteria Matrix

Zone	Spatial elements	Criteria	Location	Public-Communal-Shared-Private	
Biodiversity Strips	Biodiversity strips	1. connecting biotopes based on soil patterns 2. network based on EHS continuous element in the common ground with a minimum 3. width of 300m.	Inside the common ground	Communal	By 2020, promo restore degrade Take urgent and by 2020, protec
Transitory Agriculture (land rotation)	Pastures Leguminous crops Food farming	1. crop rotation sequence 2. maximum width 7,09% of agriculture 3. based on soil texture maximum parcel size of 16ha per use	On existing agricultural landscapes	Shared	Take urgent and by 2020, protec 15.9 By 2020, in cesses, poverty 11.3 By 2030, e sustainable hum
Agroforestry	Agro-forest	1. large parcels closer to naturally vegetated areas	Close by to natural zones	Communal	By 2020, promo restore degrade Take urgent and by 2020, protec 11.4 Strengthen
Algae farming	Algae farming as a natural zones buffer Algae farming as nitrogen run-off absorber Algae collection unit	1. Natural water 2. next to natural areas 3. with a minimum width of 100m 1. dispersed in the common grounds 2. near existing infrastructure 3. near agricultural lands 1. central location in the algae natural zone buffer	Buffers of natural 2000 and natural zones Near agricultural (artificial fertilized) fields Central location in the algae natural zone buffer	Private	14.1 By 2025, p ties, including m 14.3 Minimize a at all levels
Experimental zone	Knowledge centre R'nD' & Innovation hubs Experimental farming - pixel & precision Vertical farming & hydroponics	1. proximity urban area for better accessibility and need for human resources 2. easily accessible by public transport 1. proximity to the urban area for its connections to universities and collaboration with government agencies 1. in the common grounds 2. closer to RnD and innovation hubs 3. closer to agricultural lands 4. 1 experimental plot per 100 transitory agriculture plots as a start. 1. proximity to urban fabric or existing artificial farming techniques like greenhouses	Urban extensions Urban extensions On the common grounds central to transitory agricultural zones Urban extensions and near greenhouses	Shared	
Storage zone	Warehouse & storage Resource bank - machinery	1. closer to highways 2. easily accessible to users (farmers) - central location	Public intersections central to agricultural fields	Private Shared	

Policy	Stakeholders	Stakeholders S-scale
te the implementation of sustainable management of all types of forests, halt deforestation, ed forests and substantially increase afforestation and reforestation globally d significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, t and prevent the extinction of threatened species	farmers forestry local government Ministry of Agriculture, Nature and Food Quality European environmental agency European Commission nature	farmers Ministry of Agriculture, Nature and Food Quality Staatsbosbeheer Local government of Westvoorne, Brielle, Hellevoetsluis, Rotterdam, Maassluis, Westland European environmental agency European Commission nature
d significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, t and prevent the extinction of threatened species. ntegrate ecosystem and biodiversity values into national and local planning, development pro- reduction strategies and accounts. nhance inclusive and sustainable urbanization and capacity for participatory, integrated and man settlement planning and management in all countries	farmers local government national government European environmental agency Ministry of Agriculture, Nature and Food Quality Copernicus Land Monitoring Service European Commission nature	farmers Ministry of Agriculture, Nature and Food Quality Staatsbosbeheer Province of South-Holland Copernicus Land Monitoring Service nature
te the implementation of sustainable management of all types of forests, halt deforestation, ed forests and substantially increase afforestation and reforestation globally. d significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, t and prevent the extinction of threatened species. efforts to protect and safeguard the world's cultural and natural heritage	farmers forestry local government national government European environmental agency European Commission nature	farmers Ministry of Agriculture, Nature and Food Quality Staatsbosbeheer Province of South-Holland nature
revent and significantly reduce marine pollution of all kinds, in particular from land-based activi- marine debris and nutrient pollution nd address the impacts of ocean acidification, including through enhanced scientific cooperation	farmers forestry local government national government European environmental agency European Commission WISE infrastructure companies	farmers Ministry of Agriculture, Nature and Food Quality Staatsbosbeheer Province of South-Holland Rijkswaterstaat infrastructure companies nature
	farmers forestry local government national government European environmental agency European Commission EEA (European Education Area) students universities employees WISE nature	The Ministry of Education, Culture and Science Province of South-Holland farmers Staatsbosbeheer Province of South-Holland Rijkswaterstaat students universities primary schools secundairy schools European environmental agency European Commission EEA (European Education Area) nature
	farmers private enterprises local government nature	Local government of Westvoorne, Brielle, Hellevoetsluis, Rotterdam, Maassluis, Westland farmers private enterprises ICT-companies nature

Zone	Spatial elements	Criteria	Location	Public-Communal-Shared-Private	
Public intersections 1.includes program that connects to (local) public life 2. includes program that connects agricultur	Land bank office Forums Infrastructural cross-overs Engagement zones	1. intersections with local roads with the common grounds 2. intersection of various land covers for better spatial/visual connectivity 3. interaction with local community 4. It is a point and not a zone. These are designed per local context.	1. Intersections with local roads with the common grounds 2. Intersection of various land covers for better spatial/visual connectivity	Shared Public Public Public	
Urban agriculture	Community farming Greenhouses	1. close proximity to urban fabric 2. easily accessible by bike and public transport 3. common land accessible by other than environmental stewards 4. interaction with local community 5. maximum of 1km away from the city edge 6. be a connector between urban patch and common ground	1. Urban extensions in the transition overlaps between the 2.Urban space and the common ground 3. At the border of an urban space	Communal Private	
Energy landscapes	Biomass energy units Hydrogen energy units Nitrogen extractors Green ammonia production Solar & wind energy	1. Existing energy infrastructure 2. Potential transformable landscapes to energy infrastructure - industrial use 3. Closer to urban fabric for the use of energy to minimise transmission losses	Industrial zone or the port	Private	

Policy	Stakeholders	Stakeholders S-scale
	local government national government tourists inhabitants employees nature	farmers Ministry of Agriculture, Nature and Food Quality Staatsbosbeheer Local government of Westvoorne, Brielle, Hellevoetsluis, Rotterdam, Maassluis, Westland European environmental agency European Commission private enterprises Province of South-Holland urban architects urbanists nature
	local government local inhabitants nature	Local government of Westvoorne, Brielle, Hellevoetsluis, Rotterdam, Maassluis, Westland Inhabitants of Westvoorne, Brielle, Hellevoetsluis, Rotterdam, Maas-sluis, Westland nature
	infrastructural companies local government Ministry of Economic Affairs and Climate Policy (EZK) European Commissioner for Energy nature food industries	infrastructural companies Ministry of Economic Affairs and Climate Policy (EZK) European Commissioner for Energy nature Province of South-Holland local food industries

Appendix 4 / UN Sustainable Development Goal Indicators

Goal 1. End poverty in all its forms everywhere		
3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination		C030901
	3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)	C030902
	3.9.3 Mortality rate attributed to unintentional poisoning	C030903
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all		
4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	4.4.1 Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill	C040401
4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development	4.7.1 Extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment	C200306
Goal 5. Achieve gender equality and empower all women and girls		
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.1 Proportion of domestic and industrial wastewater flows safely treated	C060303
	6.3.2 Proportion of bodies of water with good ambient water quality	C060302
6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	6.5.1 Degree of integrated water resources management	C060501
	6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation	C060502
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1 Change in the extent of water-related ecosystems over time	C060601
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all		
7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption	C070201

Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation		
9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all	9.1.1 Proportion of the rural population who live within 2 km of an all-season road	C090101
	9.1.2 Passenger and freight volumes, by mode of transport	C090102
9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	9.4.1 CO2 emission per unit of value added	C090401
Goal 10. Reduce inequality within and among countries		
10.3 Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard	10.3.1 Proportion of population reporting having personally felt discriminated against or harassed in the previous 12 months on the basis of a ground of discrimination prohibited under international human rights law	C200204
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable		
11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	11.3.1 Ratio of land consumption rate to population growth rate	C110301
	11.3.2 Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically	C110302
11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage	11.4.1 Total per capita expenditure on the preservation, protection and conservation of all cultural and natural heritage, by source of funding (public, private), type of heritage (cultural, natural) and level of government (national, regional, and local/municipal)	C110401
11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning	11.a.1 Number of countries that have national urban policies or regional development plans that (a) respond to population dynamics; (b) ensure balanced territorial development; and (c) increase local fiscal space	C110a02

Goal 12. Ensure sustainable consumption and production patterns		
12.2 By 2030, achieve the sustainable management and efficient use of natural resources	12.2.1 Material footprint, material footprint per capita, and material footprint per GDP	C200202
	12.2.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP	C200203
12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	12.3.1 (a) Food loss index and (b) food waste index	C120301
12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	12.4.1 Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement	C120401
	12.4.2 (a) Hazardous waste generated per capita; and (b) proportion of hazardous waste treated, by type of treatment	C120402
12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	12.5.1 National recycling rate, tons of material recycled	C120501
12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities	12.7.1 Number of countries implementing sustainable public procurement policies and action plans3	C120701
12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature	12.8.1 Extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment	C200306
Goal 13. Take urgent action to combat climate change and its impacts4		
13.2 Integrate climate change measures into national policies, strategies and planning	13.2.1 Number of countries with nationally determined contributions, long-term strategies, national adaptation plans and adaptation communications, as reported to the secretariat of the United Nations Framework Convention on Climate Change	C130203
	13.2.2 Total greenhouse gas emissions per year	C130202
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development		
14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	14.1.1 (a) Index of coastal eutrophication; and (b) plastic debris density	C140101
14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	14.2.1 Number of countries using ecosystem-based approaches to managing marine areas	C140201
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss		
15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	15.1.1 Forest area as a proportion of total land area	C150101
	15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type	C150102
15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	15.5.1 Red List Index	C150501
15.9 By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts	15.9.1 (a) Number of countries that have established national targets in accordance with or similar to Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011–2020 in their national biodiversity strategy and action plans and the progress reported towards these targets; and (b) integration of biodiversity into national accounting and reporting systems, defined as implementation of the System of Environmental-Economic Accounting	C150902
15.a Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems	15.a.1 (a) Official development assistance on conservation and sustainable use of biodiversity; and (b) revenue generated and finance mobilized from biodiversity-relevant economic instruments	C200210

Urbanism

TU Delft