

Revitalizing the socio-ecological agricultural landscapes of North-West European Lowlands

From Degradation to Regeneration

Revitalizing the socio-ecological agricultural landscapes of North-West European Lowlands

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R&D Studio: Spatial Strategies for the Global Metropolis (AR2U086)
Research & Design Methodology for Urbanism (AR2U088)

Msc3 Urbanism, 2022-2023
Faculty of Architecture and the Built Environment
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All images, diagrams, graphics are by the authors unless stated otherwise. Sources for additional data are mentioned within the page.

Abstract

The current food production and distribution system has led to extensive degradation on both the global and local scale, requiring a transformation of the vast, urbanized rural - beyond just climate-change mitigation but radical regeneration.
The ongoing intensive agricultural practices have contaminated air, soil, and water, while their market-driven character disallows the emergence of locality and circularity, exploiting workers and small-scale farmers, and disrupting the social welfare of the countryside. This system is analysed through the lenses of ecology, economy, and society, highlighting the problematic character of the Lowlands of North-West Europe, due to the immense sprawl of degenerative agriculture practices, as well as the small and fragmented network of ecosystem-valuable spaces.
Following the most urgent climate-change scenario from the IPCC report, we will attempt the transition from a degenerative system towards a regenerative one, based on the pillars of ecosystem restoration, ensuring food security through sustainable means, and the shift towards regenerative agriculture practices. Concerns about spatial justice permeate all pillars horizontally, to ensure the socio-spatial regeneration of the countryside.
To transition towards our vision, the strategy is approached through a series of interconnected key projects. The formation of a pan-European network of tree nurseries ensures the necessary capital of seedlings for reforestation and agroforestry practices, while a trans-border policy zone can integrate conservation and agriculture, enhancing the connectivity between ecosystems. The greenhouse zone of Westland is experimented upon, aiming towards the development of a replicable model of sustainably intensive food production model. These strategic interventions are underlined by a policy framework, stressing the liveability of the Lowlands for all rural dwellers, farmers, and workers, through access to services, education, and housing.
Through this experimentation we hope to have highlighted that the examination of the countryside needs to be intrinsically tied to any effort of envisioning a future of climate-change mitigation and socio-ecological regeneration.

Keywords: Degradation · Countryside · Lowlands · Regeneration · Regenerative agriculture · Northwest Europe · Food security

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01 introduction

1.1 General introduction

By 2050 it is expected that two out of three people will live within urban environments, underlining the need for sustainable solutions to keep the city and its hinterland habitable (United Nations, 2019). In the Netherlands, it is expected that the number of dwellers in the Randstad will be 23% higher by 2050 (Manders and Kool, 2015). However, population growth is not expected to slow down after 2050 (United Nations, 2019).

Subsequently, rural areas deal with the problem of brain drain and social-economic deterioration leading to the disappearance of everyday amenities and infrastructure (Deller et al, 2005; ESPON, 2017). Consequently, rural areas are classified as lesser developed in European welfare indexes and in need of regional support to sustain (EPSON, 2021). Due to the lack of political interest towards those degrading regions in past decades, inhabitants of those areas developed low trust in governmental and political bodies, making political mediation difficult (ZEIT ONLINE, 2019). This is further emphasised by the recent wave of farmer's protests in the Netherlands related to the nitrogen crisis, showing that a dialogue or a so-called 'polder-model' is further away than ever.

From a natural standpoint erosion and pollution have degraded one-third of the world's arable land, compromising food security and natural health, over the last 40 years (Ridgman, 1990). This is largely due to agricultural practices such as tilling and chemical fertilizer use, which have degraded and polluted the soil (Maximillian et al., 2019). The UN's Food and Agriculture Organisation predicts that the remaining fertile soil will be completely degraded within 60 years if current practices continue (FAO & UNEP, 2021). Similarly, industrial practices reliant on fossil fuels have polluted the land and increased greenhouse gas emissions. Both sectors moreover prioritize economic gain over environmental sustainability.

The United Nations further states that due to urban population growth and climate change, rural fabrics must adapt towards future climate conditions, while also finding solutions to keep the brain drain from continuing without hindering the growing demand for food from the growing urbanized areas (2019). Climate change will only expand the scope of environmental problems such as causing more extreme weather and further increasing the need for fertilizer (Intergovernmental Panel on Climate Change - IPCC, 2018). Furthermore, an increase in the occurrence and intensity of heat waves, rainfall and periods of drought are expected to impact the continent. Consequentially lowering the physical conditions capable to cope with this weather.

Regenerative practices offer changes to mitigate the deteriorating countryside, however, imminent action is required. Establishing a regenerative countryside centred around ecosystem restoration, food security and regenerative agricultural practices, offers the potential to provide financial incentives that create an impetus for change. Restoring ecosystem services, ensuring food security, and promoting innovations towards agricultural production. A nature-valuing regenerative economy can not only stop but also reverse emissions.

'From degradation to regeneration' proposes a strategy for the spatial development of Northwestern Europe that allows the proposed strategy to shape the future of Europe, through a regenerative economy. As we approach the earth's limits, we must reassess our priorities, from consumption choices to land management, for climate justice, resilience, and sustainable growth. Rethinking our relationship with nature is essential.



Fig 1.1 Introduction to the NWE frame

The map shows the extents of our XL scale which comprises Netherlands, Belgium, Denmark, France, Germany, Switzerland and UK.

1.2 Agriculture in North West Europe

The ‘from degradation to regeneration strategy’ is an integrated spatial vision and development strategy outlining a desirable spatial agricultural future for North-western Europe, which sets out a path towards spatial changes by means of spatial interventions phased in a timely manner considering all actors (Speulman et al., 2023). It explores the impact of sustainability transitions and spatial claims beyond the urban areas. It contemplates circular economy, de-centralisation, and sustainable land use to reconcile claims with wider Northwest Europe and ongoing Dutch national spatial planning (Speulman et al., 2023). Moreover, the problem of social inequality is tackled by introducing the concept of socio-spatial justice. Leading to a report contributing to the political debate regarding the future of Europe.

The context for this spatial vision is formed by the frame of North-western Europe, a one million square kilometre big area, containing North France, Belgium, The Netherlands, Germany, South England, Denmark, Switzerland, and eastern Austria. The Landscape is dominated by coastal lowlands subjugated by plains of agricultural production which extend to mountainous regions with extensive tree cover. Within them, agglomerations of urbanised areas scatteredly fill the in-between throughout them.

One of the world’s most densely populated and highly urbanized regions has emerged in North-western Europe, due to the combination of complex peri-urban and semi-rural environments and the dominance of agricultural production in the lowlands, leading to significant infrastructure development.

However, currently, rural agricultural environments are already experiencing environmental problems, related to the intensification of the production landscape (Brand, 2023). Subsequently, most Dutch agricultural grounds have seriously deteriorated their natural surroundings (Brand, 2023; CBS, 2023; EPRTR, 2010). Besides, the complex spatial distribution has resulted in the uneven distribution of burdens and benefits of this development.

The historic context of this agricultural landscape lies within the ever-globalizing world, technological changes, and market liberalization of the 1980s (Van der Bie and Dehing (eds.), 1999). Besides, the so-called ‘green revolution’ transformed the agricultural production capacity throughout the lowlands after the second world war. It encompassed a transformation to a system of specialisation and scaling up of the farms and the introduction of mechanised machinery, artificial fertilizer, and spatial concentration of production, resulting in the formation of monocultural highly specialized production landscapes (Van der Bie and Dehing (eds.), 1999; The Economist, 2023; Viviano, 2021; Torrella, 2023). Accordingly, over the past few decades, agricultural production has steadily increased. Currently, the Dutch agricultural landscapes result in more than 100 billion euros of annual farming sales overseas, making it the second largest exporter of agricultural products after United States, and making twice as much cheese per head as France (The Economist, 2023).

Conversely, this increase has led to negative consequences such as increased pressure on the environment and animal welfare. For instance, Dutch agriculture emits large amounts of methane, and the use of crop protection products results in nitrogenous substances and residues that impact the environment (Brand, 2023; CBS, 2023; The Economist, 2023; The Economist, 2022; Harvey, 2018).

Contrarywise, mitigation legislation is required to combat the negative impacts and meet the EU legislation regarding pollution limits. National governments are working on implementing that legislation. Though, these implementations lead to further societal debate and regional division leading to civil unrest (The Economist, 2023, Harvey, 2018; Coates, 2023; CBS, 2023; NOS, 2023a; NOS, 2023b; NOS, 2023c, Smit, 2023).



Fig 1.2 Greenhouses in Westland

The Westland greenhouse pictured in the photo is surrounded by a seemingly natural and green landscape. However, this particular environment is not conducive to promoting biodiversity.

1.3 Definitions

WHAT IS...?

Regeneration
Regeneration means enhancing a place or system for its betterment, including moral or spiritual improvements, towards a superior state (Mang et al, 2012). Unlike sustainability, regeneration seeks to add value by designing systems that evolve with ecological health (Reed, 2007). It aims to reverse environmental degeneration and co-create human systems that mutually benefit nature, drawing inspiration from natural self-organizing abilities (Re-alliance, n.d.; Mang et al, 2012).

Circular
The circular economy's defining element is the restorative use of resources (Geisendorff & Pietrulla, 2017) – it implies the reduction of waste to a minimum through sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible, to extend the life cycle of products. It is a departure from the traditional model of the linear economy, in which products are created, consumed, and then disposed of – requiring massive quantities of inexpensive raw materials and energy (European Parliament, 2023). The concept was first presented in the 1966 book "The Economics of the Coming Spaceship Earth", in which the author claimed that "circular systems within the global economy are unavoidable in order to guarantee human life on Earth in the long run" (Geisendorff & Pietrulla, 2017). From a legislative viewpoint, in the EU Action Plan for the Circular Economy, The European Commission defines that "in a circular economy the value of products is maintained for as long as possible; waste and resource use are minimised, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value" (European Commission, 2015).
What is (environmental) degradation?
(Environmental) degradation refers to the decline of the environment due to natural or human factors Vocabulary.com, n.d.; Cambridge Dictionary, n.d.). It involves the depletion of resources, destruction of ecosystems, and extinction of wildlife, and is recognized as a major global challenge. If the environment becomes irreparably harmed, it could result at the end of human existence (United Nations Economic and Social Commission for Western Asia, 2015). Many global organizations are aware of this issue and are taking measures to mitigate its effects (European Environment Information and Observation Network, 2021).

Rural
Rural areas are typically open, sparsely populated lands with agriculture as the primary industry (National Geographic, n.d.). However, perceptions of rurality can be exclusive and inaccurate, with attributes ascribed to it often based on stereotypes. The United States Census Bureau defines rural as any population, housing, or territory, not in an urban area (United States Census Bureau, n.d.). Media may equate rural with white farmers, but this narrow view overlooks the diversity of rural communities (Bennett et al., 2019). Perceptions of rurality can vary depending on cultural background, highlighting the need for more inclusive and accurate depictions. Even for this project, coming from different ethnic backgrounds, the perceptions of rural varied heavily.

Countryside
The countryside is a district or region of a country with natural unity, often used for agriculture and seen as a place to escape the fast pace of urban life (Fairclough, G, 2015). However, historically, it was a defence against change. To promote a more forward-looking approach, our project aims to create a flexible, interconnected countryside that can adapt to future changes effectively (Fairclough, 2015). The European Landscape Convention encourages this approach, and the project hopes to make a positive impact by reimagining the countryside as a dynamic and agile space.

Agriculture
In the broadest and most inclusive term, agriculture can be defined as "the art and science of cultivating land for growing crops (farming) or raising livestock (ranching)" (National Geographic, n.d.). It is frequently qualified by words such as incipient, proto, shifting, extensive, and intensive, the precise meaning of which is not self-evident. Many different attributes are used to define forms of agriculture, such as soil type, frequency of cultivation, and principal crops or animals. The term agriculture is occasionally restricted to crop cultivation excluding the raising of domestic animals, although it usually implies both activities (Harris et al., 2014).

Regenerative agriculture
Regenerative agriculture is a holistic approach that addresses environmental and social issues, including climate change, biodiversity loss, and soil degradation (Intertribal Agriculture Council (IAC), 2022). It fosters resilient communities by promoting healthy soil for plant growth, water retention, and carbon sequestration. It strengthens rural areas, encourages community resilience, and promotes an adaptive and inclusive food system. By aligning with nature, regenerative agriculture challenges the current growth-oriented economic model (Intertribal Agriculture Council (IAC), 2022).

Intensive vs. Extensive
Intensive and extensive agriculture are two approaches to farming. Intensive agriculture involves maximizing yields on a small area. It uses high inputs including capital, labor, and technology. This method often comes at the expense of the environment causing soil degradation, water pollution, and loss of biodiversity.
Extensive agriculture involves using low inputs on a larger area of land. This approach does not aim to produce quantity but to use resources in a sustainable way and have less environmental impacts. (Encyclopaedia Britannica, 2022)
Sustainable intensification combines the benefits of intensive and extensive agriculture, and is considered a good way to sustain food security. It involves maximizing yields by using advanced technology such as precision farming techniques to reduce the use of chemicals, water and minimize waste. (CIMMYT, 2020)



Fig 1.3 Precision Farming in Westland.
During one of our field trips to Tomatoworld in Westland in the Netherlands, we were introduced to the world of precision farming and how it is revolutionizing agricultural production.

1.4 Senses and memory

Field Excursions in South Holland
During the first week of the quarter, we ventured into different areas of South Holland, to understand the various conditions and manifestations of the rural Netherlands. Our team split up and explored the peri-urban areas of Delft and Rotterdam, specifically Kinderdijk, Zuidplaspolder – Krimpenerwaard, Westland and Rotterdam-Dordrecht.

1.4.1 Kinderdijk
Kinderdijk is a village in the Netherlands that is famous for its historic windmills, which were built in the 18th century to help drain the surrounding wetlands and prevent flooding. It is a popular tourist destination in the Netherlands, and many visitors come to Kinderdijk to take a boat tour or a bike ride through the scenic countryside. Kinderdijk is an ideal case study for the integration of clean energy systems such as wind and water with the built environment. The windmills in Kinderdijk are also integrated with living functions, agricultural fields as well as it is home to rare forms of biodiversity.



Fig 1.4.1 Windmills in Kinderdijk
The traditional Dutch landscape with a windmill standing beside a peaceful canal. The area's unique landscape provides a rare thriving habitat for various species, enhancing biodiversity.

1.4.2 Westland
Making our way from the centre of Delft towards the core of Westland, it became obvious very quickly that our preconceived notions and definitions of rural were failing to suffice. The traditional picturesque Dutch polder-scape, with flat green fields, small villas, and windmills, was juxtaposed with pieces of huge infrastructure – highways, bridges, electricity poles. Apparent throughout was a sea of greenhouses, occupying every nook available: surrounding pre-war elegant villas, at the background of modernist apartment blocks or next to social housing settlements. Here nothing felt truly rural – can it still be regarded as countryside?

The traditional perception of the countryside is usually tied to ideas of natural, folk, and pure. However, in Westland, even though much of the landscape is open and green, upon closer inspection it is always controlled and artificial. The many nesting dike systems of the polder-scape, traces of machinery and intense maintenance on the grasslands hinted towards this artifice. This experience raised many questions about identity and character: Is this place regarded as rural, non-urban, local, traditional, picturesque, or folk?

Here we also had the opportunity to visit Tomato world – a high-tech horticultural research facility in the heart of Westland, that experiments intensely to produce efficient vegetable species as well as automated cultivation, pollination, maintenance and harvesting systems. The interior of their greenhouse was kept at a high security, only accessible with a protective suit. Specific species of bees could be seen roaming around, while a state-of-the-art system mapped out the interactions of each specific plant – measuring its physical characteristics, soil quality, water availability, and growth. This engineered nature remained sealed within the greenhouse, with no interactions to the external environment. How can nature become again a principal factor in a place like this?

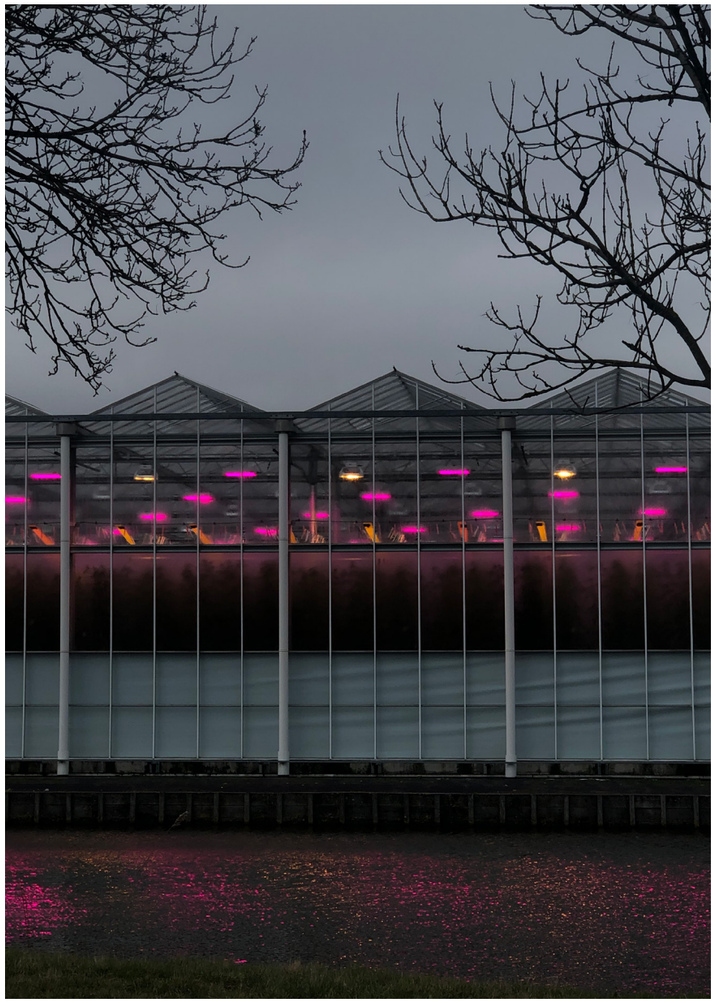


Fig 1.4.2 Verical farm in Westland
The purple LED lighting of the modern vertical farm shows just one example of how technology can improve precision farming. However this light pollution and the general practices in Westland also have negative consequences.

1.4.3 Gouda

When travelling between Rotterdam and Gouda an area used for both recreation and water storage passes the traveller. This area is part of the Rotte nature reserve in conjunction with the Willem Alexander rowing course. This area serves as a resting place for migrating birds and as a place to store large quantities of access water from rainstorms to keep the nearby Rotterdam's suburbs dry. Moreover, further along, the trip the area offers a mosaic of built-up with crops and grasslands mixed in between. Purley signifies the Dutch planning culture of the patchwork metropolis.

When continuing to tour from Gouda to Krimpen aan de Ijssel a wide-open landscape filled with purely monocultural pastures, as far the eye can see passes by. These landscapes are the heart of agricultural livestock production and home to tens of thousands of cows producing derry for the famous Gouda cheese. Occasionally a historic 'lint' village varies the terrain. These villages mostly accommodate only farms, and occasionally a small supermarket or bus stop. For schools, or shopping travelling to the bigger towns is necessary.





Fig 1.4.3 Protest banner in Gouda

A Dutch farmer displays a protest banner on his land reading "Put an end to this outrageous policy!" referring to the farming industry's frustrations with current nitrogen policies.

1.4.4 Rotterdam Dordrecht

The landscape between Rotterdam and Dordrecht is dominated by the river and its adjacent industrial landscape. Again, a form of a monocultural patchwork landscape with little to non-internal links or connections dictates an area. Occasionally villages or small natural or agricultural patches diversify this landscape. When moving along the dyke beside the river Rhine the eye catches the diversification of different industrial usages with hard transitions between them. When using the waterbus, one of the few public transport options in the area, it becomes apparent that these industries form a monotone shoreline hiding what lies behind them and prohibiting access to the shoreline. Even outside the so-considered 'built-up' areas, this coverage continues. Differences were however noticeable between the residential and industrial buildings, offering a sense of diversification. Besides, near Dordrecht and Rotterdam, the scale and density of buildings increased exponentially as can be expected from urban cores.

What stood out was that even within the few natural patches the presence of humans always dominated. Either by the apparent noise of nearby traffic or more directly by infrastructural constructions crossing through them. This raised the question of how we could combine such a dense area with connections in a fragmented landscape to assist in improving those transitions between the different functions to lead to the regeneration of the countryside.



Fig 1.4.4 Rotterdam Dordrecht industry

The dynamic landscape of the Rotterdam-Dordrecht industrial harbor is a hub of trade and commerce dominated by human presence.

1.5 Problem Statement

The co-relationship between the countryside and agriculture is a complex and dynamic one with the agricultural practices shaping the countryside and the countryside influencing how agriculture is practised in a particular area. The countryside in North-West Europe is a juxtaposition of human footprint over a diverse set of natural landscapes such as hills, forests, grasslands, and polders. wetlands, coastlines and so on. Relief features such as topography, existing soil types and the regional climatic conditions have, through the course of history, influenced the development of different agricultural techniques across the region such as pastoral farming in the mountainous areas as compared to arable farming in the lowlands, thereby shaping the socio-cultural landscapes of its region. Agriculture too has also played a pivotal role in shaping the countryside as it has dictated the patterns of land use changes over time. For instance, the Dutch population living in the lowlands invented the polder system to create their own food landscapes.

World War 2 led to widespread famine across North-West Europe, such as the 'hunger winter' in the Netherlands. This resulted in the heavy industrialization of the agricultural practices in North-West Europe including mechanization and use of chemical fertilizers and pesticides. These technological advancements might have allowed farmers to increase productivity and efficiency with reduced labour costs, but it also led to the exploitation of natural resources such as the health of soil and animal welfare. Moreover, the shift towards intensification of agricultural production focused on the selective cultivation of a few species of crops and rearing a specific type of livestock which resulted in a loss of biodiversity, environmental degradation, and disruption of the 'rights of nature'.

As per the European Environment Agency, the profit-oriented agricultural industry accounts for approximately 10% of the total greenhouse gas emissions in the European Union. Activities such as livestock production, deforestation and changing land-use patterns have resulted in the emission of significant amounts of greenhouse gases such as methane and nitrous oxide which cause environmental pollution and global warming. Moreover, excessive use of pesticides in agriculture has been directly linked to several health issues such as higher cancer rates and neurological disorders as well as outbreaks of food-borne and zoonotic diseases.

The countryside of North-West Europe has inadequate transportation infrastructure and limited access and connectivity through public transportation making it difficult for its residents to access basic education and employment, resulting in an economic disadvantage. In particular, the working lower-middle class employed in the agriculture sector are subjected to exploitation through long working hours, low wages, lack of legal protection, and limited access to safe and affordable housing, ultimately leading to discrimination, social isolation, and health problems.

The pressing issue of climate change will impact agricultural production in the countryside with increased frequency of extreme weather events such as heatwaves, droughts and storms which adversely affect crop yield, soil quality and water availability. Furthermore, sea level rise presents a major threat to coastal areas and low-lying countries like the Netherlands face challenges such as flooding and land loss, saltwater intrusion and soil salinization which will directly impact agricultural production.

The issues of exploitation through a production-oriented mindset call for a transition from a profit driven agrarian society in the countryside of North-West Europe towards a socio-ecological regenerative future.

The existing food production and distribution system leads to ecological, economical and social degradation in a global scale.

The intensive agriculture practices contaminate air, soil and water - continuously causing irreversible environmental damages.

Profit-driven practices disallow the emergence of circularity, exploit workers and small-scale farmers, disrupting the social welfare of the countryside.

Thus, there is an urgent need for a transition towards a just, ecocentric regenerative future.

profit driven agriculture causes...

DEGRADATION

contamination of air, soil and water

exploitation of resources

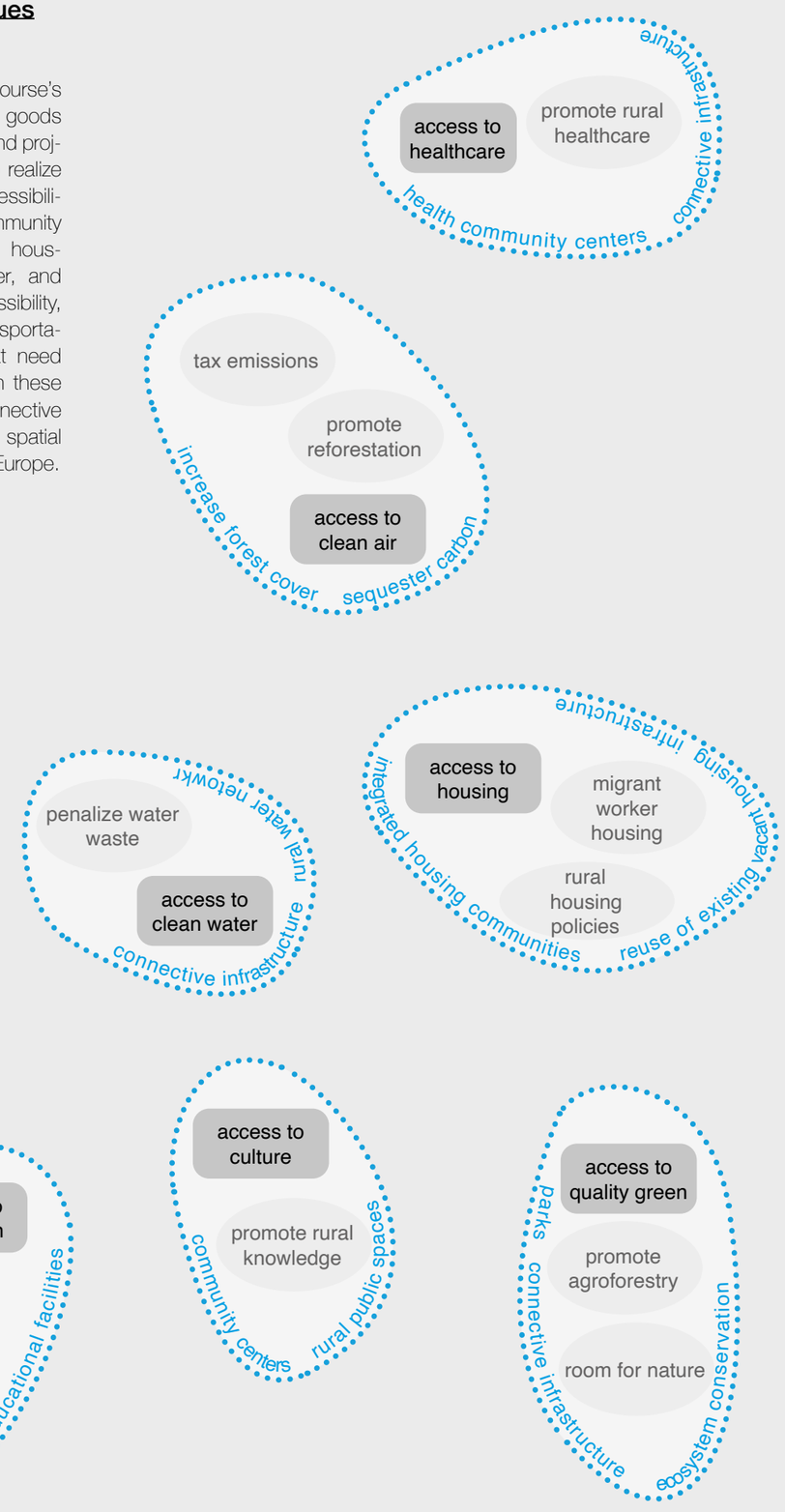
social injustice

GREENHOUSE GAS EMISSIONS

1.6 Public goods & Values

What is a public good?

Following the methodology course's exercise, a network of public goods was interrelated with policies and project ideas. We have come to realize that our main concern is accessibility – regarding education, community spaces, healthcare, culture, housing, quality food, clean water, and air, as well as physical accessibility, through connectivity and transportation. The spatial projects that need to be manifested to approach these public goods are mainly connective infrastructure that bridges the spatial divides of rural north-western Europe.



1.7 Existing policies

2030 Agenda for Sustainable Development

United Nations 2030 Agenda for Sustainable Development is a global action plan that was adopted by all United Nations Member States in September 2015 which seeks to strengthen universal peace globally. The agenda consists of 17 Sustainable Development Goals (SDGs) that are integrated and indivisible within three dimensions of sustainable development (economic, social, and environmental). The Goals and targets will invigorate action over the next fifteen years in critical areas for humanity and the planet, for today and future generations. (United Nations, 2015)

Paris agreement

The Paris Agreement is a legally binding international agreement on climate change which was adopted on 12 December 2015 at the UN Climate Change Conference (COP21) in Paris. Its overarching goal is to keep the increase in the global average temperature below 2°C and limit the temperature increase to 1.5°C above pre-industrial levels. The Paris Agreement works on a five-year cycle of climate action plans, carried out by countries, and entered into force in 2016. (United Nations Framework Convention on Climate Change, 2015)

European Green Deal

The European Green Deal is a new growth strategy aiming to convert the EU into a fair and prosperous society, competitive economy, and resource efficiency. It aims to protect, preserve, and enhance the EU's natural capital, and protect people's health against environment-related risks and impacts while simultaneously, this transition must be just and inclusive. Overall, it is an integral part of this Commission's strategy to implement the United Nation's 2030 Agenda and the sustainable development goals aiming to have no net emissions of greenhouse gases in 2050. (European Commission, 2019)



Fig 1.7.1 Sustainable Development Goals
Showing the 17 SDG's, each represented by a unique icon along with their respective targets, indicators and what pillar they are related to.

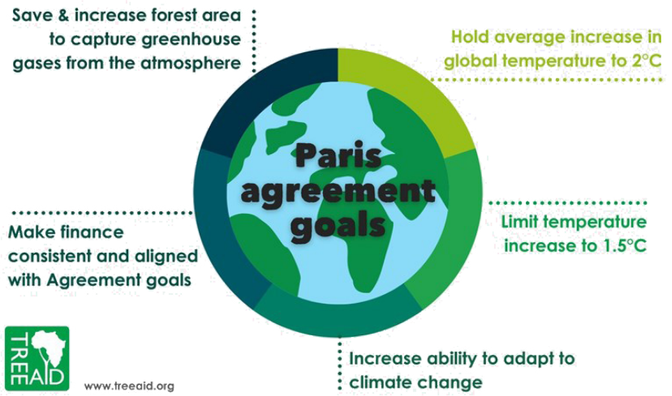


Fig 1.7.2 Paris agreement goals
Graphic of the five main goals of the Paris Agreement. These include limiting global warming to 1.5°C, increasing the ability to adapt to global warming and saving and increasing forest area.

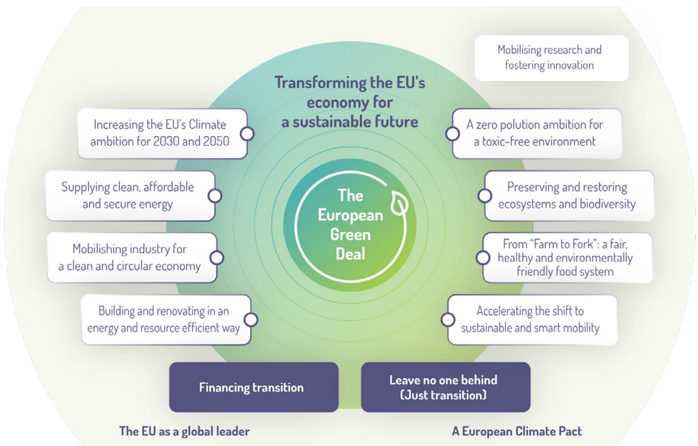


Fig 1.7.3 The European Green Deal
The EU Green deal seeks to transform economy, aiming to ensure a just transition while tackling the climate change crisis.



Fig 1.7.4 Farm to Fork
Showing the key components of the Farm to Fork Strategy which is part of the European Green Deal.

Farm to Fork strategy

The Farm to Fork Strategy is an essential part of the European Green Deal aiming to create a fair, healthy, and environmentally friendly food system. The Strategy aims to expedite the transition to a sustainable food system which will have a neutral or positive environmental impact aiming to climate change mitigation, biodiversity protection, food security and public health. The strategy presents both regulatory and non-regulatory initiatives, with the common agricultural policies as crucial mechanisms to promote a just transition. (European Commission, 2019)

Rural Action Plan

The Rural Action Plan was adopted in December 2021 illustrating the European Commission's commitment to acting for rural areas. One of its initiatives is to create a Rural Pact, aiming to strengthen multi-level governance mechanisms for the EU's rural areas, which have an essential role in the future of rural areas. The Rural Pact is a framework for collaboration between authorities and stakeholders which intends to achieve the shared goals of the long-term vision for the EU's rural areas. (European Union, 2021)

Environment Action Programme

The Environment Action Programme (EAP) sets out a long-term vision for 2050. Objectives include protecting, conserving, and enhancing the EU's natural wealth, turning the EU's economy into a resilient economy capable of being resource-efficient, green, competitive, and carbon-neutral and protecting the EU's citizens from environmental risks and ensuring health. The objectives will be reached by integrating policies, improving knowledge sharing, and investment schemes (O'Briain, 2018).
Building on the EAP, an EU biodiversity strategy was introduced, it aims to halt and revere the loss of biodiversity and ecosystem services in the EU and helps to stop global biodiversity loss. It implements clear targets and mid-term reviews to assess whether the Eu is on the right trajectory to meet the objectives (European Commission, 2023b).

EU Nature Restoration Laws

The EU Nature restoration law gives legal protection and a spatial policy to the need for restoring wetlands, rivers, forests, grasslands, marine ecosystems, and the species they host. It targets and legally binds restoration for specific habitats and species, covering 20% of the EU's land and sea area by 2030, and utilizing all ecosystems in need of restoration by 2050 (European Commission, 2023c). Targets include improving and re-establishing biodiverse habitats on a large scale for wetlands, forests, grasslands, rivers and lakes, heath & scrub, rocky habitats, and dunes, with the goal of bringing back species populations by enhancing and expanding their habitats (European Commission, 2023c). Every EU member state is required to make a National Restoration Plan, outlining how they will meet the set targets and is legally bound to monitor and report their progress to the European Environmental Agency (European Commission, 2023c).

Natura 2000

Natura 2000 is a vast network of essential breeding and resting sites for endangered species and rare natural habitats protected throughout all 27 EU countries, including marine areas (European Commission, 2023d). The purpose is to guarantee the preservation of Europe's most valuable and at-risk species and habitats, classified under both the Birds Directive and the Habitats Directive (European Commission, 2023d). The primary focus of conservation and sustainable usage of the Natura 2000 areas is centred on collaboration between people and nature. Nevertheless, Member States are responsible for ensuring that these sites are managed sustainably from both ecological and economic standpoints.

Approximately 18% of the EU land cover and 8% of its marine cover is covered by Natura 2000 protected nature, making it the world's largest network of protected areas. However, the areas are not connected within but stretch the entire EU and are fragmented throughout (European Commission, 2023d).

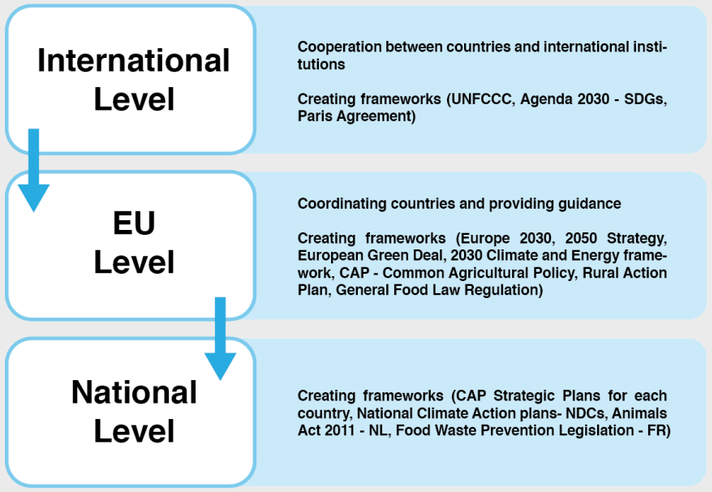


Fig 1.7.5 Graphic on political levels

This graphic shows the hierarchy of international, EU, and national levels and the frameworks they created.

Interreg

The Interreg program is a European Territorial Cooperation program that aims to promote cross-border cooperation between regions and countries within the European Union (EU) (European Commission, 2023e). The program focuses on addressing common challenges, developing shared solutions, and promoting sustainable development. The program provides funding for a wide range of activities, including research and innovation, environmental protection, cultural and heritage preservation, and social and economic development. Projects funded under the program are expected to have a tangible impact on the communities involved and contribute to the overall goal of promoting cohesion and integration within the EU (European Commission, 2023e). The program emphasises three pillars, Interreg A focus on cross-border cooperation between neighbouring regions, Interreg B focuses on cooperation between larger regions or groups of regions, and Interreg C focuses on territorial cooperation between member states and non-EU countries (Interreg, 2023).

Circular Economy Action Plan

The new circular economy action plan (CEAP), one of the main elements of the European Green Deal, was adopted in March 2020 to introduce legislative and non-legislative measures. The EU's transition to a circular economy will reduce pressure on natural resources and will secure sustainable growth. It is also a precondition to achieving the EU's 2050 climate neutrality target and halting biodiversity loss (European Commission, 2020).

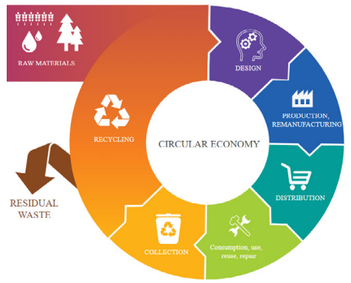


Fig 1.7.6 Circular Economy Action Plan

The graphic shows the necessary measures and changes in a circular economy.

Common agricultural policy (CAP)

The common agricultural policy is a partnership between society and the agricultural sector that ensures a stable supply of food, secures farmers' income, protects the environment, and strengthens rural areas. More specifically it pursues to establish a sustainable future for European farmers, provide better-targeted support to smaller-scale farms, and empower greater flexibility for EU countries to adopt measures to local conditions. It was initiated in 1962 and each country within the EU needs to formulate their own CAP Strategic Plans at a national level. On 2 December 2021, the agreement on the reform of the common agricultural policy was formally adopted. Agriculture and rural areas are instrumental in the European Green Deal, and the CAP 2023-27 will be crucial in reaching the ambitions of the Farm to Fork and biodiversity strategies (European Commission, 2023).

Land use, land use change & forestry (LULUCF) regulation for 2021-2030

Land use, land use change and forestry regulation are important parts of the 2030 climate and energy framework that was adopted on 14 May 2018. EU Member States need to ensure that greenhouse gas emissions from land use, land use change or forestry are offset by at least an equivalent removal of CO_2 from the atmosphere in the period 2021 to 2030. (European Commission, 2018)

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02

methodology

2.1 Research Framework

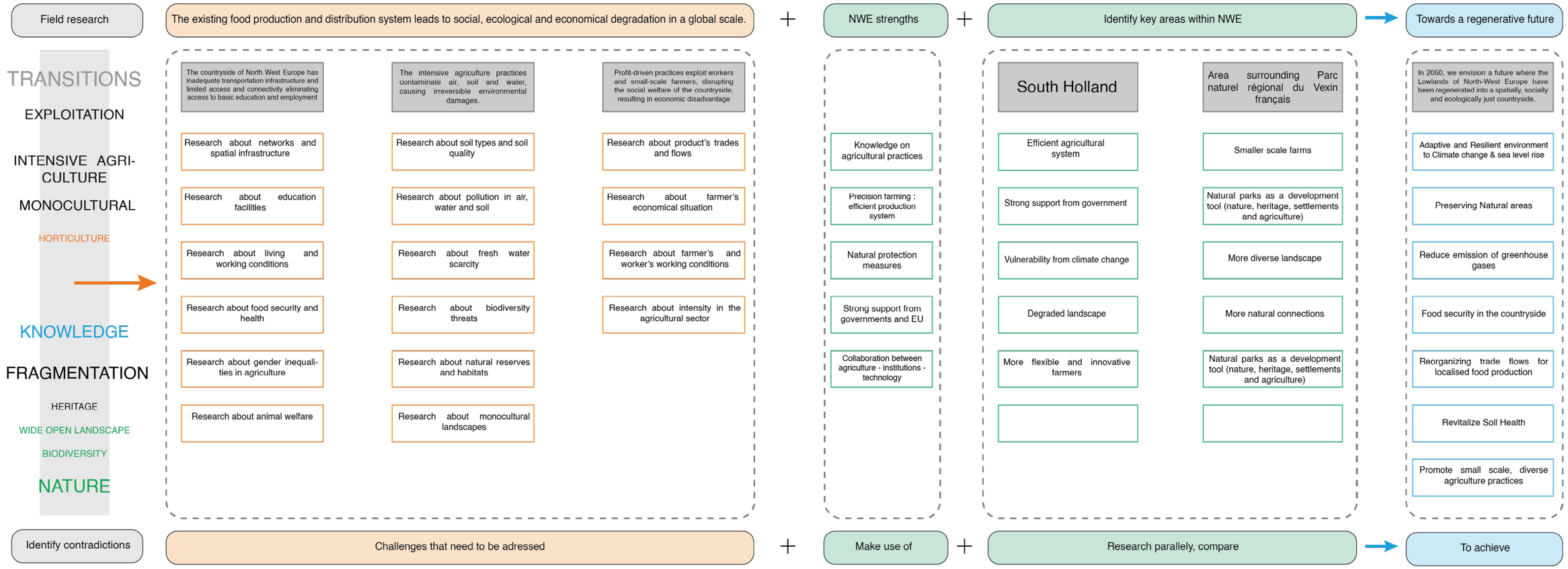


Fig. 2.1 Research framework diagram

Graphic shows how the research was structured from looking into the existing food production and distribution system to creating a vision for a regenerative future.

2.2 Research questions + Methodology

How can the degraded countryside of North-Western Europe transition towards a socio-ecological regenerative Future ?

Analysis

A **How is the current food production and distribution system causing degradation?**

Ecology

A1 What are the ecological impacts of this system globally and in Europe?

Economy

A2 What are the consequences of the profit driven economy, relating to circularity, trade and small scale food producers?

Society

A3 How are rural communities, farmers and seasonal workers disadvantaged regarding connectivity, working and living conditions?

Theoretical framework

What is a regenerative system?

What is spatial justice in the countryside?

What is a sustainability transition?

Vision / Strategy

B **How do we approach a spatially, socially and ecologically just countryside?**

Ecosystem restoration

B1.1 How can fragmented ecological spaces be connected and strengthened through a nature network?

B1.2 How can we protect coastal areas from sea level rise?

Regenerative agriculture practices

B2.1 How can we use regenerative agriculture practices to restore biodiversity, assist in reforestation and revitalize soil health?

B2.2 What are requirements for regenerative practices to occur?

Sustain food security

B3.1 What is needed to ensure food security in a sustainable way while minising the use of resources?

B3.2 How can the food production network become more circular and local?

B3.3 How can a network of high tech food production knowledge emerge and be upscaled in North West Europe?

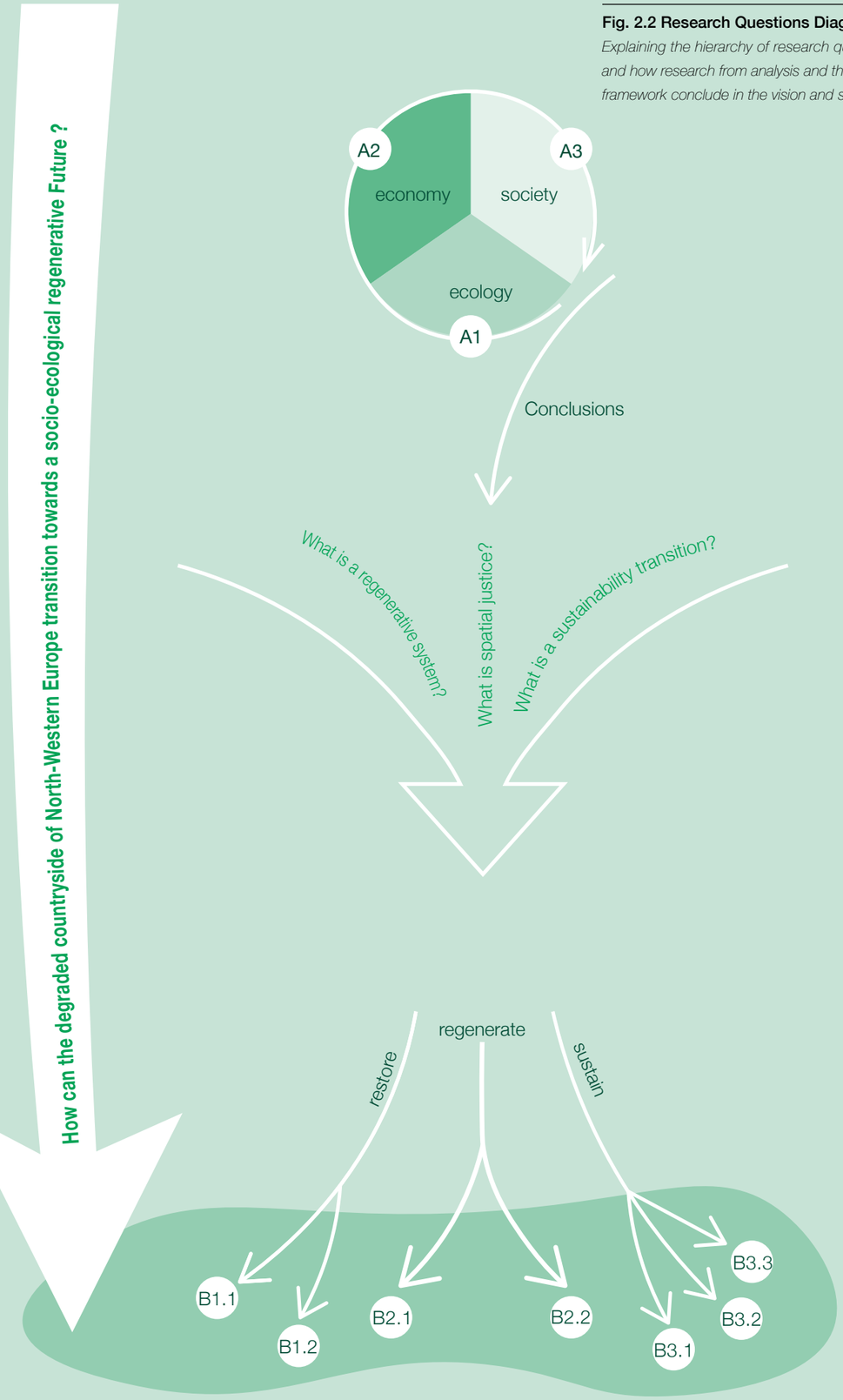


Fig. 2.2 Research Questions Diagram

Explaining the hierarchy of research questions and how research from analysis and theoretical framework conclude in the vision and strategy.

2.3 Theoretical Framework

Regenerative development

This project employs the idea of regenerative development to envision a countryside that not only reverses the damage from past use but also empowers itself to regenerate. The current agricultural use of North-western Europe's landscapes diminishes their worth and potential. This project aims to restore the landscapes' resilience and well-being beyond sustainable development, creating a regenerative countryside.

The concept of regeneration relates to the improvement of a place or system, by making it more active or successful, to a spiritual or moral reform, and to the restoration towards a better or more worthy state. (Mang et al, 2012). Even though sustainability and regeneration are often mentioned in one breath, we do not define them as the same but see sustainability as a foundation for a regenerative future. While sustainability is intrinsically tied to "a reduction in the damage caused by excessive resource use", regeneration goes beyond that notion, attempting to not just minimize the damage caused to the environment, but move towards a system that adds value (Wahl, 2019). It is an effort to "learn how one can participate with the environment by using the health of ecological systems as a basis for design" (Reed, 2007). The crossover lies within economic, social, and environmental sustainability.

Subsequently, economic sustainability requires an equitable utilization and restoration of limited natural resources such as materials, land, water, and nutrients. Social sustainability enables healthy, safe, and liveable communities for present and future generations. Environmental sustainability maintains natural processes, and biodiversity, and sustains human life by preserving the capacity of ecosystems (Reed, 2007). Nevertheless, purely a transition toward a sustainable situation is not sufficient to restore the environment to a state of equilibrium. Thus, regenerative approaches seek to "not only reverse the degeneration of the earth's natural systems but also to design human systems that can co-evolve with natural systems". Accordingly, this approach aims to enhance society's well-being by regenerating and strengthening the support systems necessary for future growth. It goes beyond sustainable development by emphasizing the capacity-building aspect of development (Wahl, 2019; Gabel 2016; Mang & Reed, 2012).

The regenerative development encourages us therefore to "design human systems that co-evolve with ecological systems to generate mutual benefits and greater expression of life and resilience" (Re-alliance, n.d.). This approach draws inspiration from the "self-healing and self-organizing capacities of natural living systems" (Mang et al, 2012). Consequently, the regenerative countryside has the capacity to restore itself.

Regenerative agriculture

Regenerative agriculture is considered a holistic approach which can assist to address a range of social and environmental challenges, including climate change, soil degradation, and biodiversity loss, while also promoting resilient communities and agricultural systems by maintaining healthy soil, which promotes plant growth, improves water retention, and sequesters carbon from the atmosphere (Intertribal Agriculture Council (IAC), 2022). Moreover, regenerative agriculture aims to encourage community resilience and strengthen rural areas and promote an adaptive and inclusive food system that contributes to both the health of the inhabitants as well as the health of the landscapes. Overall, regenerative agriculture acts in alignment with nature and promotes a fundamental rethinking of the current growth-oriented economic model (Intertribal Agriculture Council (IAC), 2022).

What is spatial justice in the rural?

The concept of spatial justice pertains to the spatial dimensions of social justice, addressing issues such as inequality, segregation, and exclusion based on geographic location or physical space (Israel & Frenkel, 2017). In the project spatial justice is used to rationalise the benefits and burdens of the production landscape, the fair distribution of landscape qualities, and the empowerment of silent stakeholders. Spatial Justice is generally divided into distributive and procedural parts (Marcuse, 2009).

The distributive part is covered by an aspect covering the land and one covering the landscape itself. The land is perceived as a resource or a common asset, whereas the landscape is considered a public good. Additionally, land quality may be unevenly distributed. While it is not feasible to distribute land, it is possible to repurpose or regenerate it, which can enhance spatial justice regarding land.

The procedural part is covered by establishing a network of hubs that enable people to network. Due to culture and the growth of individuals intertwined with the development of the landscape, it is crucial to involve them in the decisions phase. Furthermore, given that the landscape is a common good, society has a right to participate in shaping its future. Given this, an equal distribution between landscapes offers different goods to be made. This translates to farmers' need to transfer their land to serve societal values, and these values should be distributed as much as possible, instead of serving their economic gain.

Consequently, landscapes are expected to combine multiple societal purposes, economic, social, and environmental protection, and development. Ensuring a just allocation of the landscape requires, therefore, making it available to diverse applications and equitably distributing their impacts. Achieving this goal entails transitioning to a new approach to landscape utilization, the regenerative countryside.

Just Transition

A just transition refers to a deliberate and equitable shift from an unsustainable and fossil fuel-dependent economy to a sustainable and low-carbon economy that prioritizes social justice and workers' rights (ILO, 2004). According to the International Labour Organization (ILO), a just transition is "a process that seeks to ensure that the shift to a low-carbon economy results in increased decent work, social equity and the protection of human rights" (ILO, 2004). The concept is also recognized by the United Nations Framework Convention on Climate Change (UNFCCC), which states that a just transition "creates decent work and quality jobs, safeguards workers' rights and ensures an inclusive transition that leaves no one behind" (UNFCCC, 2019). Consequently, the project proposes a just transition that involves a collaboration between governments, employers, workers, and communities to achieve a fair and sustainable transition to a regenerative countryside.

The rural, landscape, countryside

In a project encircling the space outside the densely built areas clear theoretical definitions of what is rural, landscape and the countryside are needed.

Rural is outlined as an open swath of land with little too few dwellers. Agriculture is the primary industry and welling generally takes place within small settlements, villages, or towns (National Geographic, n.d.). Beyond strict definitions, researchers, policymakers, media, and residents tend to ascribe attributes to their perception, which can be exclusive and inaccurate. Consequently, within the project, coming from different backgrounds, the perceptions of rural varied heavily.

According to Pols et al. (2005), a landscape is a cohesive entity that emerges from the interplay between humans and the environment. It is discernible from neighbouring areas and encompasses a distinct character. Landscapes are public goods, as per Lefebvre et al. (2015), which means that they are neither rivalrous nor excludable (Baldock, Hart and Scheele, 2011). This implies that the delight by one person does not diminish their availability to others. Consequently, the well-being, quality, and sustainability of landscapes are crucial for the entire society, as highlighted by Baldock, Hart, and Scheele (2011).

The countryside is outlined to be a region containing a kind of natural unity" (Fairclough, G, 2015). It is usually used for agricultural purposes and has a slower pace of life. Therefore, it fits into the view of an urban-rural divide that sees rural areas as recreational for urban dwellers and as conservative. Consequently, within our project, we are aiming to create a more agile, and interconnected countryside that will be able to adapt effectively to future changes.

Furthermore, between culture and landscape, there is an inherent relationship, the landscape is an alluviation of our history (Pols et al., 2005). Meaning that landscapes possess a certain place's identity, as they consist of patterns, structures, and palimpsests that have evolved over time (PBL, 2019). Since landscapes evolve alongside humans, they are constantly changing, reflecting the dominant culture of their dwellers (Pols et al., 2005). Consequently, it is crucial to consider cultural notions while developing a spatial strategy.

Transition Theory

The transition theory has been applied to comprehend the interplay between the evolution of culture and the landscape in the context of the production landscape, and the current socio-technical regime. Subsequently, it has influenced the strategy. According to the transition theory, transitions in socio-technical systems happen due to a coherent and complex interplay of technologies, engineering practices, scientific knowledge, production processes, skills and procedures, and consumer needs (Hoogma et al., 2005). The socio-technical landscape encompasses a framework contemplating the interplay of actors, influenced by various factors such as paradigms, politics, economics, cultural and societal values, and environmental issues. While the landscape itself changes at a slow pace, it, however, significantly impacts the change dynamics (El Bilali, 2019; Geels, 2011).

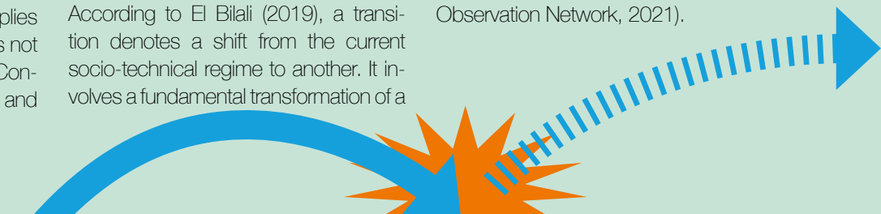
According to El Bilali (2019), a transition denotes a shift from the current socio-technical regime to another. It involves a fundamental transformation of a society's culture, institutions, and practices (Drift, 2020), which occurs due to the co-evolution of developments across all levels of the socio-technical system (Drift, 2020; El Bilali, 2019). For a transition to take place, the existing regime must be destabilized, and a new one must be able to emerge. The landscape can destabilize a regime, as changing trends and paradigms at this level exert pressure on the regime to change.

The socio-technical regime represents the prevailing system (El Bilali, 2019), the deteriorated countryside. However, socio-technical regimes seldom undergo transformation or reconfiguration (Bilali, 2019), primarily due to lock-in mechanisms, which contribute to its stability (Geels, 2011).

Consequently, the productive landscapes of Northwestern Europe are entrenched in the socio-technical regime of agricultural production. The goal of the report is to highlight how with strategic interventions this socio-technical regime can change.

Degradation

Degradation is the act of lowering something or someone to a less respected state (Vocabulary.com, n.d.) or the "process in which the beauty or quality of something is destroyed or spoiled" (Cambridge Dictionary, n.d.). Specifically, "environmental degradation is the deterioration of the environment through depletion of resources such as air, water and soil, the destruction of ecosystems and the extinction of wildlife. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable" (United Nations Economic and Social Commission for Western Asia, 2015). This procedure can be entirely natural in origin, or it can be caused or hastened by human activities. Many global organizations acknowledge environmental degradation as one of the major challenges facing the planet, and if the environment becomes irreparably harmed, it could result in the end of human existence (European Environment Information and Observation Network, 2021).



2.4 Conceptual Framework

The main framework that serves as the base of our conceptual process is the transition that Reed defined from a degenerating system towards a regenerative one. This is a relation of the energy required for the system to sustain itself, from more energy related to conventional or green practices to the neutrality or net zero of sustainability, all the way to the least energy required for the restorative, reconciliatory and regenerative levels. (Reed, 2007)

The sequence of the “R-ladder” is used to structure our overall goal – the transition towards the regenerative economy. In this scheme, moving from the linear economy, the re-use economy deals with closing existing loops through recycling and recovering. The circular economy both slows loops, through the reuse, repair, refurbishment, remanufacture, and repurpose of flows, and narrows loops, through refusing, rethinking, and reducing. Finally, the regenerative economy incorporates aspects of narrowing loops but focuses on the regeneration of the biosphere through restoring, renewing, and revitalising natural and social resources.

The 3 pillars of People-Planet-Prosperity are translated into the examination lenses of Ecology, Economy, and Society – stressing the importance of taking nature, human and non-human actors into consideration, but also the economic viability of any attempt towards change. These lenses form a trio that is examined along all steps of the upwards transition.

We identify a need for a multi-faceted transition, which is expressed through three big conceptual moves: from degradation towards sustainability, towards restoration and revitalization, and towards regeneration.

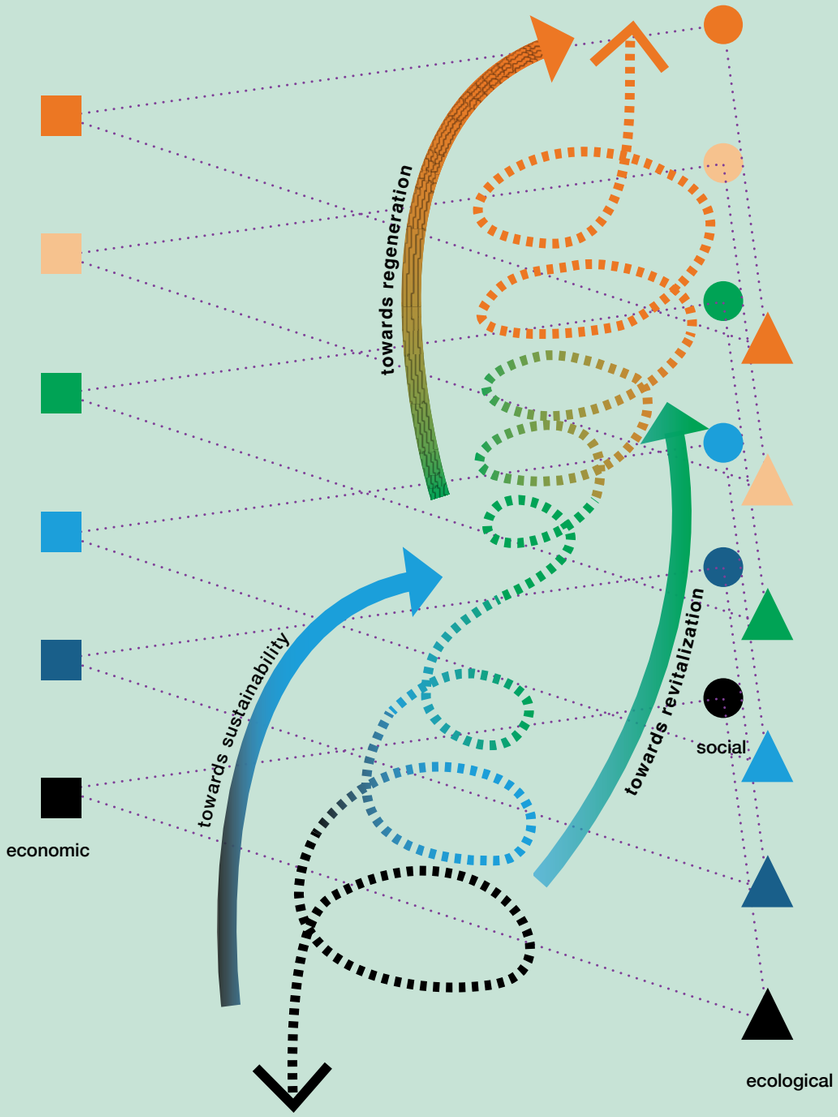


Fig 2.4 Conceptual Framework

Illustrating the transition from degraded system to sustainability, revitalization, and ultimately regeneration, using the 3 pillars of ecology, economy, and society.

2.5 Alignment of Goals with existing policies Framework

2.5.1 Proposal to Paris Agreement

Paris Agreement Goal: Save and increase forest area to capture greenhouse gases from the atmosphere

Proposal: With our scenario we are proposing an increase of 5% in the forest cover which would require about 83 million trees while at the same time turning 33% or one-third of the agricultural land into agroforestry which would require 360 million trees. A total of 450 million trees would require area is 23.000 square kilometers, or almost the size of the Netherlands (33.000km^2)



Limit temperature increase to 1.5°C

Proposal: Due to agriculture's production capacity and crop type sensitivity to the climate, the changing climatical condition poses serious challenges and risks to the future food supply. The chosen IPCC (Intergovernmental Panel on Climate Change) scenario means a temperature rise of 1.5°C. (EPA, 2023).

Increase ability to adapt to climate change

Proposal: The project creates a connected and resilient rural network in Northwestern Europe which will encourage the formation of an adaptive and flexible environment to climate changing conditions and future threats through a strong natural system. Moreover, we are envisioning that the regenerative agricultural landscapes will facilitate the revitalization of the countryside, ensuring a resilient and secure food system.

2.5.2 Proposed addition to SDG's

Economy



Achieve higher levels of economic productivity through diversification, technological upgrading and innovation

Support countries develop policies that generate decent jobs in rural areas

Provide better, more secure and varied jobs are urgently needed in rural areas

Help strengthen technical and entrepreneurial capacities, and improve working conditions, particularly for youth, women and migrant workers.

Create a more coherent knowledge exchange system through strategic interventions

Increase access to finance and investments for smallholder producers



Resources channeled to small cities and towns can play a catalytic role in rural transformation

Diversifying employment into non-agricultural activities
Providin
g small-scale producers with affordable access to technologies and infrastructure are essential to accelerating poverty reduction

Promote sustainable development in rural communities through investments in transportation, storage, irrigation and communication technologies.

Improving rural infrastructure, and strengthening markets and rural-urban linkages can contribute to a more interconnected and vibrant society, while slowing the exodus of rural people to cities.



Provide adequate working and living conditions to workers and farmers

Enhance inhabitants participation and improve their life quality



Create Trans European Nature Network

Create sustainable food production and knowledge network

Create regenerative agricultural practices and tree nurseries network

Establish partnerships between different stakeholders and actors (organizations about reforestation, EU, provinces, farmers, land owners, trade companies,)



Adapt agriculture to more tolerant and less resource-intensive types

Ensure sustainable food production systems and implement resilient agricultural practices that increase productivity, help maintain ecosystems, strengthen capacity for adaptation to climate change and progressively improve land and soil quality

Global food waste and losses along production and supply chains, including post-harvest losses

Society



Build the resilience of the poor and reduce their exposure and vulnerability to climate-related extreme events, shocks and disasters

Accessible, healthy food and stable food chain



Remove pollution from water, soil and air and create a healthier environments

Health goes beyond human health to also include animal, plant and environmental health

Strengthen natural networks (connect existing fragmented protected areas) - Better environmental quality

Foster a sense of shared responsibility for the health and well-being of the land and the people who depend on it



Secure food availability with sustainable and innovative interventions (vertical farming, aquaculture)

Shift to renewable energy and change water management system (adapt agriculture to more tolerant and less resource-intensive types)

Build stronger, more resilient communities

Provide better connecting networks and infrastructure in the countryside

Strengthening natural networks - establishing biological corridors to enhance landscape connectivity and landscape-level biodiversity.



Enhance women participation in agricultural sector and decision-making in rural areas



Establish partnerships and a strong network of institutions
Enhance participation in decision-making for inhabitants in rural areas

Provide access to infrastructure and essential amenities for the inhabitants of rural areas

Provide access to affordable and healthy food for everyone

Provide access to knowledge and information. Through strategic interventions we intend to spread the knowledge out of the institutions and small companies (establish knowledge exchange networks)



Sustain food security in an uncertain future (climate change scenario)
Agroforestry will increase food production whilst enchancing the environment



Promote renewable energy sources for agricultural purposes



Strengthen education system in rural communities

Educate and train farmers to be able to support the knowledge intensive regenerative agricultural practices

Propose research centers about regenerative agricultural practices

Create sustainable food production and knowledge network

Create regenerative agricultural practices and tree nurseries network

Biosphere



Improve soil health with regenerative agricultural practices such as agroforestry, conservation agriculture crop and livestock integration

Restore forests, heathland, peatland and riparian ecosystems with regenerative agricultural practices
Protect biodiversity

Improve water quality securing aquatic life

Restore aquatic ecosystems with restorative aquaculture

Protect biodiversity



Clean water from pollution and restoring riparian ecosystems.

Improve water quality by providing nutrients to the water with regenerative agriculture practices such as agroforestry

Support countries to monitor water resources use and levels of water stress.



Build resilience related to climate extreme events, shocks and disasters

Assisting in mitigation against climate change impacts such as temerature increase, sea level rise, droughts

Introduce climate adaptive crop types (or specifically saline agriculture)
Building resilience o
f farming communities to cope with floods and droughts and applying clean water technologies.

Enchanced carbon storage on farm land through agroforestry, forests and peatland restoration

Mitigating the impacts of climate change (reduce greenhouse gas emissions) by creating more ‘local’ food and tree production system

2.6 Operational Framework

With the Paris Agreement countries commit to limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C. (Intergovernmental Panel on Climate Change - IPCC, 2018) It is a hybrid legal form that relies on the transparency of nations in reaching their climate goals rather than legally binding policies. However, as a global agreement, it is difficult to make nations accountable for their actions. (D. Bodansky, 2021)

Global warming - why 1.5°C?

Already people feel the impacts of global warming in their day-to-day lives. In 2022 around 33 million people have been affected by floods in Pakistan alone, destroying 2 million acres of croplands, perishing 735.000 livestock and damaging 662.000 homes. (UNHCR, K. Afridi 2022)

Communities in the Sahel region are among the most vulnerable to the impacts of climate change. Heatwaves and droughts cause more food insecurity, destroy livelihoods and force people to leave their homes. (UNHCR Press release 2022)

In Europe the effects of climate change also become visible. In 2021 extreme weather events in Germany caused more than 80 billion Euros of damages with a major flood destroying major infrastructure and countless homes. (BMUV German Ministry for the Environment, nature conservation, nuclear safety, and consumer protection)

When comparing global warming scenarios of 1.5°C and 2°C it becomes clear that we must act now. Impacts of climate change, their force and frequency increase with rising temperatures. 200 million more people will be affected by droughts, the number of extreme heatwaves will double, and people exposed to flooding will increase 1.3 times when reaching 2°C compared to 1.5°C global warming. (Intergovernmental Panel on Climate Change - IPCC, 2018)

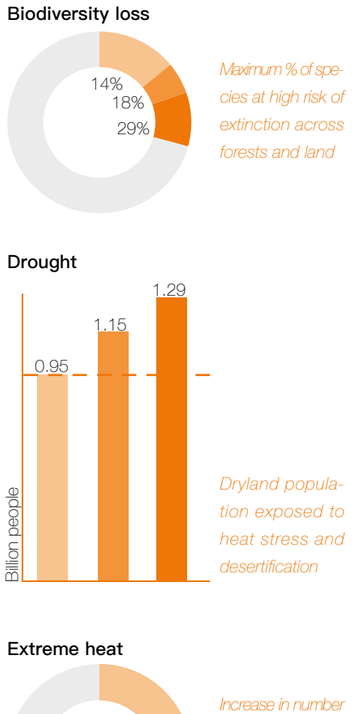


Fig 2.6.1 Comparing risks of global warming
Comparing risks of rising temperatures for different climate pathways of 1.5°C, 2°C and 3°C

Time frame

At the current rate, people are burning fossil fuels, and only seven to eight years remain before the 1.5°C limit is passed. To stick to the target, countries, companies, and individuals must cut global emissions by 45% by 2030 (compared to 2010). Seeing the urgency of the climate crisis and taking into consideration the IPCC report and its predictions for future pathways gives a time frame until 2050 to reach net zero emissions. This is an ambitious goal to reach but seeing the urgency of this scenario is an important aspect of the future. (IPCC, 2018)

Sea level rise

With its geographic location as a coastal area, the Netherlands is specifically vulnerable to sea level rise and other impacts associated with it such as increased flooding and salinity of groundwater. Sea levels will continue to rise well beyond 2100 even if emissions are cut to net zero. This is due to the thermal expansion of the ocean and the melting of ice sheets and glaciers. The magnitude and rate of this rise depend on future emission pathways with the worst-case scenario for 1.5°C being 1m (IPCC, 2018)

keep global warming within

1.5°C

net zero emissions by

2050

sea level rise by 2100

1meter

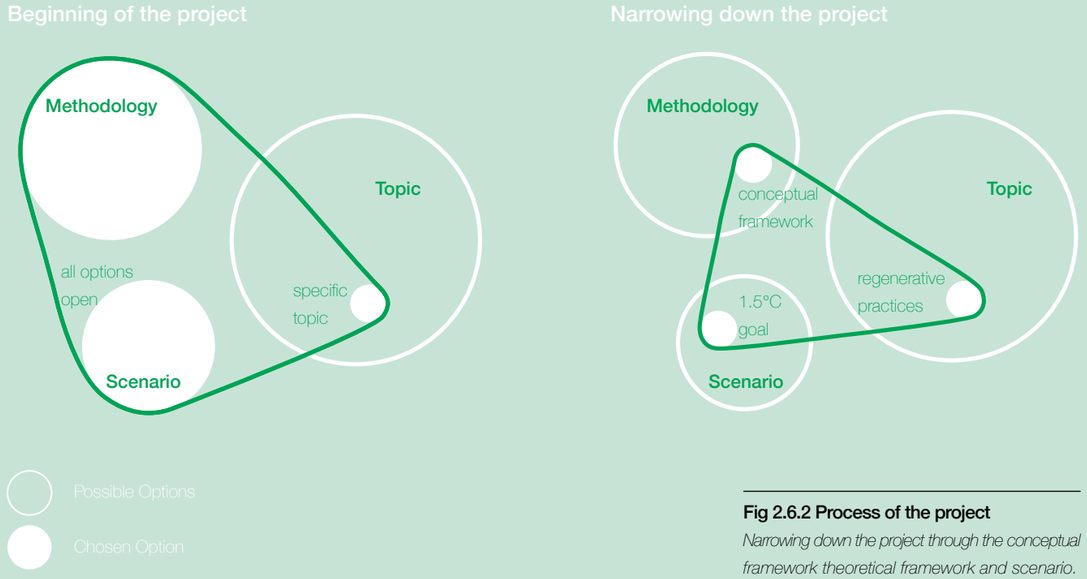


Fig 2.6.2 Process of the project
Narrowing down the project through the conceptual framework theoretical framework and scenario.

03

analysis

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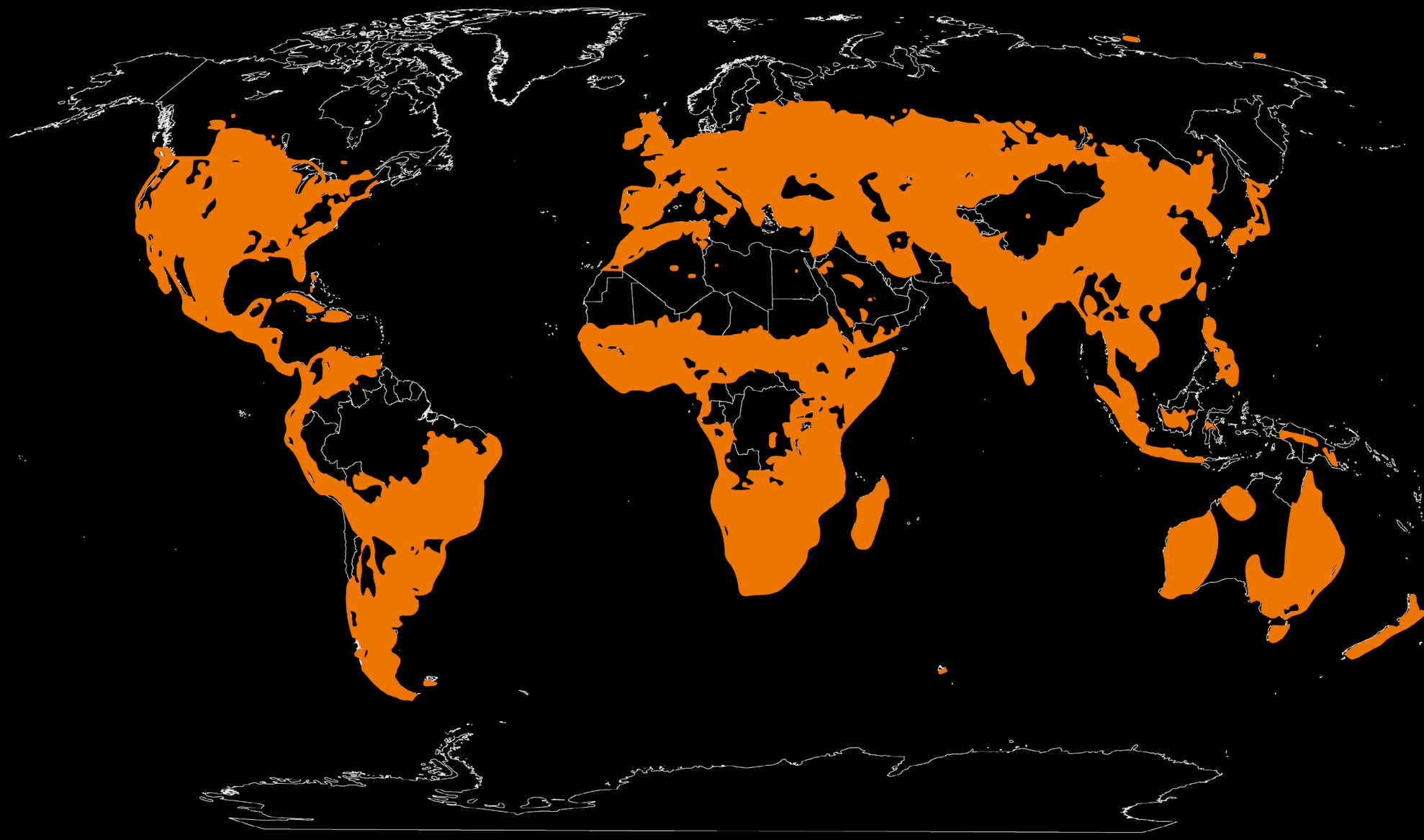
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3.1 Global degradation

3.1.1 Global land cover

In a global scale, almost half of the world's land is used for agricultural production – 46% amounting to over 48 million square kilometres. This extensive use of our planet's natural resources has impacted wilderness and threatened biodiversity to never-before-seen levels.

This leaves only 37% for forests; 11% as shrubs and grasslands; 1% as freshwater coverage; and the remaining 1% – a much smaller share than many suspects – is a built-up urban area which includes cities, towns, villages, roads, and other human infrastructure. (Ritchie & Roser, 2019)



48 million km² of global land cover is used for agriculture. This is around 46% of habitable land.

Fig 3.1.1 Global Agriculture land cover
The above map shows the land used for agricultural practices around the globe

3.1.2 Growth of agricultural land

While the global agricultural cover has grown immensely since the industrial revolution, European land has remained virtually the same. With a growing European population and a rich history of colonialism, Europe exploits the world to sustain itself. A report from WWF states that even though Europe is the world's largest exporter of agri-food products (in economic terms), the travel model revolves around "importing low-value raw products, such as cocoa, fruits and soybeans, and exporting high-value ones like wine and chocolate – making a positive contribution to the EU economy, but not necessarily to the global food supply." (WWF, 2022)

Even within the continental limits, the EU produces more animal products than what is recommended for our health based on dietary standards – a system that is sustained through more than half of the grain crops grown domestically being fed to the animals, as well as importing massive amounts of soy and other types of feed. At the same time, almost 40% of the food produced within the EU is never eaten, which comes with enormous costs to the climate and biodiversity. (WWF, 2022)

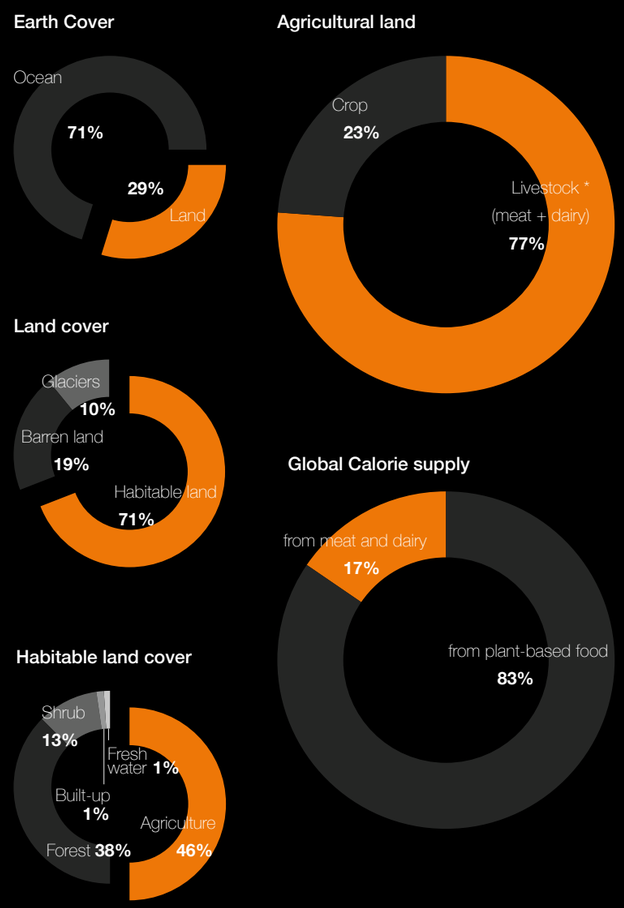


Fig 3.1.2.1 Global numbers
Showing the relation of earth coverage, land use, and calorie supply on a global scale

Fig 3.1.2.2 Development of agriculture
The graph shows the development of agricultural land cover since 1500, comparing steady levels in Europe with high increases in all other parts of the world

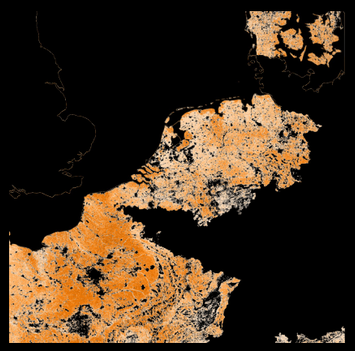
3.2 Ecological degradation

3.2.1 Land used for agriculture

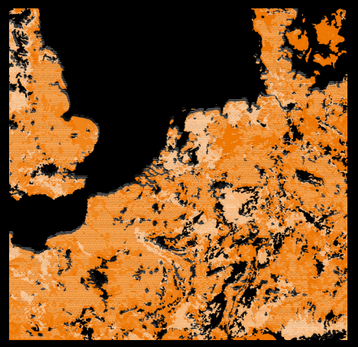
Ever since humans started to cultivate the land, the natural land cover has decreased (Copernicus, 2023), research by Winkler, Fuchs, Rounsevell, and Harold has shown that in the last four decades, 32% of the global land area has been affected by land-cover changes regarding agriculture (Winkler, et al., 2021). Agriculture occupies a significant proportion of Europe's land area. Therefore, it, therefore, plays a crucial role in maintaining natural resources and cultural landscapes and is a prerequisite for other human activities in rural areas. Although, farming has contributed over the centuries to creating and maintaining a rich variety of landscapes and habitats current agricultural practices can also have adverse environmental impacts. Degradation of soil, pollution of soil, water and air, the fragmentation of habitats and loss of wildlife can be the result of inappropriate agricultural practices. (European Communities, 2009). Within the North-western European context, this has resulted in a decrease of 0,59% to an approximate 43,40% agricultural land cover with a size of 433.989,9138 km^2 (Copernicus, 2023).

The agricultural land cover can be divided into the categories of croplands, approximately 306.520 km^2 and pastures, approximately 138.471 km^2 (Copernicus, 2023). Pastures are used for the cultivation of livestock and have a monocultural covered of two types of grass, Lolium perenne or Poa spp (Smit et al., 2008). The croplands are predominantly utilized to cultivate cereals, maize, and potatoes (Smit et al., 2008). The agricultural areas in Northwestern Europa are predominantly located in the coastal lowlands.

The intensified agricultural tradition in the Netherlands has resulted in a patchwork of monocultural production landscapes with high yields but low biodiversity (Wijnands et al., 2002). Due to the wide implementation of crop rotation systems outside the Netherlands, the agricultural character is still that of a patchwork but one with a heterogeneous character (Reheul D. et al., 2017).



Crop types



Agriculture land cover and soil quality

64% agriculture cover in the Netherlands

42% pastures
58% cropland

Fig 3.2.1 Agriculture land cover
The following map shows the types of agricultural practices within the frame: croplands and the pastures primarily.

Cropland vs Pastures
Croplands
Pastures

100m

London
Rotterdam
Hamburg
Ruhr
Brussels
Paris

3.2.2 Forest cover in NWE

As a result of yield-driven agricultural practices natural land cover often took a fall resulting in large areas being deforested (Winkler, et al., 2021). In Europe, ecological landscape restoration and afforestation increased significantly over the last decades (Reyer C., 2009). Nevertheless, deforestation in the period from 2000-2018 still accounted for approximately 0,127% of natural land cover loss (Copernicus, 2023). Current natural land cover in Northwest Europe covers 293.608,54 km^2 or approximately 29% of the total land cover in Northwest Europe (Copernicus, 2023).
The natural land can be divided up into predominantly forest and grasslands. Of these, the forests account for roughly 68% of the cover (Copernicus, 2023). Natural grasslands account for approximately 16% (Copernicus, 2023). Due to the dominant agricultural cover in the coastal lowlands, natural areas dominate the eastern highlands. Along the edge soft edge dominate the transition zone between higher naturally dominated areas and lower agricultural-dominated areas.



1. Hard edge near Fürstenberg (GER)



2. Softer edge near Dürstenberg (GER)

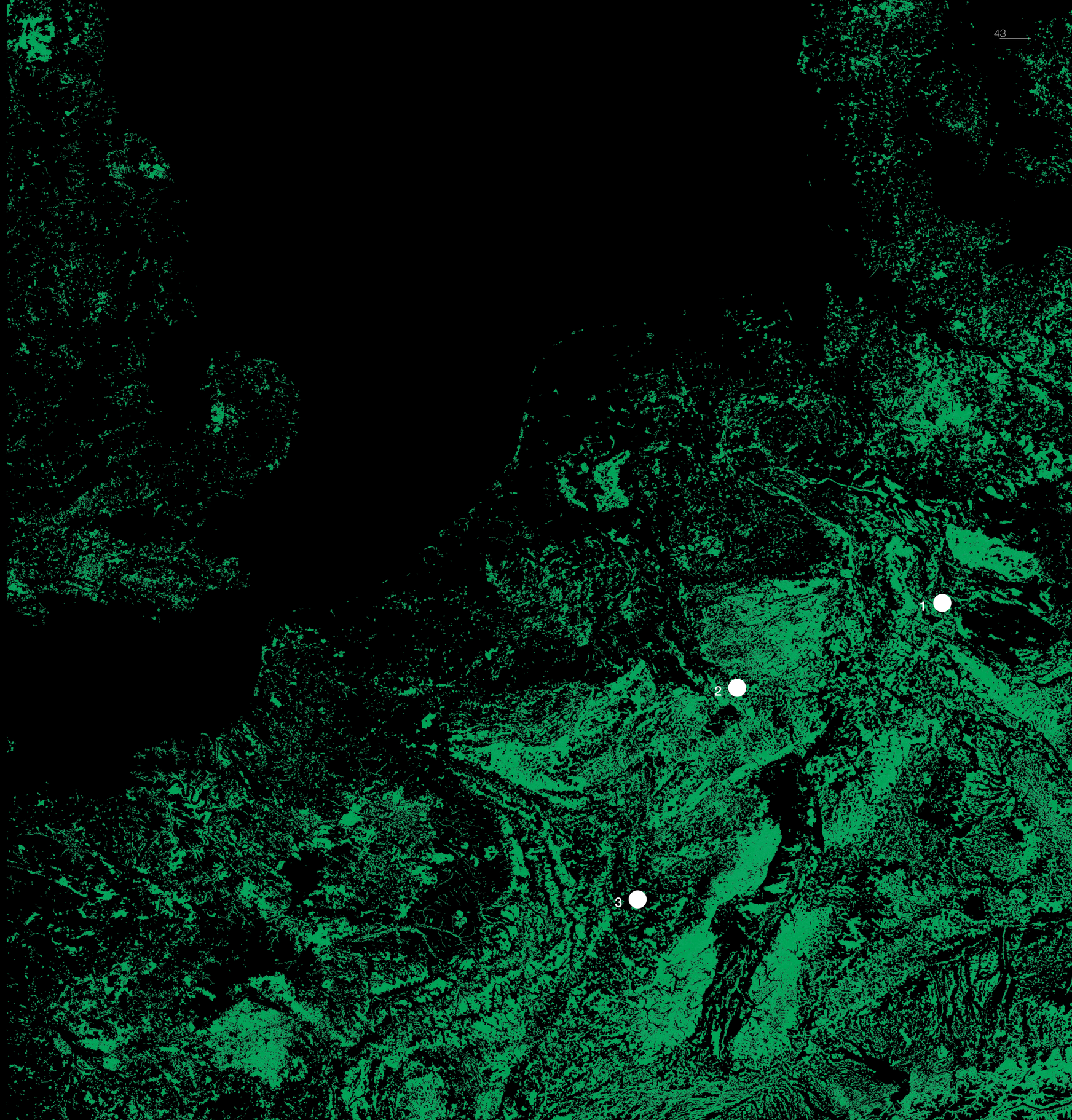


3. Disburst situation near Stainville (FR)

Fig 3.2.2 Forest cover NWE
The following map shows the spread of forests within the NWE frame. The low lying area near the coast has lesser cover due to more human interventions.

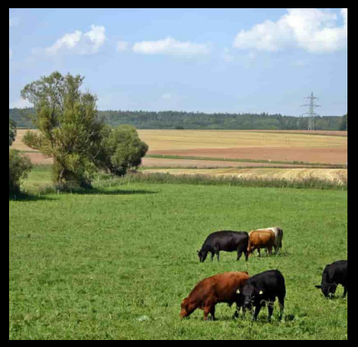
Forest areas
Forest

100m



3.2.3 Pollution in NWE

North-western Europe witnessed an increase in agricultural yields over the last decade - in 2021 production was one-fifth higher compared to 1995 (CBS, 2023). As a result of the intensive agricultural practices in the European lowlands, these areas are the most polluted (Brand, 2022).
Nevertheless, according to recent research by the Dutch statistical bureau (2023), pollution from the agricultural sector has decreased since 1995 but most drastically in the earlier years while recently it has stagnated. The most prominent pollution coming from agricultural practices is nitrogen, which causes in the Netherlands 80% of the ammonia emissions and 10 per cent of the nitrogen oxide emissions (Brand, 2023). Consequently, agriculture is responsible for the depletion of nature, especially the biodiversity of heathlands and forests depletes significantly (Brand, 2023). Nitrogen pollution centres around the production and use of fertilizer. The production is predominantly in the German Ruhr area, Antwerp, and Rotterdam. The use is mostly within the agricultural fields in the lowlands, especially in the Netherlands and Belgium's monocultural fields. Due to that the nitrogen contaminates the soil and then spreads through the groundwater to the estuary of the catchment area, the critical values and the pollution is the worst in the Netherlands (Brand, 2023; EPRTR, 2010).



1. Nitrogen pollution in soil

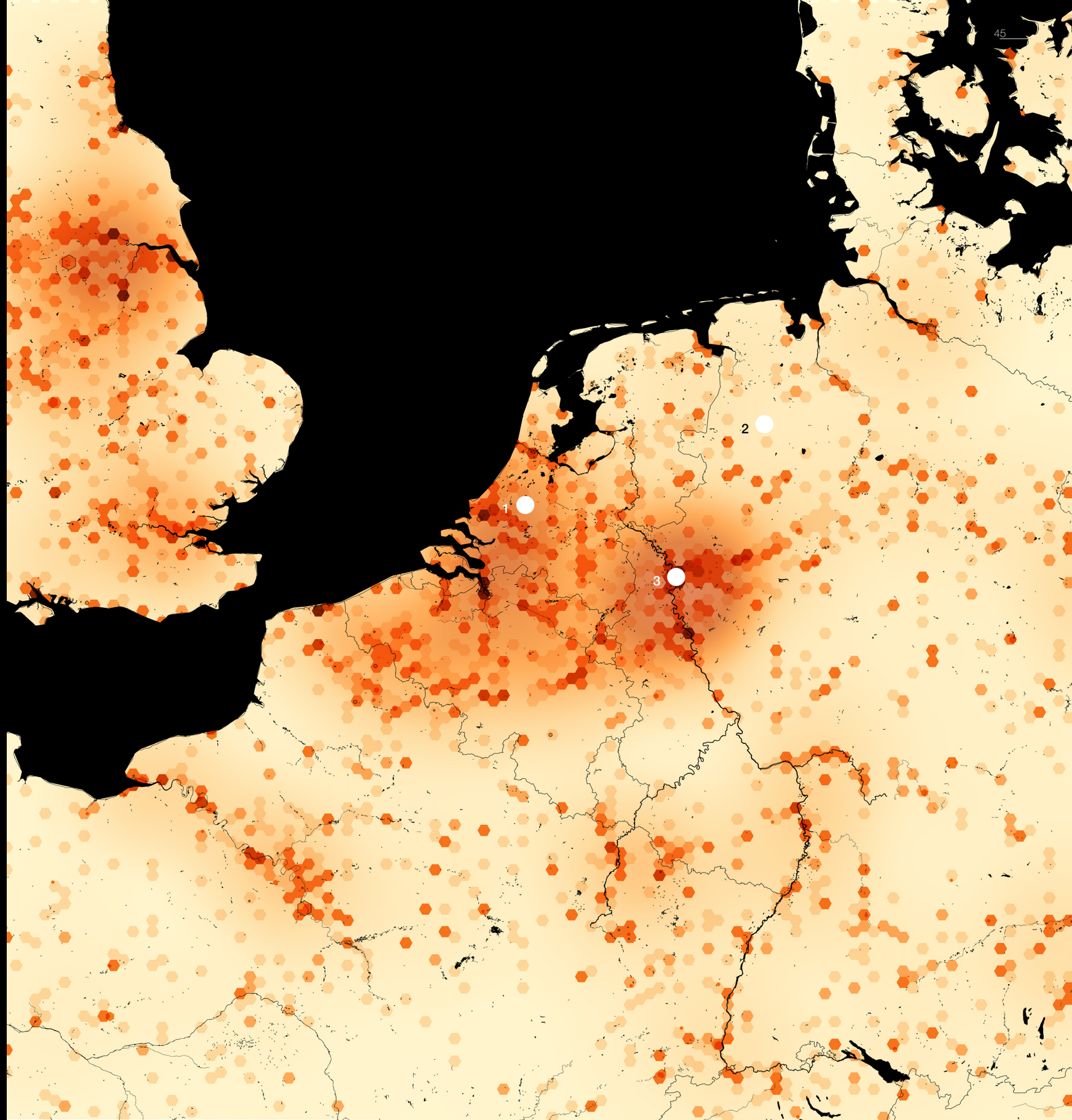


2. Nitrogen pollution in water



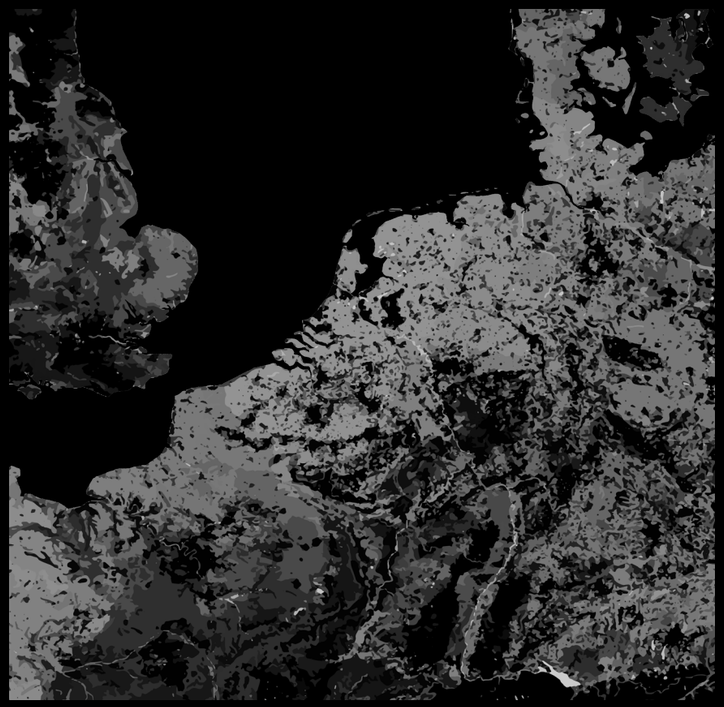
3. Nitrogen pollution in air

Fig 3.2.3 Nitrogen Pollution Conclusion
The following map shows the point sources of nitrogen pollution in the NWE frame. The Ruhr region and the Rotterdom port are the biggest contributors in this.

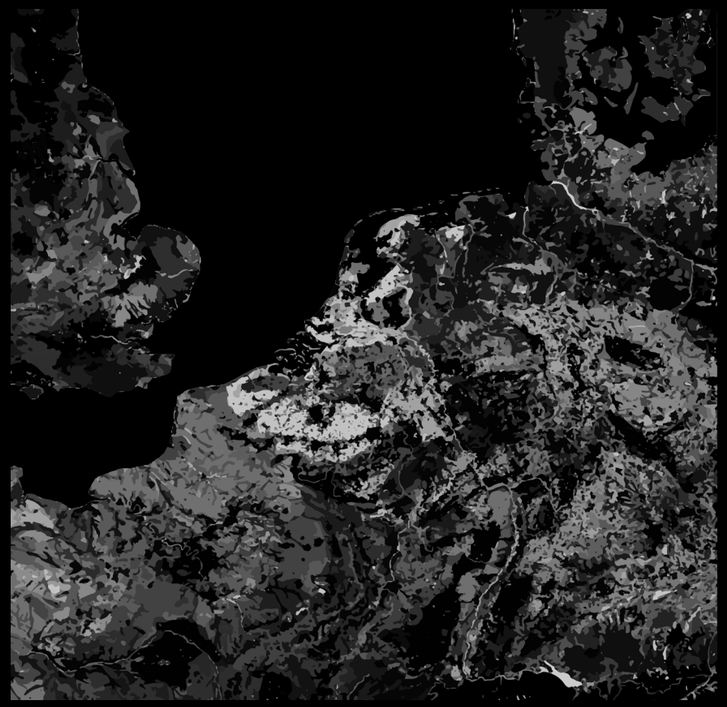


3.2.3 Pollution in NWE

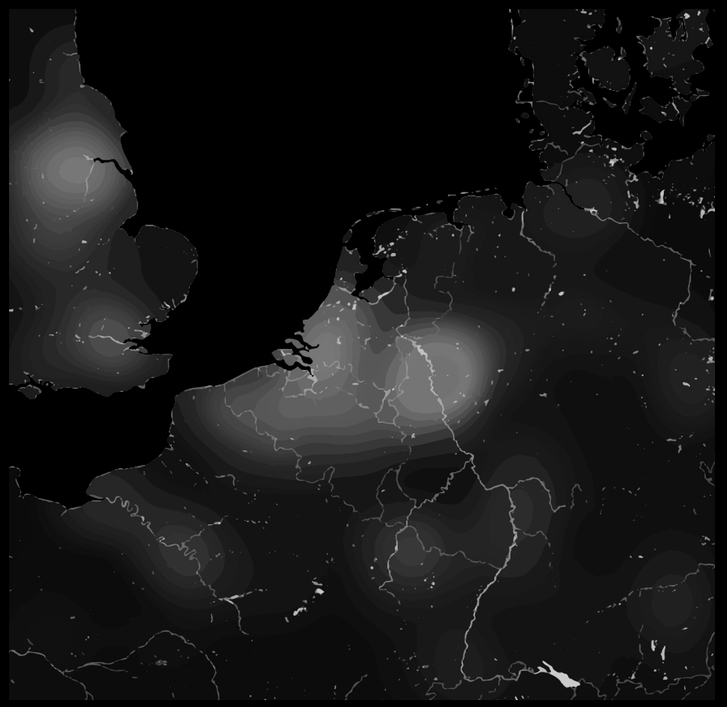
Individual agricultural nitrogen pollution is the worst by crop farmers on sand soils, due to the intensive use of fertilizer, and by dairy farmers due to the ammonia pollution from the cows' excrement and the large population of cows on small land areas.
Other pollution from agricultural industries is relatively low, for example, greenhouse gas emissions cannot be measured one-to-one directly to agriculture. But indirectly accounts for 12% of the Dutch total in 2020, for Northwest Europe these numbers will be roughly the same (Brand, 2023).



Nitrogen pollution in soil



Nitrogen pollution in water



Nitrogen pollution in air

Fig 3.2.3.4 Nitrogen pollution in layers
The following maps show the pollution of nitrogen in soil, water and air in North-West Europe with the lightest areas being the most polluted

3.2.4 Soil quality

Agricultural soil is in danger of losing certain features of healthy soils because of the intensification of agricultural practices. The uncontrolled application of fertilizers, pesticides and soil cultivation techniques is used to compensate for losses resulting from the degradation of the soil, which damages healthy soil even more. (International Federation of Agricultural Producers (IFAP, 2010)

Soil health has become a growing concern for farmers and other chain actors of the agricultural sector because it provides 95% of the food for humans, but more than 33% of the Earth's soils are already degraded. Soils were high on the agenda of the 2021 UN Food Systems Summit and of the 2022 UN climate conference (CoP27) (Netherlands Food Partnership, n.d.) because of the adverse impacts on natural resources (soil, water, biodiversity) that unsustainable agriculture practices and land use can have such as increased pollution. Sustainable land use can help to reduce the impacts of agriculture and livestock, preventing soil degradation and erosion. In addition to erosion, soil quality is affected by other aspects of agriculture. These impacts include compaction, loss of soil structure, nutrient degradation, and soil salinity. (World Wildlife Fund, n.d.)

Irreversible degradation of soil implies not only ruining the main asset of the current generation of farmers but also reducing the farming opportunities of future generations. Therefore, there must be a sustainable use and management of agricultural soil, with a view to safeguarding the fertility and agronomic value of agricultural land. (European Soil Bureau Network European Commission, 2005).



Soil quality

Fig 3.2.4 Quality of soil

This map is based on a soil assessment set given by the Muencheberg Soil Quality Rating (SQR) system. The SQR system allows for clearly distinguishing between soils of higher and lower quality.

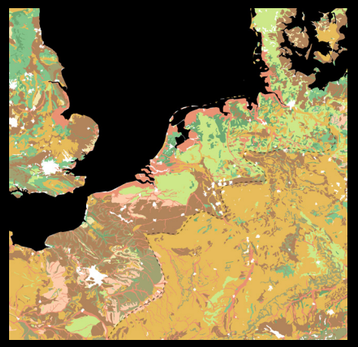
SQR values soil quality

- 80 - 100 very good
- 60 - 80 good
- 40 - 60 moderate
- 20 - 40 poor
- 0 - 20 very poor

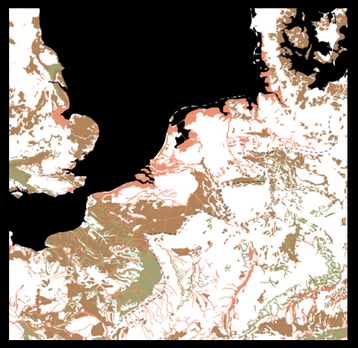
100m

3.2.5 Soil Types and Potential

The most dominant types of soil in our Northwestern Europe frame are Luvisol, Fluvisol (clay) and more specifically in the Lowlands are Luvisol, Fluvisol (clay) and Podzol.
Extensive research indicated that the most suitable for crop production soil types of the NWE frame are Luvisol, Fluvisol, Chernozems, Phaeozems and Cambisol. Luvisols are fertile soils widely used for agriculture especially for small grains, sugar beet and fodder, in sloping areas but they can also be used for orchards and/or grazing. Fluvisol a clay-containing type of soil has the potential to be fertile depending on the condition that was created, while the most productive ones can be found along the major river valleys of Europe such as the Rhine, Seine, and their estuaries. They can be used for food crops and orchards. Chernozems, Phaeozems and Cambisol are rich in organic matter which makes them amongst the most productive soil types in the world and are used mainly for cereal crop production (ISRIC – World Soil Information, n.d; European Soil Bureau Network European Commission, 2005).
The most suitable soil types for grazing of the NWE frame are Luvisol, Fluvisol, Chernozems, Phaeozems, Cambisol and Leptosol. Luvisols, Fluvisol and Chernozems can be used for extensive grazing. Furthermore, Cambisol and Phaeozems can be used for cattle rearing and fattening on improved pastures and Leptosols have the potential for wet-season grazing.
Another essential part of NWE's landscape refers to the soil which has a major ecological role in forest ecosystems, involving many organisms and individual chemical processes. Soil provides moisture, nutrients and physical support for plants and serves as a filter for toxic substances and a receptor for natural wastes. Differences between agricultural and forest soils derive, in part, from the fact that often the most "desirable" soil has been selected for agricultural use and the remainder left for native vegetation such as forest. ("Forest Soils | SpringerLink") Fortunately, soil requirements for forest trees frequently differ from those for agricultural crops because trees grow well in poor drainage, steep slopes.

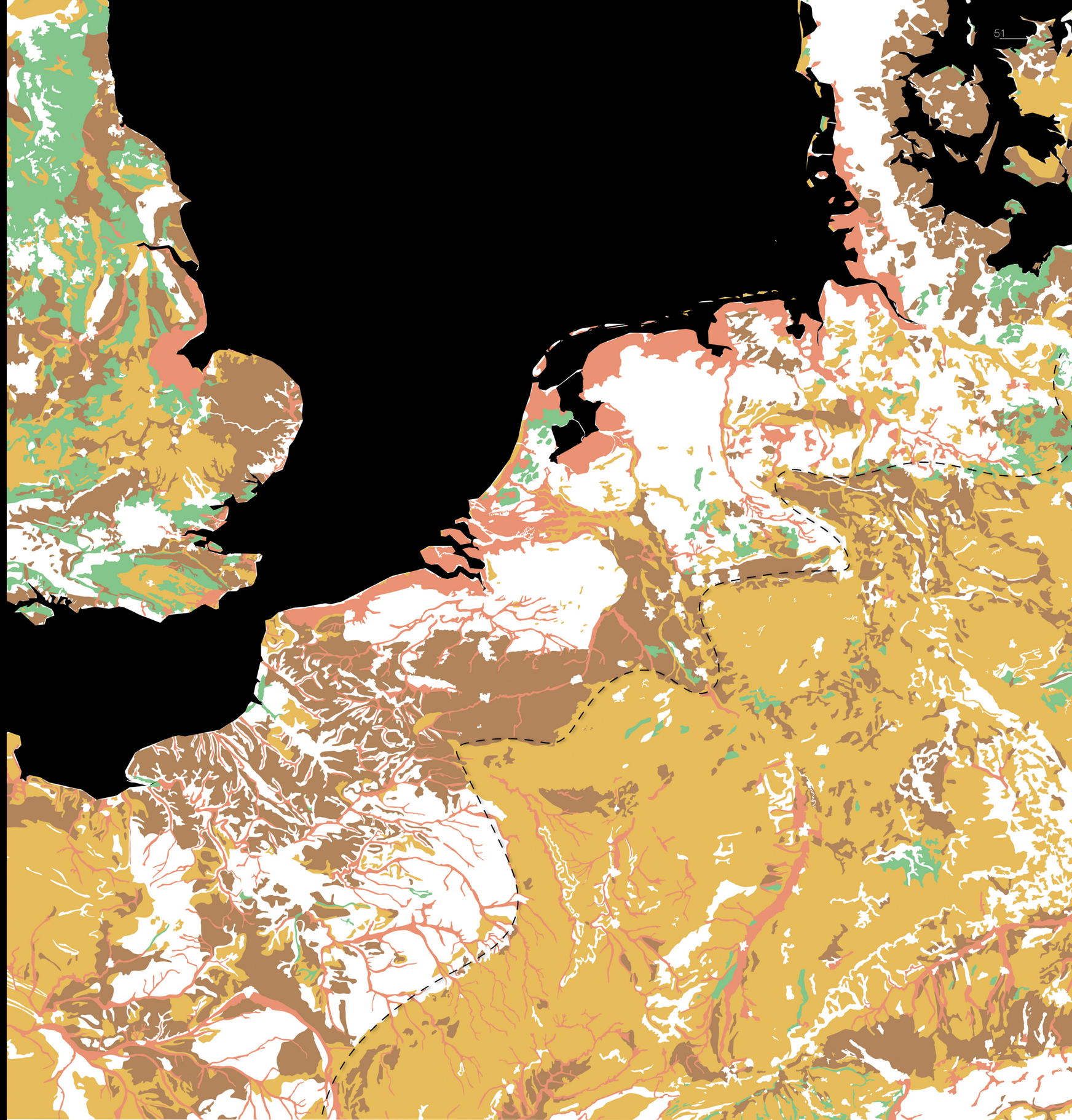


Soil appropriate for forest



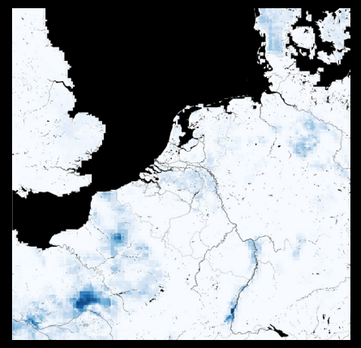
Soil appropriate for livestock

Fig 3.2.5.1 Soil suitable for crop production
The following map shows the potentials of soil for growing crops based on the types of soil present in the region.

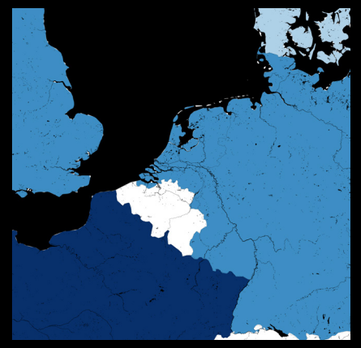


3.2.6 Degradation of water resources

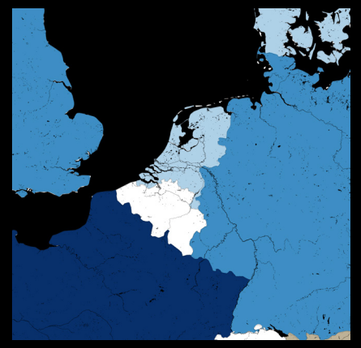
Growing crops and cultivating agriculture both require large amounts of water. Subsequently, the dominant agriculture production area shows increased water consumption compared to areas with lower yields (EEA, 2015). Especially the eras adjacent to the river Rhine show spikes in water usage. Also, the peat- pasturelands show an increased water consumption. Water usage trends over the period 2007-2016 however show a decrease in the use of water for agricultural practices (EEA, 2016).
However, due to the agricultural area of lowlands, North-western Europe lies within the catchment area of large mixed rivers, and they have a sufficient water supply. However, within the rapidly changing climate conditions, this certainty cannot be guaranteed.



Potential for reusing water in agriculture



Water intensity of crop production 2007



Water intensity of crop production 2016

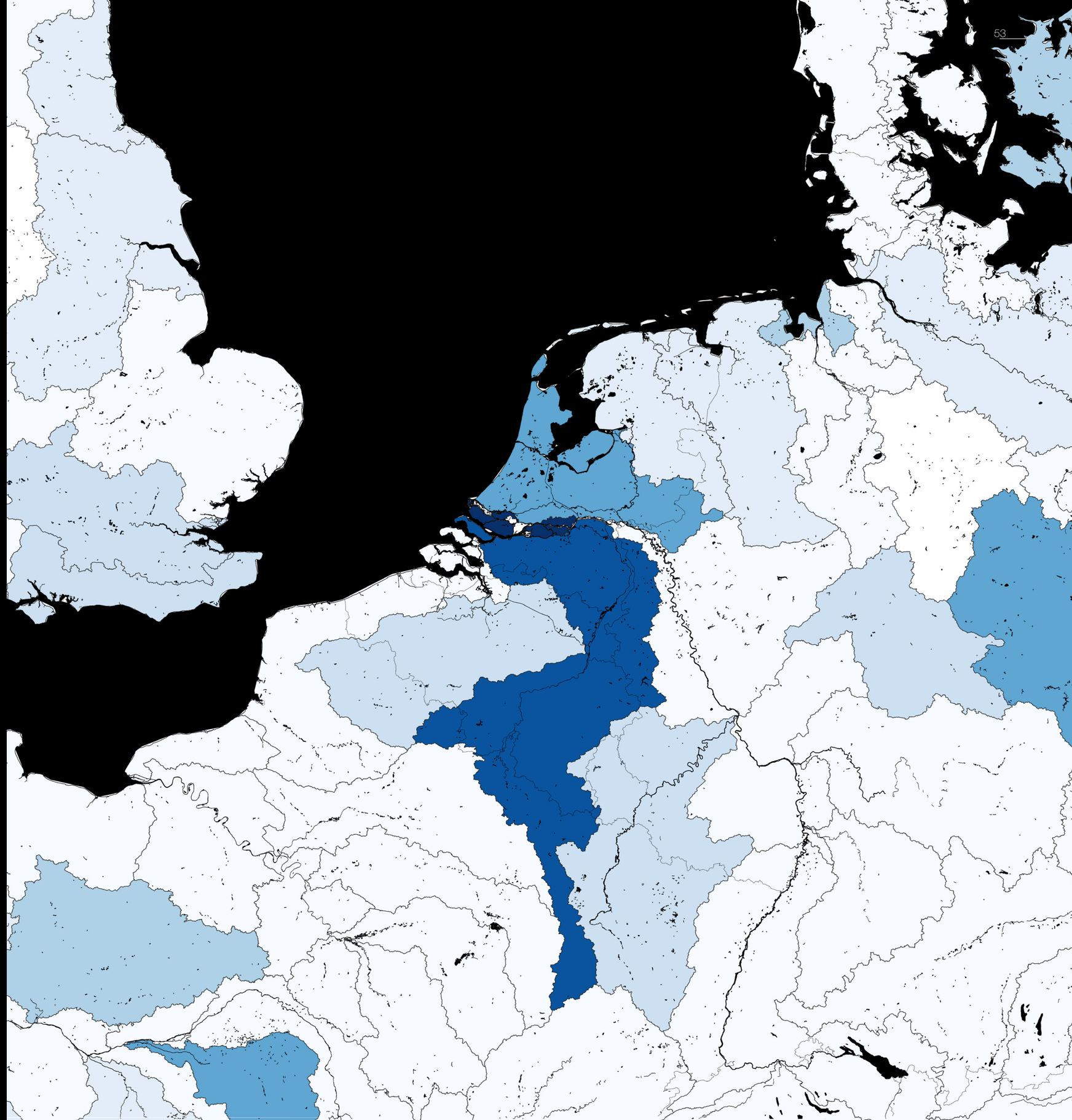


Fig 3.2.6 Water exploitation in river basin
The following map shows te exlpoitation of water in the EU river basin, especially along the rhine delta due to the presence of big cities and industrial centres along its banks.

3.2.7 Climate change

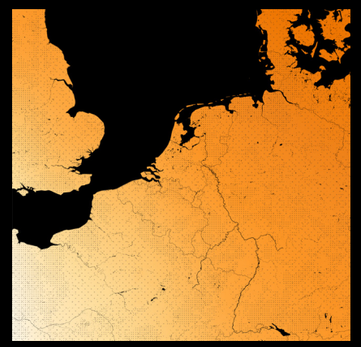
Due to agriculture's production capacity and crop type sensitivity to the climate, the changing climatical condition poses serious challenges and risks to the future food supply. The chosen IPCC (Intergovernmental Panel on Climate Change) scenario means a temperature rise of 1.5°C. Other impacts regarding the changing climate mean more frequent heatwaves, heavier precipitation, increases in droughts and risks of salination of the land.

For North-western Europe it means that on average the mean yearly temperature will rise by 2,67 degrees. Of which mostly happens more in the northern and inland regions. For precipitation, it means on average an increase of roughly 10 per cent in the east, while the agricultural planes of France must deal with roughly 2% more droughts. The climatic changes will imply a necessary crop change or lengthen the growing season (EPA, 2023).

For the North-western regions sea-level rise also poses a risk, the map on the right, for instance, highlights in orange the areas which will likely flood. Consequently, the current pastures occupying these areas will no longer be available to be utilized for grazing and changes to the system are required.



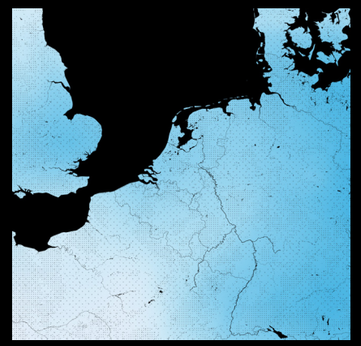
Mean temperature change Europe



Mean temperature change NWE



Precipitation change Europe



Precipitation change NWE

Fig 3.2.7 Areas vulnerable to sea level rise

The following map shows vulnerable areas to flooding and specifically sea level rise in North-West Europe.

Areas below 1m elevation

100m

3.3 Economic degradation

3.3.1 Trade Flows

As was pointed out in the Global Land Cover, Europe has a colonial history of importing inexpensive raw materials, to then export or internally consume high-price products...
This exploitive system has created problematic interdependencies: at the centre of our examination frame, the Netherlands still imports most of its soy from Brazil, to use as animal feed in the farming industry - despite the recent legislative attempts to limit the soy imports at a European level. Surprisingly, a sharp rise in soy imports from Brazil can be noted after 2018, amounting to 1,86 billion euros in 2021, more than half of the total 4,16 billion euros. (CBS, 2022).



Fig 3.3.1 Im - and export of soy related items
Soy imports from Brazil to the Netherlands that are used to export expensive high quality goods to neighboring countries. Value includes dairy products, eggs, and meat

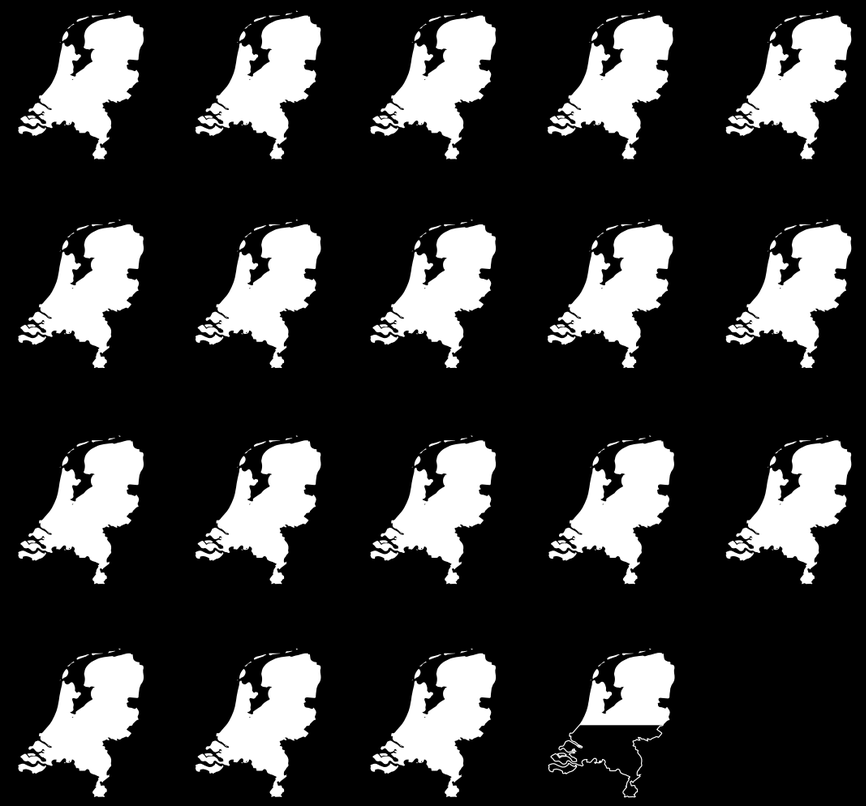
100m

3.3 Economic degradation

3.3.1 Trade Flows

Environmental consequences of the pressures on soy production in Brazil have been well documented in the past years. The continuous deforestation of the Amazon rainforest for arable land comes with the destruction of important animal habitats, damage to the capacity in carbon storage and oxygen release, as well as the exploitation and displacement of native people. More than 777 million square kilometres have been deforested during the past 50 years – about 18,5 times the size of the Netherlands. (Londoño & Casado, 2019)
However, imports of soy from Brazil have nearly doubled in the past 10 years from 1.3 billion kilo in 2010 to 2.39 billion kilo.

In the last fifty years, Brazil's Amazon has lost about one fifth of its forest cover. Almost 777,000 km² 18.5 times the size of the Netherlands



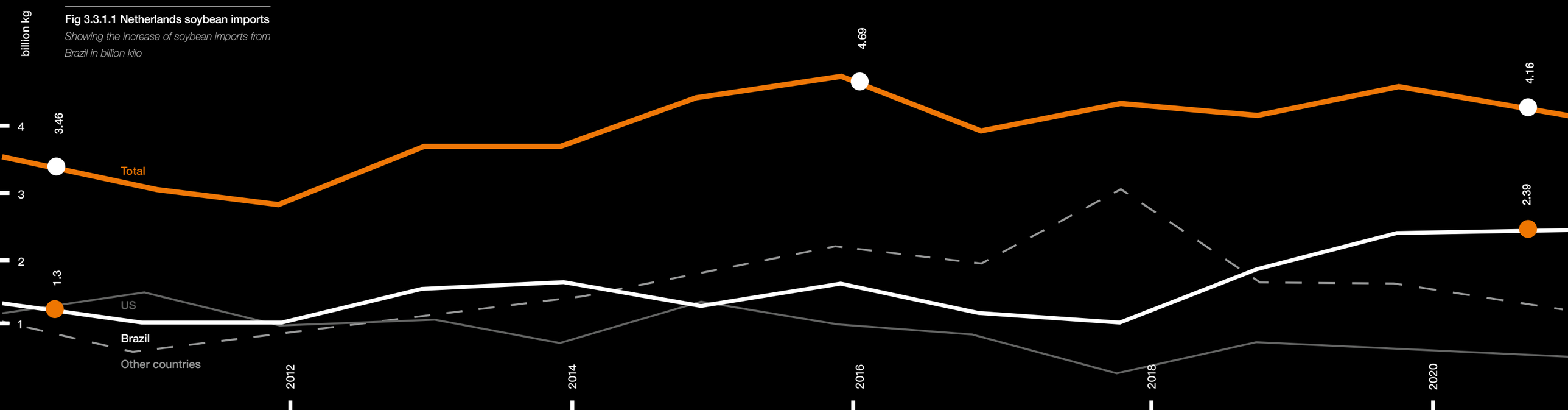


Fig 3.3.1.1 Netherlands soybean imports
Showing the increase of soybean imports from Brazil in billion kilo

3.3.2 Redundant Flows

Following the trail of the immense soy imports as animal feed, an examination of the trade relations between the Netherlands and its neighbouring countries shows that some questionable product and monetary flows emerge. For example, the monetary exports of butter towards the UK are almost the same as the ones imported, at 45 million USD and 40 million respectively, or the 340 million USD worth of exports of milk to Germany being close to the 210 million imported. Similarly, money related to egg imports and exports to Belgium is almost the same at 100 million USD. Finally, and oddly enough, animal food both exported to France with a gross income of 315 USD, but also imported for 240 million. Gaulier & Zignago, 2010) Of course, this approach disregards the quality or type of the products in question but does clearly illustrate the need for a radical restructuring of the trading system. While circularity within a local context is more easily understood as beneficial, in national trade it can be redundant, leading to emissions within the transportation or food waste.

In an interconnected global economy, farm animals are traded just like other commodities, and different countries have become hyper-specialized in various parts of the livestock supply chain. (Kevany, 2016) The Netherlands is one of the biggest exporters of live animals for slaughter – an industry that has been pointed out various times as poorly regulated, causing immense animal rights violations. In 2019, a total of 950 million live animals were exported within our research frame (The Netherlands, France, Germany & Belgium – coincidentally the top 4 exporters in Europe), from which Germany tops the list with 315 million and the Netherlands 295 million. (Kevany, 2016) Animal transport is incredibly stressful if not lethal – for example in 2019 nearly all the 14 thousand sheep died when the export ship capsized on its way from Romania to Saudi Arabia.



Fig 3.3.2 Redundant flows

The Netherlands both imports and exports the following products with neighboring countries in a similar quantity. This leads to questionable trade flows that can be improved in a more local network

3.3.3 Monopoly of land ownership

During the past century, the nature of land ownership has shifted rapidly. Within the 27-member EU, only the top 3,1% of farms controlled 52,2% of the farmland (Pasquini, 2017), while 44% of the total farms in Western Europe received 80% of the total subsidies provided through the Common Agricultural Policy in 2011. Another report states that for the entire EU, 80% of the subsidies go to only 20% wealthiest farmers. (Boerengroep, 2017) At the same time, a decrease has been documented in the number of farms at the European level, from 14 million in 2005 to 10 million in 2016 – especially affecting small-scale farms that own land less than 5 hectares (EPRS, 2022).

Examining the Dutch case, the total number of farms has decreased from more than 400 in 1950 to only 50 in 2020 – showing a decline of 22 farms per day in 2016. However, the area of the average farm has more than tripled, from about 10 hectares in 1950 to almost 35 (CBS, 2022). In the period of 1950-2016, six out of seven farms disappeared in the Netherlands, while the number of agricultural and horticultural companies plunged from 410.000 in 1950 to 55.000 in 2016 (CBS, 2017).

From the perspective of a trade unionist, with the dominant role of retailers in the buyer-driven horticultural chain: “The prices are dictated by the retail sector, that’s a big problem now, because you have three big companies in Europe who are setting the conditions, and they determine the price as well. This is why only big farmers can cope with that pressure and survive” (Siegmann, Ivosevic & Visser, 2021).

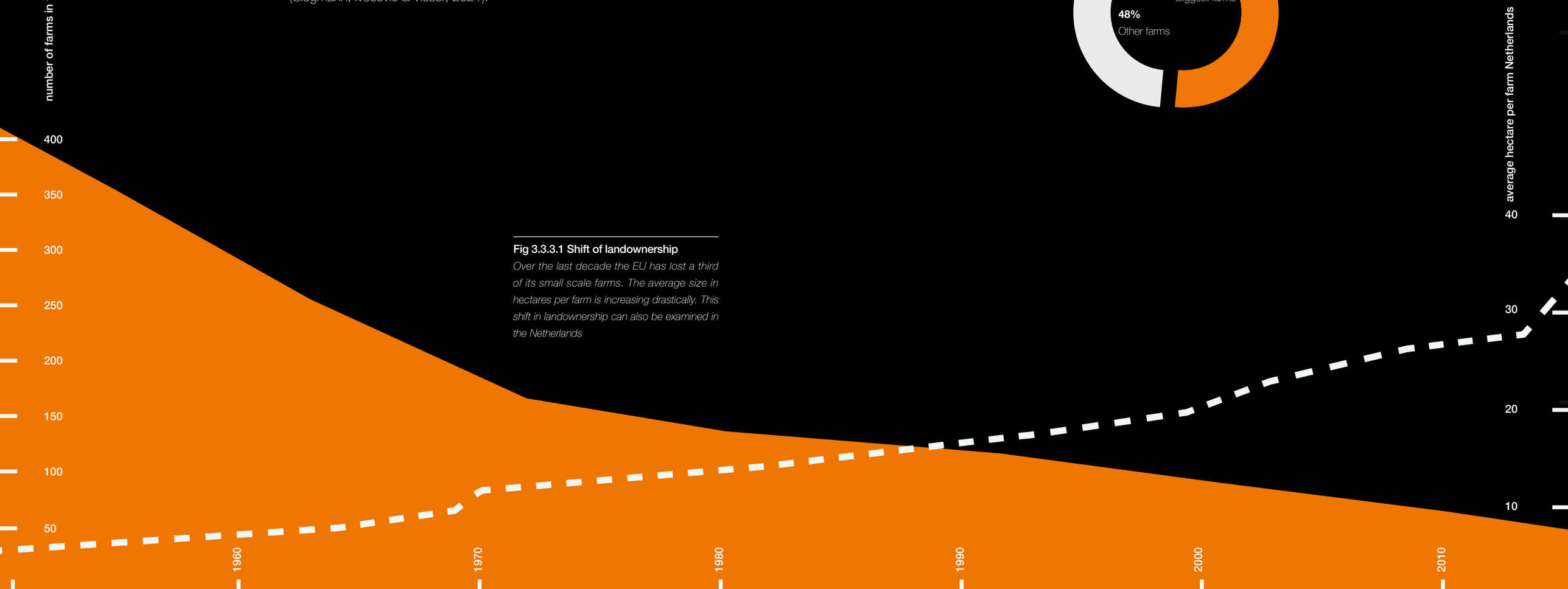
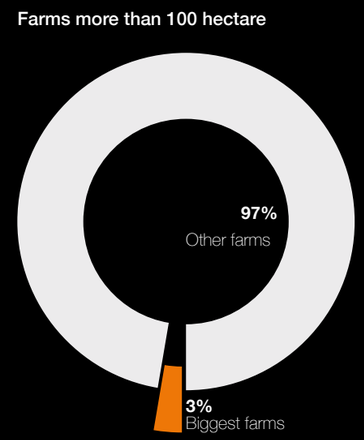


Fig 3.3.3.1 Shift of landownership

Over the last decade the EU has lost a third of its small scale farms. The average size in hectares per farm is increasing drastically. This shift in landownership can also be examined in the Netherlands



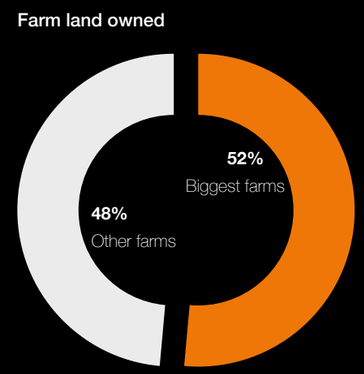


Fig 3.3.3.2 Relationship of farmland

3% of farms that are larger than 100 hectare own 52% of farm land in the European Union. 336.000 farms control almost 91 million hectare of EU land.

3.4 Social Degradation

3.4.1 Connectivity

Many factors contribute to social degradation in North Western Europe. While the region is generally prosperous and well-developed, there are significant differences in terms of connectivity and access to services.This leads to spatial injustice and unequal opportunities, mainly for rural communities. Understanding where these regional differences are and what causes them is essential for addressing the challenges of social degradation and promoting a more just society.

This map highlights the regional differences in a 10 by 10 km^2 grid, showign the population density and motorway network connections of North-West Europe. In the netherlands and Velgium a highly dense and well-connected area can be examined while Paris, as a metropolitan area, is characterized by low density and limited connections in its surroundinga. This indicates a challenge for social integration and connectivity or rural areas in the region.

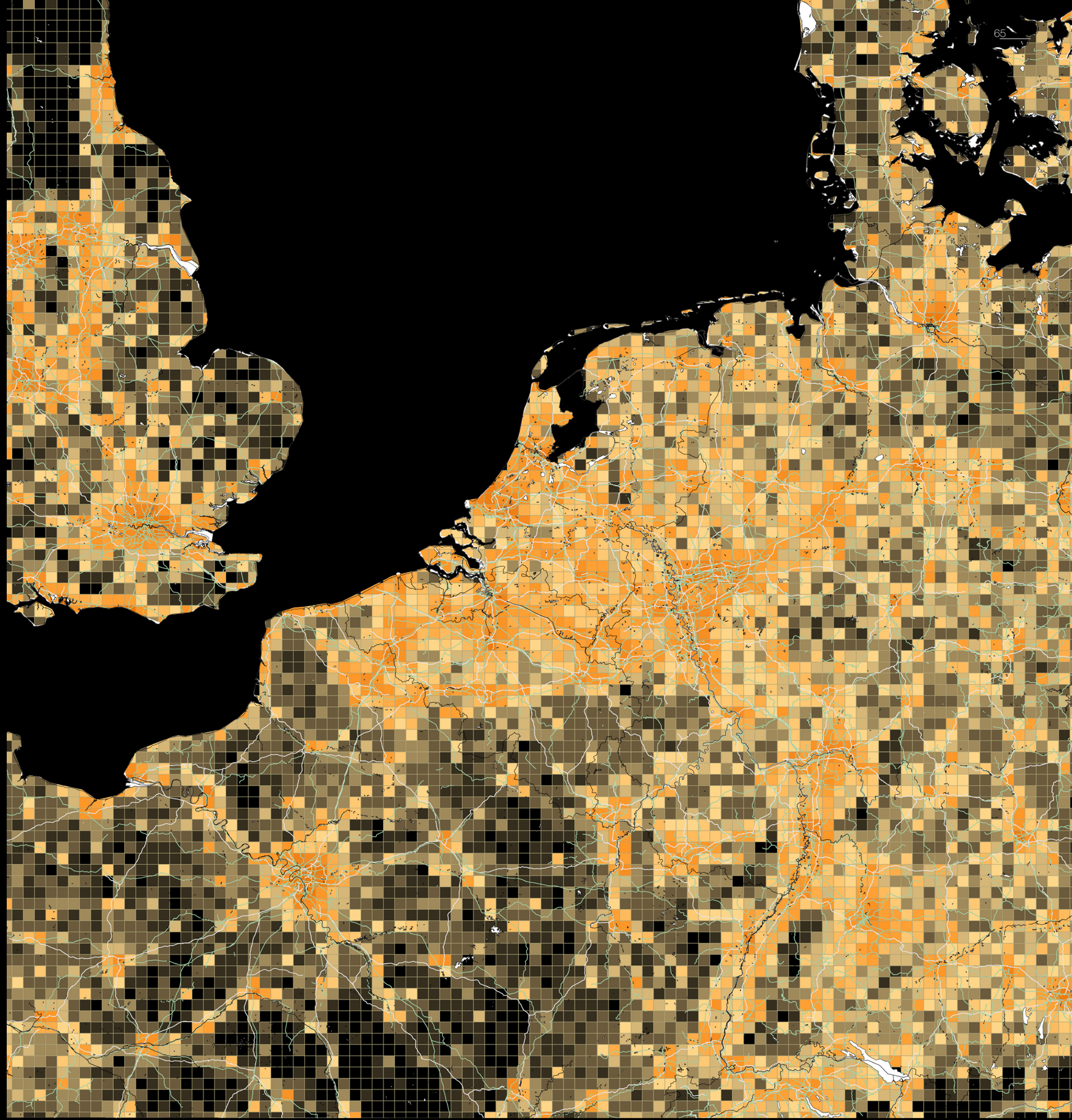


Fig 3.3.2 Population density per 10 km^2

The following map shows the relationship of population density and connectivity. Especially rural areas in France away from Paris are not well connected to other urban areas.

3.4.2 Social

Farmers

The degradation caused by the food production system is extended to the social realm as well, with strong impacts to the livelihood of both farmers and workers.

In France, agriculture incomes have been reported as being among the lowest in the country, at about only 350 euros per month for more than 30% of the farmer populace. This has severe impacts on their wellbeing and mental health – one farmer commits suicide almost every other day, especially men aged 45 to 54. The French National Public Health Agency has emphasized that the mortality rate of French farmers is 20% higher than that of the general population, while 30% higher specifically for dairy cattle farmers. Simultaneously, the French National Institute for Agricultural Research (INRA) has pointed that the number of smallholders who commit suicide is higher compared to large farmers, making the power struggle and disparity between the two groups even more evident. (Michalopoulos, 2018)

The Dutch farmers also exhibit concerning figures in their suicide rate – between 2013 and 2016 the rate rose from 12.5 to 17.4 per 100.000 farmers, which is considerably higher than the national rate of 10.6. The agricultural sector is among the top 10 sectors with the most suicides. (Zelfmoord Preventie, n.d.)

Seasonal workers

In France, agricultural incomes are already among the lowest in the country, at €350 per month for more than 30% of them.

"One French farmer commits suicide every two days".

Comparing suicide rates in the Netherlands

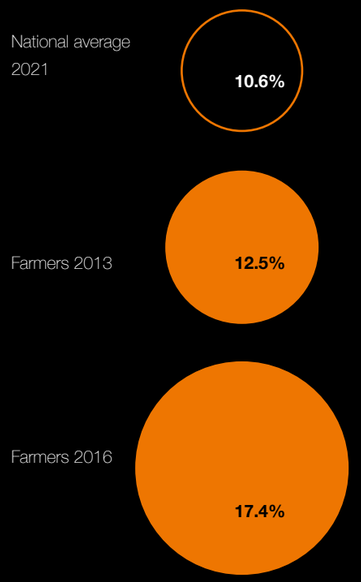


Fig 3.4.2 Suicide rates in the Netherlands
Suicide rate per 100.000 people per year. Comparing the national average (2021) with rising suicide rates of farmers (2013 to 2016)

Seasonal workers

Working and living conditions in South Europe are widely known and documented to be poor, but recent studies have pointed out that for migrant workers Northern Europe is far from an ideal working place as well.

In the Netherlands, there are many mechanisms that support and enable the exploitation of migrant workers. Most importantly, the 1999 Flexibility and Security Act legalized employment agencies to provide indirect contracts with phased entitlements: workers are paid for the hours worked while gradually building up social rights (notice period, paid holidays, and pension rights), while the contract can end at any time. (Siegmann et al., 2020)

This has led to a seasonal employment system, in which "a flexible contract with a low wage and little certainty is the rule rather than the exception and employment agencies, contracting and payrolling are also widely used" because of efforts by growers "to keep prices low by reducing labour costs with all kinds of mechanisms to below the legally required minimum or collective wage." Consequently, many migrant farmworkers in this rich country experience working poverty. Migrant workers from Central and Eastern Europe (CEE) form the bulk of the agricultural labour force. About a fifth of them work at or below the minimum wage, earning an average of ten euros an hour, half the wage of other European workers employed in the Netherlands. (Selberg et al., 2020)

In Germany, about 286.000 people, mainly from Romania and Poland, work in the fruit, vegetable, and wine production industries every year. In 2020, during the height of the COVID-19 pandemic, the agriculture sector suffered major losses due to the inability of importing labour in the form of seasonal workers (Schulz, 2020). Despite the dependency on this social capital, the living and working conditions in Germany are also exploitive and abusive.

Number of seasonal workers in agriculture sector

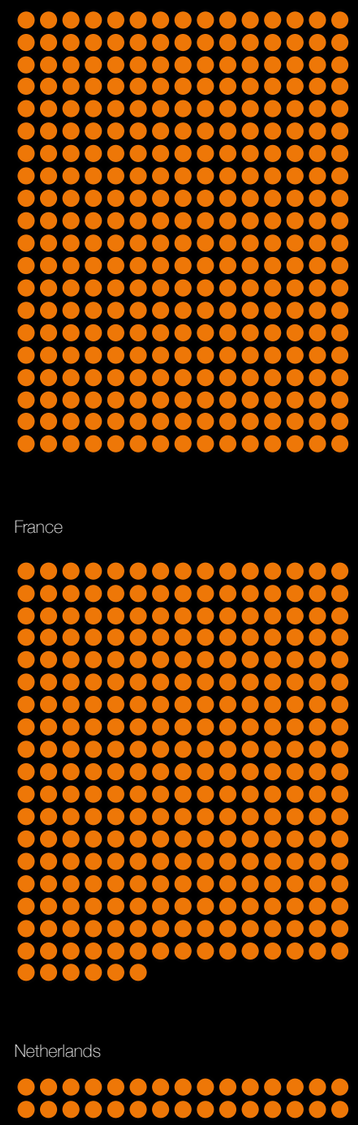


Fig 3.4.2.1 Number of seasonal workers
The number of seasonal workers differ in Europe. Certain goods such as asparagus, strawberries and grapes are handpicked and therefore more labour intensive. (Shown in 1.000s)

I have been working here for 16 years, 11 years for a temporary work agency. I usually worked long hours, from 6 a.m. to 6 p.m., sometimes until 7 a.m. Say more than 12 hours. I receive a bare wage for this, according to the stipulated hourly wages and no allowances for working on public holidays, […] on Saturdays or Sundays, [or] for overtime. (Male migrant worker from Poland) (Siegmann et al., 2p20, p. 2)

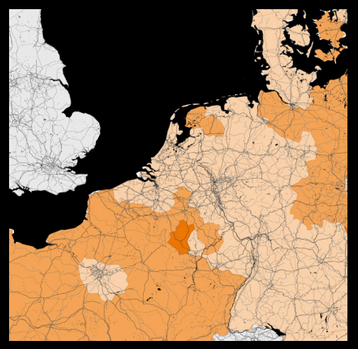
Where do you go with these kinds of complaints? […] You have the labour inspectorate, but well. You have the unions, but you can only approach them if you are a member. They can do something if it concerns large groups. Same with the Labour Inspectorate. Individual complaints are not actually processed. Only when people really get together. (Coordinator migrant organization) (Siegmann et al., 2020, p. 3)

If you open your mouth, you get the boot and you are on the street. Because the two-go hand in hand (social worker supporting workers experiencing labour exploitation) (Siegmann et al., 2020, p. 3)

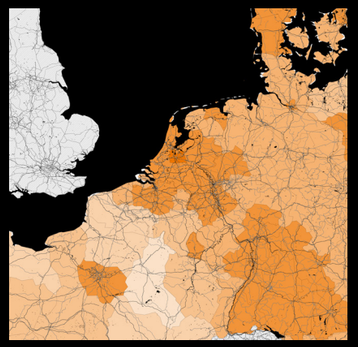
3.4.3 Regional difference

North-western Europe can be characterised by regional differences. Not only houses the region's many different languages and offer a wide variety of cultural differences and nuances, but regional differences can also be witnessed through the lens of Territorial Quality of Life indexes. The measurement of Territorial Quality of Life involves data that encompasses all the factors that enable a good life, necessary for achieving homeostasis in people's living environment. Consequently, it encompasses elements that are essential for maintaining a healthy personal life, an inclusive economy, a healthy society, and a healthy environment (Federal Institute for Research on Building, Urban Affairs and Spatial Development, 2020). Therefore, outcomes related to the territorial quality of life and good life enablers index highlight that predominantly the regions in proximity to both nature, urban, and rivers perform well.

Additionally, southern, and eastern regions in the frame have poorer scores due to socioeconomic conditions. Furthermore, regions identified where community engagement is low and trust in public institutions are weak, this is the case for the eastern parts of the frame, and the UK, underperform, while Nordic countries perform well.
Considering the regional differences regarding the competition to both attract and detract people and companies to regions and regional competition among regions themselves it once again becomes clear that the regions home to urban centres and nature are the most prosperous. Consequently, considering the European categorisation by the European Commission regarding the need for European support to develop the regions a similarity arises that matches the regions labelled as not being competitive or offering a good life.



Regional cohesion



Regional competitiveness index

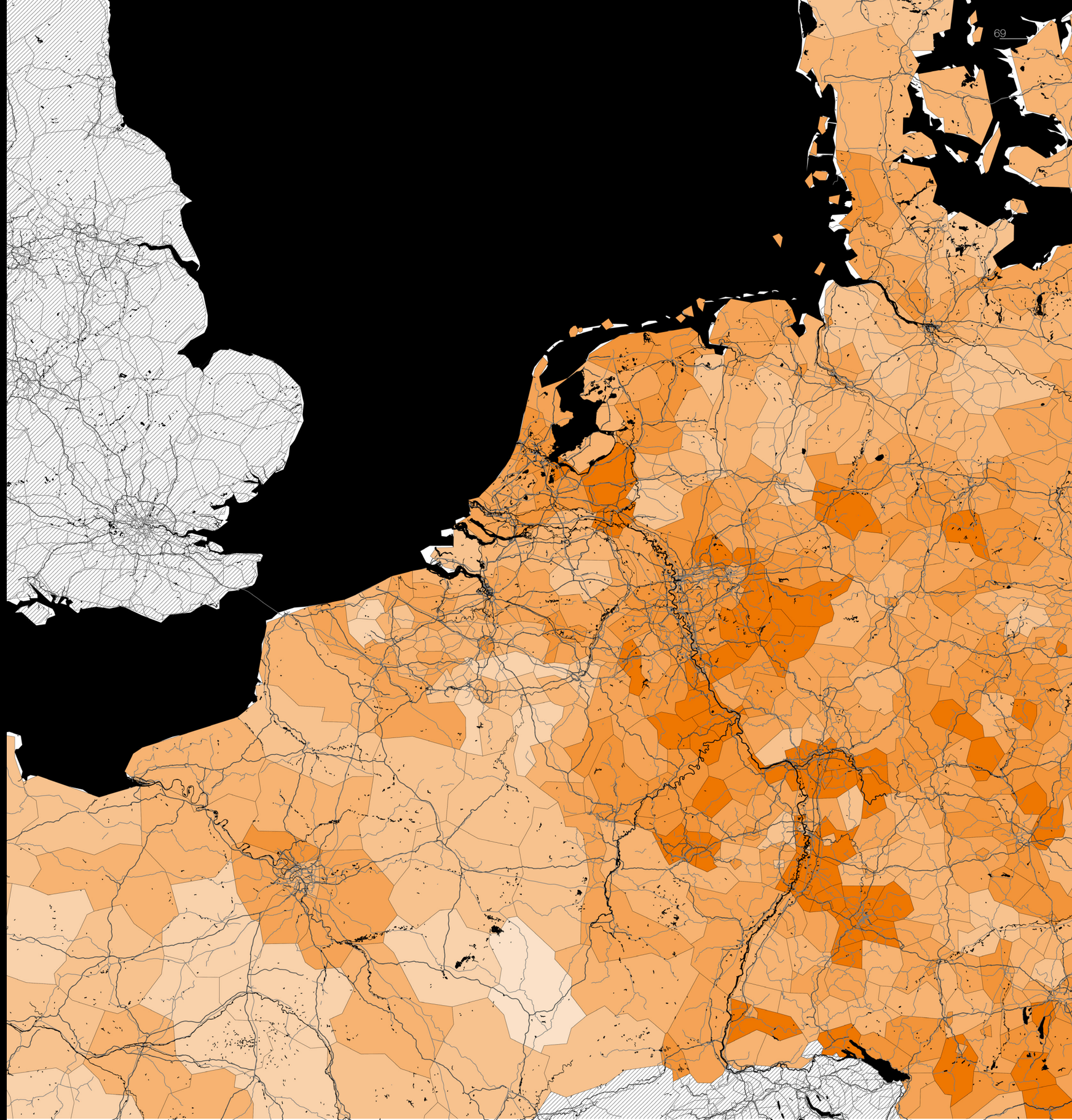
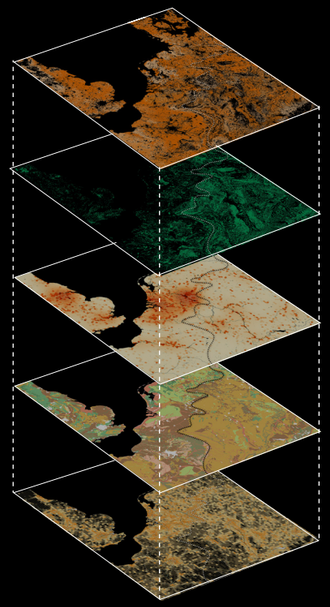


Fig. 3.4.3 Good life index
The map shows the Territorial Quality of Life index, highlighting regional differences. Regions in proximity to nature and urban areas perform well, while those with poorer socio-economic conditions under perform.

3.5 Conclusion - why lowlands?

After the analysis of ecological, economic, and social degradation, it becomes evident that the Lowlands of North-West Europe are the region with the most extensive agriculture cover and most intensive food production practices while presenting extraordinarily little forest cover. The edge of our frame is defined through both topographical and geological features along the inland, and extends into the North Sea, as an opportunity to consider the often poorly utilized coast of North-West Europe, in terms of food production and ecosystem restoration. Rivers as morphological formations transcend our frame and are intended to be analysed as a principal element of the strategy later.



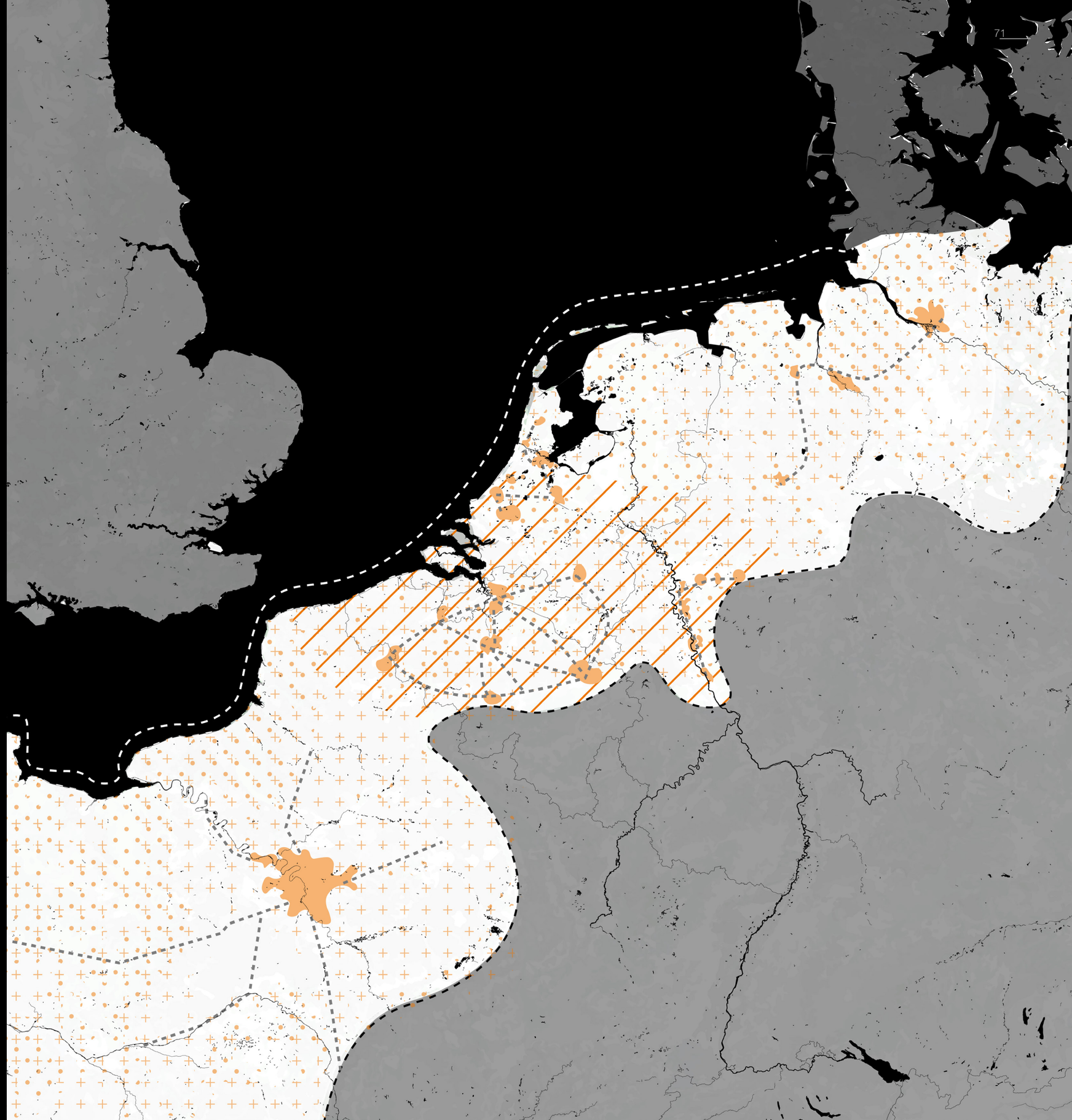


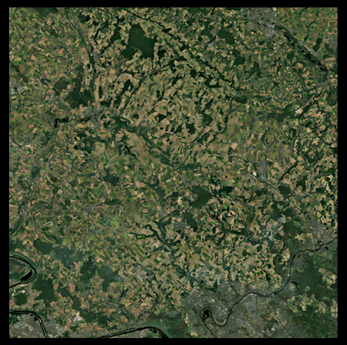
Fig. 3.5 Analysis conclusion map
The analysis through three lenses has shown main degradation in the Lowlands of north west Europe, resulting in our L frame.

3.6 Introducing M frames

As per the general goal of the studio, the development of the strategy will be centred on the contribution of South Holland towards the overall system in the North-West Europe frame. Hence, we are defining our first frame of examination on the coast of South Holland. Here the role of the province can be further examined, as an existing hub of high technology and education on revolutionary farming techniques, but also as a coastal area endangered by the rising sea level.
The second keyframe is defined in France, specifically Northern Paris, as a juxtaposition to the Dutch frame. Here we can envision how the strategy could unfold through a low-tech approach, where most of the land is covered in extensive agriculture practices.



South Holland M frame



Paris M frame

Fig. 3.6 Choosing specific regions
The M frames of South Holland and Paris were chosen because to their contrasting regional characteristics in terms of landscape, culture and agricultural practices.

Crop lands
Pastures
Most polluted areas
Main urban centers
Main networks

100m

04

vision

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4.1 Vision Statement

In 2050, we envision a future where the Lowlands of North-West Europe have been regenerated into a spatially, socially and ecologically just countryside. The lost connection between nature and society will be invigorated through an integrated and resilient rural network, which facilitates a transition towards an adaptive and just future as well as mitigates the adverse effects of climate change and sea level rise, overexploitation and ecosystem degradation.

A regenerative countryside aims to restore the balance between ecological, economic and social sustainability. The ecology-driven practices revitalize the natural resources such as soil health, freshwater availability and reduce the emission of greenhouse gasses. The economic values focus on reorganizing trade flows to promote localized food production and small-scale, diverse agricultural practices in the countryside. On the social front, the regenerative approach aims to ensure health and well-being through food security, legal protection rights and creation of more opportunities in the countryside.

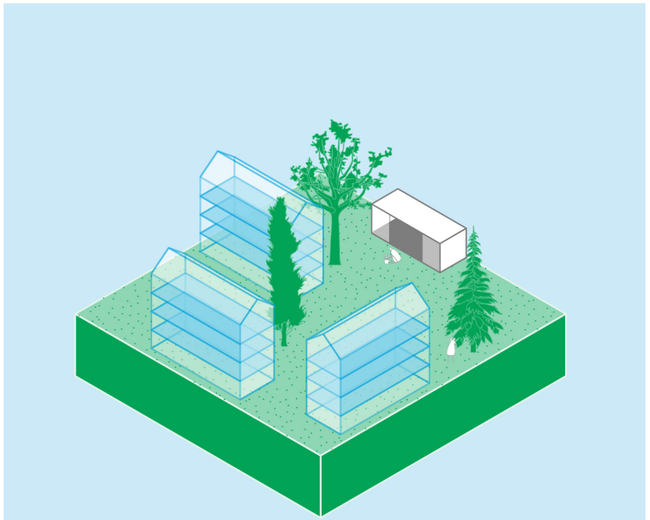
Thus, the regenerative countryside of North West Europe will create a multifunctional and diverse ecosystem wherein a healthy society co-exists and evolves in coherence with the natural landscape. These emerging regenerative landscapes are context specific, resulting in an inclusive, resilient and adaptive agricultural system which generates ecological, economic and social benefits in the future.



4.2 Vision Goals

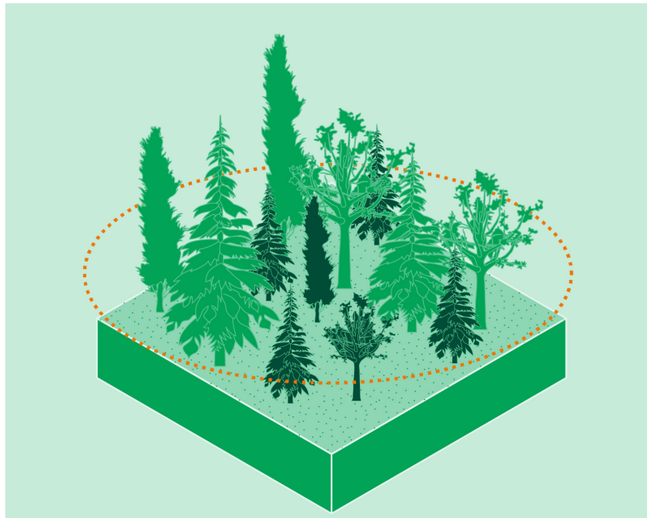
Moving forward from the general definition of the vision, towards the unpacking of its components and the formation of our strategy, we will structure our thinking around three main goals. Reflecting on the transition from a degrading system towards a regenerative one, sustainability concerns will be addressed under the goal of Sustainable Food Security, restoration, and revitalization under the pillar of Ecosystem Revitalization, and finally the transition to regeneration under the goal of Regenerative Agriculture.

With climate change mitigation as the first general focus, Sustainable food security is the shorter-term plan to reach a zero-emission food production system by 2050. Ecosystem revitalization is a much longer-term plan, as the amount of land that needs to be restored is vast and the process much more complex. In between the previous goals, the transition to Regenerative Agriculture practices can be initiated from the beginning and slowly expand towards the entirety of the agricultural land cover.



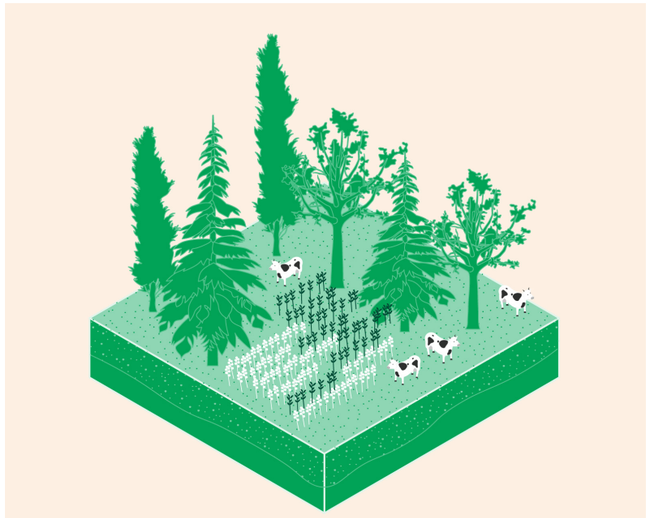
Sustainable food security

After research on extensive regenerative agriculture practices ,it becomes evident that the yield in food production usually cannot be the same as the current intensive agriculture practices, which require enormous inputs of fertilizers and intense management. To alleviate the land of its production intensity, and within a rising global population, means that there is a need for a sustainable way of approaching food security. At the same time, it has been illustrated in the previous analysis that Europe produces much more than it consumes. Aiming towards a more sustainable and spatially confined way of ensuring food security some intensive agricultural practices will be taken into consideration.



Ecosystem revitalization

Ecosystem revitalization includes the restoration and rehabilitation of existing damaged or degraded ecosystems, as well as the expansion of them into new territories. It is crucial for the preservation of biodiversity, mitigation of climate change and improvement of the health and resilience of both human and non-human habitats. It is a key tool for achieving the United Nations' Sustainable Development Goals and ensuring a healthy planet for all future generations to come. Again, a few relevant approaches to ecosystem revitalization will be examined, that is specific to the frame of North-West Holland.



Regenerative agriculture

The region of North-West Europe is highly dependent on agriculture, causing immense environmental degradation – as was illustrated in the previous chapters. Moving from an agricultural system that focuses on maximization of yield, towards regenerative farming approaches can regenerate soil health, promote biodiversity and ecosystem services, and improve the long-term sustainability and resilience of the region's agricultural system. Regenerative agriculture can address not only environmental but also social issues that are associated with conventional farming practices – like promoting rural livelihoods and ensuring food security in the countryside. To provide the theoretical framework for this transition, some of the key practices of regenerative agriculture will be examined.

4.2.1 Sustainable Food Security

i. Precision farming

Precision farming is a management approach that focuses on (near real-time) observation, measurement, and responses to variability in crops, fields, and animals. (“Who is the father of precision farming? (2023)”) It can help increase crop yields and animal performance, reduce costs, including labour costs, and optimize process inputs. All of these can help increase profitability. At the same time, precision farming can increase work safety and reduce the environmental impacts of agriculture and farming practices, thus contributing to the sustainability of agricultural production. (EIP-AGRI, 2018)

ii. Vertical Framing

Vertical farming involves growing crops throughout structures rather than in the ground, which requires fewer resources and eliminates the need for soil. Moreover, the food production in a vertical farm is not influenced by external weather conditions or other natural factors. A wide variety of plant species can achieve optimal growth rates year-round when grown in controlled environments with constant monitoring and manipulation of environmental factors like light, humidity, and temperature. The vertical farming strategy aims to boost the efficiency rate. Temperature, light, humidity, and gases can be artificially controlled to enable indoor food and medicine production. Chemicals are kept out of the environment because closed growing systems are used. The concept of vertical farming has brought together a wide range of experts in robotics, aeroponics, aquaponics, and hydroponics. (Mohd et al., 2022) Intensification of food production through vertical farming could alleviate the agricultural land, allowing for a transition towards extensive regenerative practices that remediate soil and provide more space for ecosystem services.

iii. Aquaponics

“Aquaponics is a technology that couples tank-based animal aquaculture with hydroponics—involving microbiological processes - using water from aquaculture for plant nutrition and irrigation.” (“The aquaponic principle—It is all about coupling - Baganz - 2022 ...”) (Baganz et al, 2021) It is a portmanteau of aquaculture (the farming of aquatic organisms) and hydroponics (the soilless cultivation of plants) that refers to a technology coupling both in one system where the nutrient-rich water from aquaculture is used as fertilizer for the cultivated plants. Microorganisms, especially bacteria, are the third key component due to their functions in nutrient transformation. (Baganz et al, 2021) In aquaponics, the aquaculture effluent is diverted through plant beds and not released to the environment, while at the same time, the nutrients for the plants are supplied from a sustainable, cost-effective, and non-chemical source. Thus, this integration removes some of the unsustainable factors of running aquaculture and hydroponics systems independently. Moreover, aquaponics contributes to food security26 and food sovereignty. Applied locally within community-supported agriculture, it can also play a role in food assistance, in line with the respective UN convention. (Baganz et al, 2021)

iv. Hydroponics

Hydroponics is a technique of growing plants in nutrient solutions (water-containing fertilizers) with or without the use of an inert medium (sand, gravel, vermiculite, rock wool, perlite, peat moss, coir, or sawdust) to provide mechanical support (Sharma et al., 2018). Maharana and Koul (2011) defined hydroponics as a technique of growing plants in soil-less conditions with their roots immersed in the nutrient solution. (“(PDF) Hydroponics in vegetable crops: A review - ResearchGate”) It was coined in 1930 by W. E. Gericke of the University of California, meaning water and labour in other wordTs i.e., water working or growing plants in a nutrient solution without soil. (Sheikh, 2006)

v. Aquaculture

Aquaculture, or the farming of fish, bivalves, crustaceans, and seaweeds, is an important and rapidly growing food-production industry around the world (Weitzman, 2019). Some of its benefits include the strengthening of marginal economies through increasing employment and reducing food prices, the improvement of aquatic biodiversity through recovering of protected species and improvement of water quality the reduction of pressure on fishery resources when done sustainably. Furthermore, they perform effectively in carbon sequestration and ocean acidification buffering due to the potential for restorative aquaculture to provide this climate adaptation and mitigation benefits. (The Nature Conservancy, 2021). It is important though, to regulate the intensity of the practice as it can also potentially lead to localized sedimentation, eutrophication of the water column, as well as pollution from chemical, pharmaceutical and toxicant inputs. (Frankic, 2003).



Fig 4.2.1.1 Vertical Farming
The scalability of vertical farming with aquaponics: combining horticulture with fish farming- in which waste from the fish is transformed into organic fertiliser for the leafy greens.

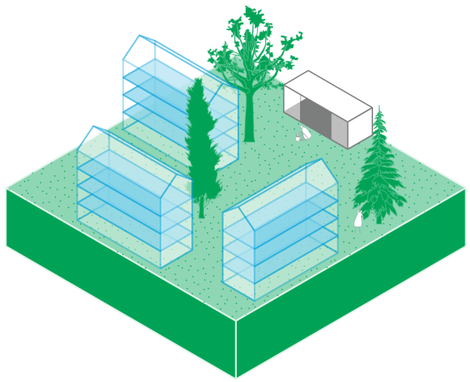


Fig 4.2.1.2 Aquaculture
Integrating seaweed and bivalves to increase wild fish stocks and reduce local ocean acidification.

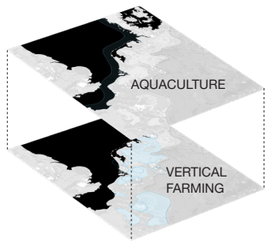


Fig 4.2.1.3 Precision Farming
Precision farming has been embraced in the netherlands as a means of optimizing crop production while minimizing waste and reducing environmental impact.

Potentials for Sustainable Food Security



Sustainable food security is identified as one of the primary goals in our visions and keeping the scenarios of climate change in mind, we envision that a bulk of the food productoin will shift into vertical farms where food can be grown in a controled and regulated environment. These food hubs shall be positioned next to the regions which are densely populated and shall be spread throughout the Lowlnads region to prmote localized food production. With rising sea levels and saliniization, there shall be greater emphasis on promoting aquaculture as well.



Layers for Sustainable Food Security



Fig 4.2.1.4 Food Security Potential Map

The above map shows the potential areas which shall support the practices of vertical farming and aquaculture in our to meet our goal of sustaining food security in the future.

4.2.2 Ecosystem Revitalization

i. Reforestation and Aforestation

Following the IPCC report guidelines, afforestation, and reforestation both refer to the direct human-induced establishment of trees on non-treed land through planting, seeding and/or the human-induced promotion of natural seed sources. The two terms are distinguished through the examination of the period in which the non-forest has prevailed. Reforestation relates to the establishment of forest on land that had recent tree cover, afforestation refers to areas that have been without forest for much longer. - or has “not supported forest in historical time”. These practices typically lead to an increase in biomass and dead organic matter carbon pools, as well as soil carbon pools to a lesser extent. Accumulation of carbon in biomass after afforestation varies greatly depending on the species of the trees and the specific site but can range globally from 1 to 35 tones of CO2 per hectare yearly (IPCC, 2007).

ii. Wetland restoration

In the past millennium, almost 80% of Europe’s wetlands have been lost – they do however still cover most of the North. They include bogs and fens (most common in the boreal, Atlantic, and temperate parts of the continent), riverine wetlands along streams and rivers, and freshwater tidal wetlands, which have become the mote rare in Europe’s temperate zone. Wetlands are extremely important habitats for biodiversity conservation, as they host their own characteristic plants, animals, and microbial species, but also because they play a crucial role in the life cycle of migratory birds. As they are heavily protected through policies like Ramsar and EU directives, as well as national legislations, wetlands in theory should no longer suffer major damages anymore. Within our examination frame, large wetland restoration programs already exist in the Netherlands, UK, Denmark, and Germany (Verhoeven, 2014).

iii. Peatland restoration

Peatlands are a type of wetland that is characterised by a thick water-logged soil layer made up of dead and decaying plant material. Globally they cover around 3,5 billion square kilometres, or 3-4% of the planet’s land surface, and store one-third of the total carbon in soils. The release of the stored carbon occurs when the dead organic matter is metabolized by bacteria and turned into carbon dioxide (Parmentier et al., 2009).

The majority of existing peatland restoration work that has been conducted in Western Europe has been funded through the EU Life Projects, NGOs, and governmental programmes, or through private companies (including peat extraction companies, water companies and horticulture companies). Between 1993 and 2015, the EU-LIFE nature programme alone invested 167.6M € in 80 projects, which aim to restore over 913 square kilometres of peatland habitats in Western European countries, mostly in protected sites part of the Natura 2000 EU network. (“An overview of the progress and challenges of peatland restoration in ...”) Further development of schemes is needed that enable the restoration of peatlands through engaging corporate sponsorship (Andersen et al., 2017).

iv. Heathland restoration

Heaths are characteristic biotopes in north-western Europe, found in nutrient-poor, acidic to slightly acidic habitats, where substrate composition seems to be of less importance. (Jansen et al., 1996) The term health was not connected to a vegetation type but to common fields for cattle grazing on chemically poor sandy soils. During the 20th century, most of the heaths were transformed into arable land and forest plantations. Soils were deeply ploughed, and soil archives were severely damaged or even destroyed. Restoration of these ecosystems should be aimed at diminishing the effects of soil acidification, eutrophication and lowering of groundwater tables. Since the reduction of atmospheric inputs is a long-term process, measures will have to be taken on a smaller, local scale, e.g., in vegetation, soil or hydrological conditions (Jansen et al., 1996).

Looking to the Netherlands, despite the realization of many health restoration projects during the last decades, the area of the present heaths is just a fraction of the health area in AD 1900: from about 600.000 hectares to 30.000 hectares today – only 5% of the pre-industrialization heathland coverage (Doorenbosch & Mourik, 2016).

Several experiments have been carried out since 2005, aiming to accelerate the vegetation and surface-dwelling fauna. In the new reserve “Reijerscamp”, situated in the Central Netherlands, a 10-year monitoring project was carried out in an abandoned sandy field area of ca 200 ha from 2006-2015. Immediately adjacent to the National Park “Dwingelderveld” (in the north of the Netherlands) the “Noorderveld”, consisting of 200 ha of the arable field was acquired for nature restoration. The examination of these two case studies showed that the site adjacent to the existing heathland complex was inhabited by the characteristic heathland species extraordinarily faster than the other site. Thus, connectivity or adjacency to existing heathlands could be a crucial spatial principle for their restoration and expansion, especially for species with low dispersal powers (Vermeulen & Turin, 2019).



Fig 4.2.2.1 Restoring Peatlands
Globally peatlands store twice as much as carbon as all the world’s forests.



Fig 4.2.2.2 Restoring Heathlands
Heathlands develop over nutrient poor soils. In netherlands, they have decreased by 95% between 1900 and 1950.

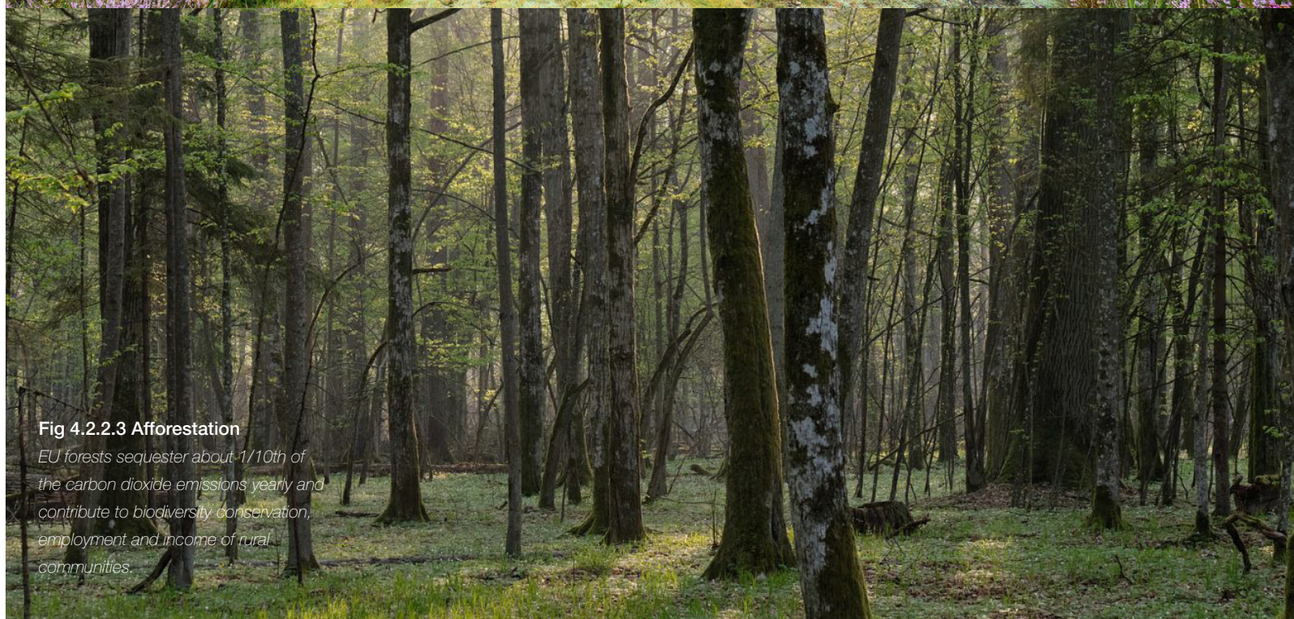
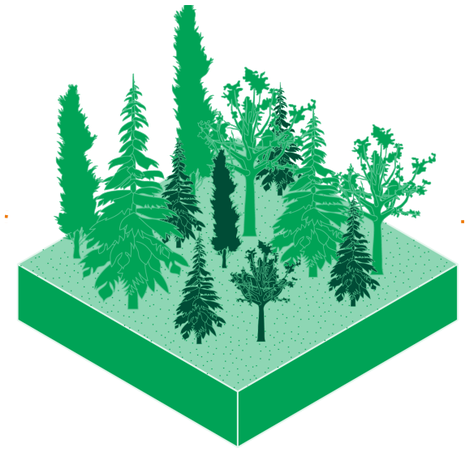
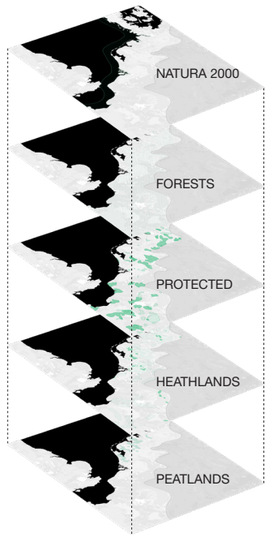


Fig 4.2.2.3 Afforestation
EU forests sequester about 1/10th of the carbon dioxide emissions yearly and contribute to biodiversity conservation, employment and income of rural communities.

Potentials for Ecosystem revitalization



Ecosystem revitalization is defined as an important goal of the project because in order to transition towards a regenerative future which is a haven for biodiversity and is marked by a strong connect between man and nature, it is imperative to restore the natural ecosystems of the region and add new energy to them.



Layers for Ecosystem Revitalization

Fig 4.2.2.4 Ecosystem revitalization

The above map shows the potential areas in the natural ecosystem which need to be revitalised in order to achieve our goal of a regenerative countryside in Lowlands 2100.

- Potential for Forests
- Natura 2000
- Large protected patches
- Peatlands
- Heathlands 1830
- Water
- Natural connections
- Expansion of Natura

100 km

4.2.3 Regenerative Agriculture

i. Conservation Agriculture

Conservation agriculture is defined as a system of agronomic practices, including reduced tillage, or no tillage of the soil, having permanent organic soil cover through retaining crop residue, and crop rotations. The aim of these practices is to increase crop yields while supporting ecosystem services. It is primarily practised on large-scale, mechanized farms, and requires large applications of herbicides to control weeds that are normally controlled by tillage. While it was not initially perceived as a carbon-sequestering practice, it is now researched as a potential technology to mitigate greenhouse gas emissions. It produces soil conditions that result in reduced erosion and runoff, as well as improved water quality when compared to conventional agricultural practices. (Palm et al., 2014)

ii. Agroforestry

According to the US Forest Service, (US Forest Service, n.d.) agroforestry is the intentional mixing of trees and shrubs into crop and/or animal production systems, to enhance the long-term production of food and other useful products while protecting the soil and water, diversifying, and expanding local economies, providing wildlife habitat, and ensuring a more pleasing and healthier place to work and live. Agroforestry practices can be grouped into the following categories:

a. Riparian Forest Buffer

This practice uses trees, shrubs and other plants growing adjacent to streams, ponds, lakes, and wetlands to protect water bodies from the negative impacts of adjacent agricultural fields. These buffers can be designed to produce income while accomplishing their conservation purposes.

a. Windbreaks

Field windbreaks protect the soil while improving crop yields and providing potential additional sources of income. Windbreaks can be designed to mitigate odoris, reduce heating costs, control snow, and improve wildlife habitat. Forest Farming: In forest farming, high-value speciality crops are grown under the protection of a managed forest canopy. (“Forest Farming – The Agroforestry Research Trust”) Crops such as ginseng, shiitake mushrooms, ramps, goldenseal, and pine straws can be profitably produced with this practice.

c. Alley Cropping

An alley cropping system integrates crops such as vegetables in alleyways between high-value trees and shrubs. The agricultural crop provides annual income until the trees can yield a long-term income product.

d. Silvopasture

Silvopasture is a practice where trees, livestock, and forages are intentionally managed together in a system. These Working Trees provide shade and comfort for livestock while growing into high-value products.

e. Special Application

Working Trees can be used to accomplish landowner objectives such as the production of bioenergy feedstock. Any Agroforestry practice can be designed to incorporate special needs such as wildlife habitat, annual income, or carbon storage.

f. Case studies

AGFORWARD (AGroFORestry that Will Advance Rural Development) is a four-year research project funded by the European Union, which started in January 2014 and ended in December 2017. (AGFORWARD EU, n.d.) Four case studies within our North-West Europe frame were examined: Agroforestry for poultry systems in the Netherlands, Fodder trees for cattle and goats in the Netherlands, Apple orchards grazed in France, and Multi-functional hedgerows in the bocage systems of France.

This brief examination made evident that agroforestry practices require high investment costs and are very reliant on knowledge and resource sharing. Farmers seemed to be most hesitant about learning new farming techniques that they would use only a few times a year, e.g., a poultry farmer learning how to cut and maintain hedgerows. At the same time, many farmers seemed to be fearful of agroforestry being a slow transition towards their land becoming conserved forest area. This hints towards the need for concrete policies, which would reassure the stakeholders regarding the ownership of their land, as well as convince that agroforestry would be to their ecological, economic and social benefit.

iii. Integrating livestock

Integrated crop–livestock systems are a form of sustainable intensification of agriculture that relies on synergistic relationships between plant and animal system elements to reinforce critical agroecosystem processes, with potential impacts on resilience to weather irregularities. (“What is livestock and crop integration? – Tonyajoy.com”) (Peterson et al., 2020) Benefits include reducing the use of inorganic fertilizers and pesticides, reducing animal feed costs, increasing soil health and biodiversity, and providing increased yield and productivity.



Fig 4.2.3.1 Silvoarable
Protects soil and enhances biodiversity, enhances the local rural economy and other cultural and recreational opportunities.

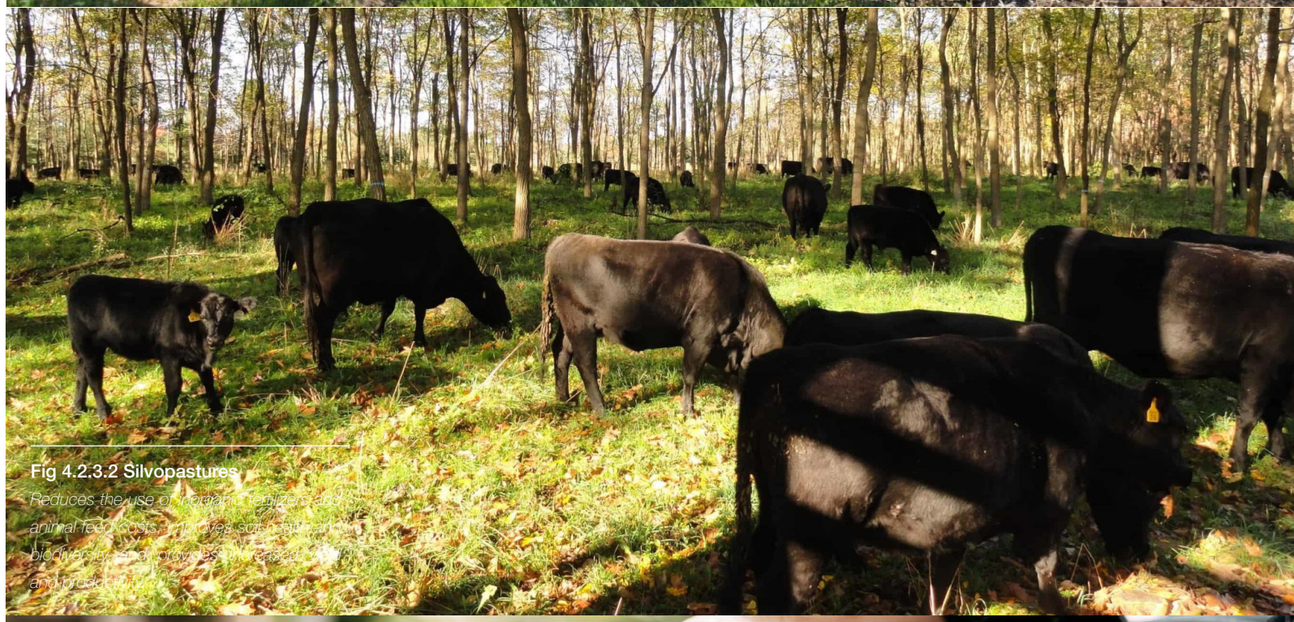
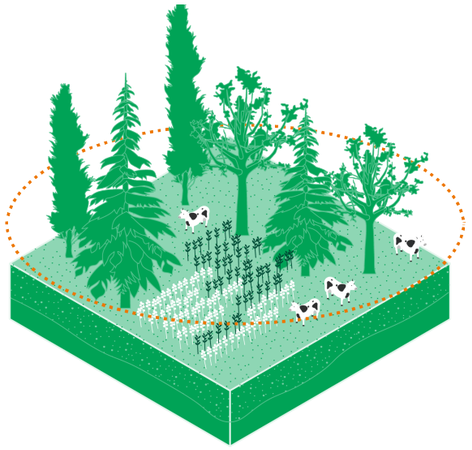


Fig 4.2.3.2 Silvopastures
Reduces the use of inorganic fertilizers and animal feed costs, improves soil health and biodiversity, and provides increased yield and productivity.

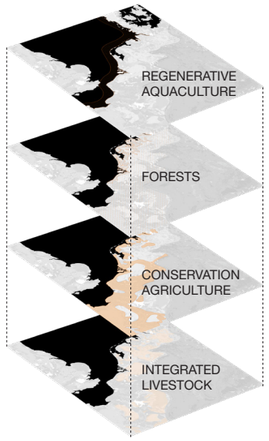


Fig 4.2.3.3 Conservation Agriculture
Reduces erosion and run-off and improves water quality as compared to conventional agricultural practices.

Potentials for Regenerative Agriculture



A layered approach is followed to decide upon the areas where regenerative agriculture will take place in the envisioned future. These consist of Regenerative Aquaculture, Aforestation, Conservation Agriculture and Integrated Livestock practices,



Layers for Regenerative Agriculture

Fig 4.2.3.4 Regenerative Agriculture

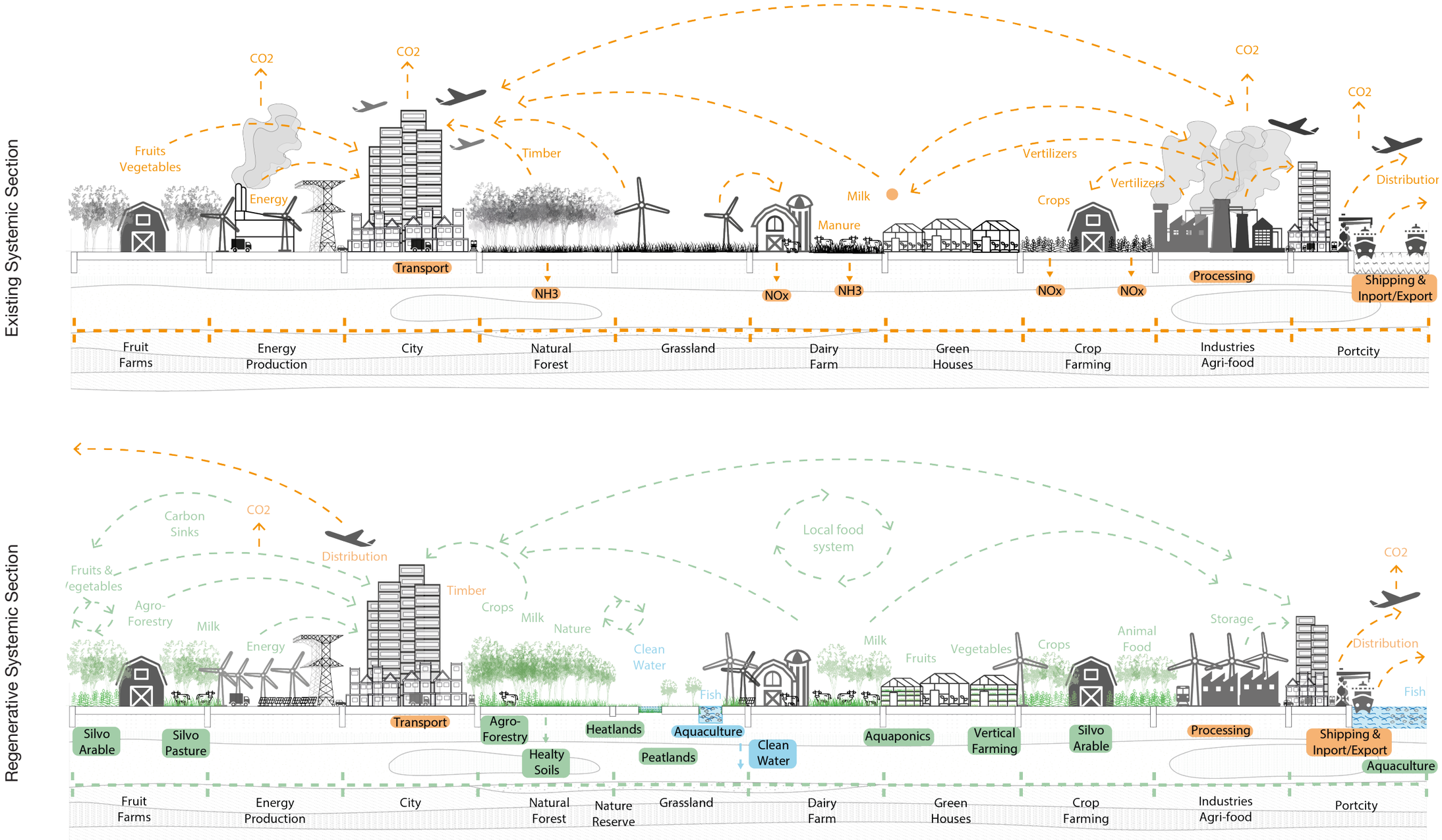
The above map shows the potential areas in the region which can house regenerative agricultural practices in Lowlands 2100.

- Potential for Forests
- Regenerative Aquaculture
- Conservation Agriculture
- Integrated Livestock
- Swamp Forests
- Water

100 km

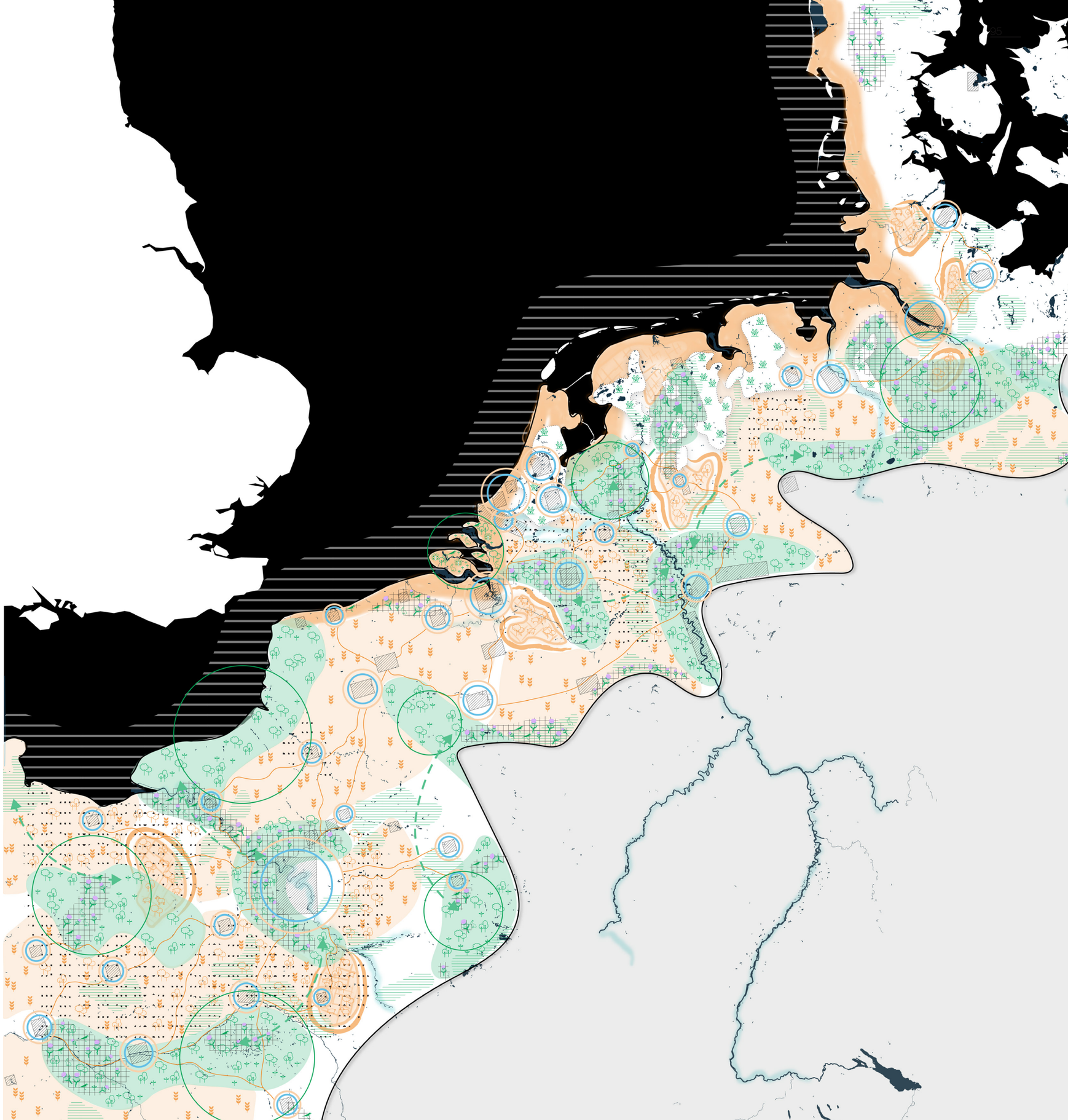
4.3 Systemic Flows

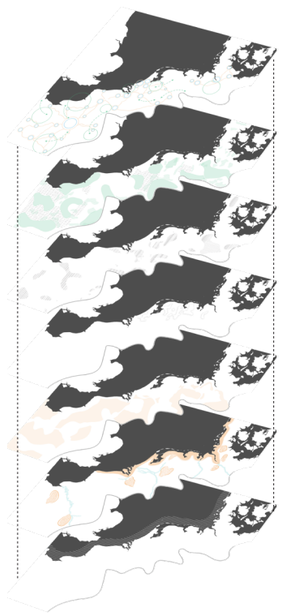
Systematic sections are used to define the transition from a degenerating to a regenerative system. The sections highlight how in the degenerating current situation long transport flows and the use of fossil fuels dominate. Through the lens of the vision, the future regenerative countryside is generalised and broken down into sustainable food security, ecosystem revitalization, and regenerative agriculture dimensions and associated flows which act as the planner of the regions defining the spatial dynamics.



4.4 Vision map

In the envisioned regenerative future for the NWE Lowlands in the year 2100, the region shall be flanked by a highly integrated and resilient network of regenerative agricutural hubs, sustainable food security hubs and revitalized ecosystem zones. The vulnerable coastal region shall have adapted to the change climate and sea levels and the existing monocultural intensive croplands and pastures have transitioned towards more integrated practices which in turn regenerate the ecosystem.





Layers for Vision Map

Fig 4.4 Vision Map for NWE Lowlands

The map above shows the envisioned regenerative future for the lowlands in 2100.

05

strategy

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5.1 Strategic principles

The set of values defined in our vision are translated to a set of strategic principles which fall under the goals of sustainable food security, ecosystem revitalization and regenerative agriculture practices.

Values

socio-spatial justice

access to knowledge

equality

community resilience

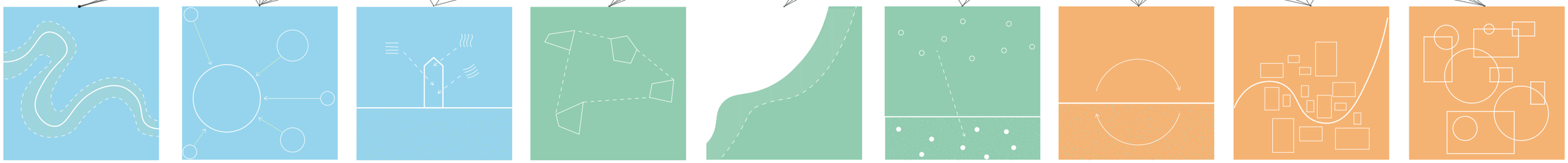
healthy soil

respect for biodiversity

access to a healthy environment

ecosystem regeneration

healthy food



riparian buffer zones

localised consumption of food, trees & knowledge

promoting precision farming

connect & strengthen ecological network

coastal buffer zones

store carbon and absorb

restore and preserve soil

adapting agriculture to climate change into a resilient system

integrating monofunctional landscapes

Strategic Principles

sustainable food security

ecosystem revitalization

regenerative agriculture

5.2 Strategy Map Lowlands

ecological corridors are added

coastal buffer zones are created to protect against sea level rise

heathlands are restored and new forests are added which act as carbon sinks

riparian buffer zones are around the river systems

localised consumption of food, trees & knowledge is promoted

precision farming is in all-regions of the Lowlands

soil remidiation techniques are used to preserve soil heath

adapting agriculture to climate change into a resilient system

monofunctional landscapes are combined into more integrated ones

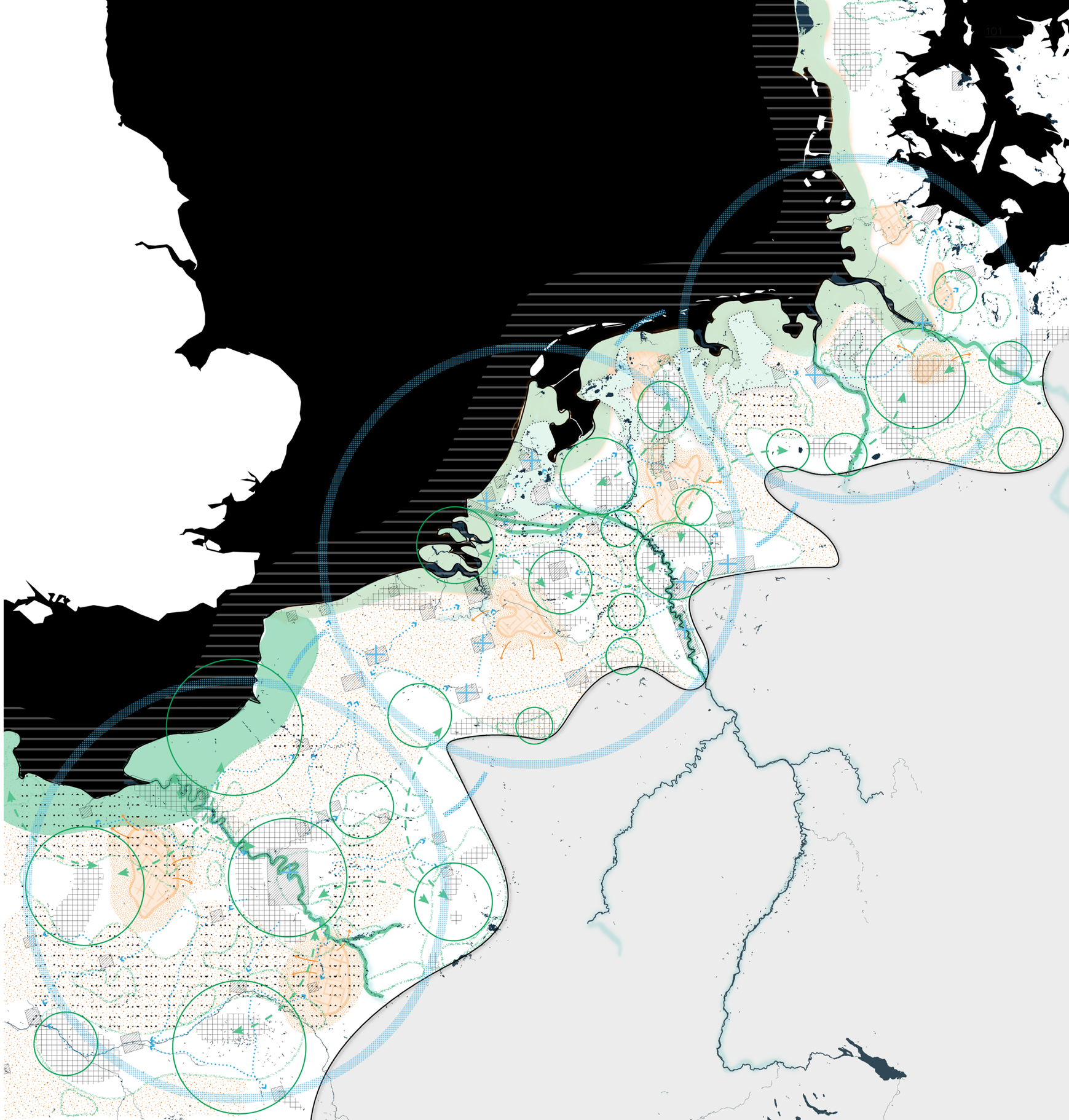


Fig 5.2. Spatialized Strategy Principles

The map above shows the spatial implications of the strategy priciples on the European lowlands.

5.3.1 Stakeholder Analysis

Private

Small scale farmers
Interest: being supported for their practices that have less impact on the environment

Female businesses
Interest: sustain their business concept and support other female businesses in their work

Young aspiring farmers
Interest: making a living of their farm land, making enough profit to support their family

Future generation
Interest: being considered in todays decisions as these have impacts on their future prosperity and ability to live

Supermarket chains
Interest: making profit on the products they sell and expanding their economic value over time, their behavior is based on consumption

Big production companies
Interest: making as much profit as possible. They are only willing to change practices if it has benefits for them and usually do not consider the environment

Banks
Interest: investing in projects that they see future profit in, they change their investments with consumer behavior and trends

Trading companies
Interest: sustaining or increasing import and export of products to increase profit

Public

European Union
Interest: reaching goals of the European Green deal and the Paris Agreement

National government
Interest: Economic prosperity and voter support while also reaching EU and global climate goals

Provinces
Interest: changing towards regenerative practices while sustaining economic prosperity

Municipalities
Interest: changing towards regenerative practices while sustaining economic prosperity

Civic

Education facilities
Interest: stay up to date on technological improvements, support farmers in changing their practices

Rural inhabitants
Interest: maintaining their way of live. Governmental support in the lack of infrastructure in their communities

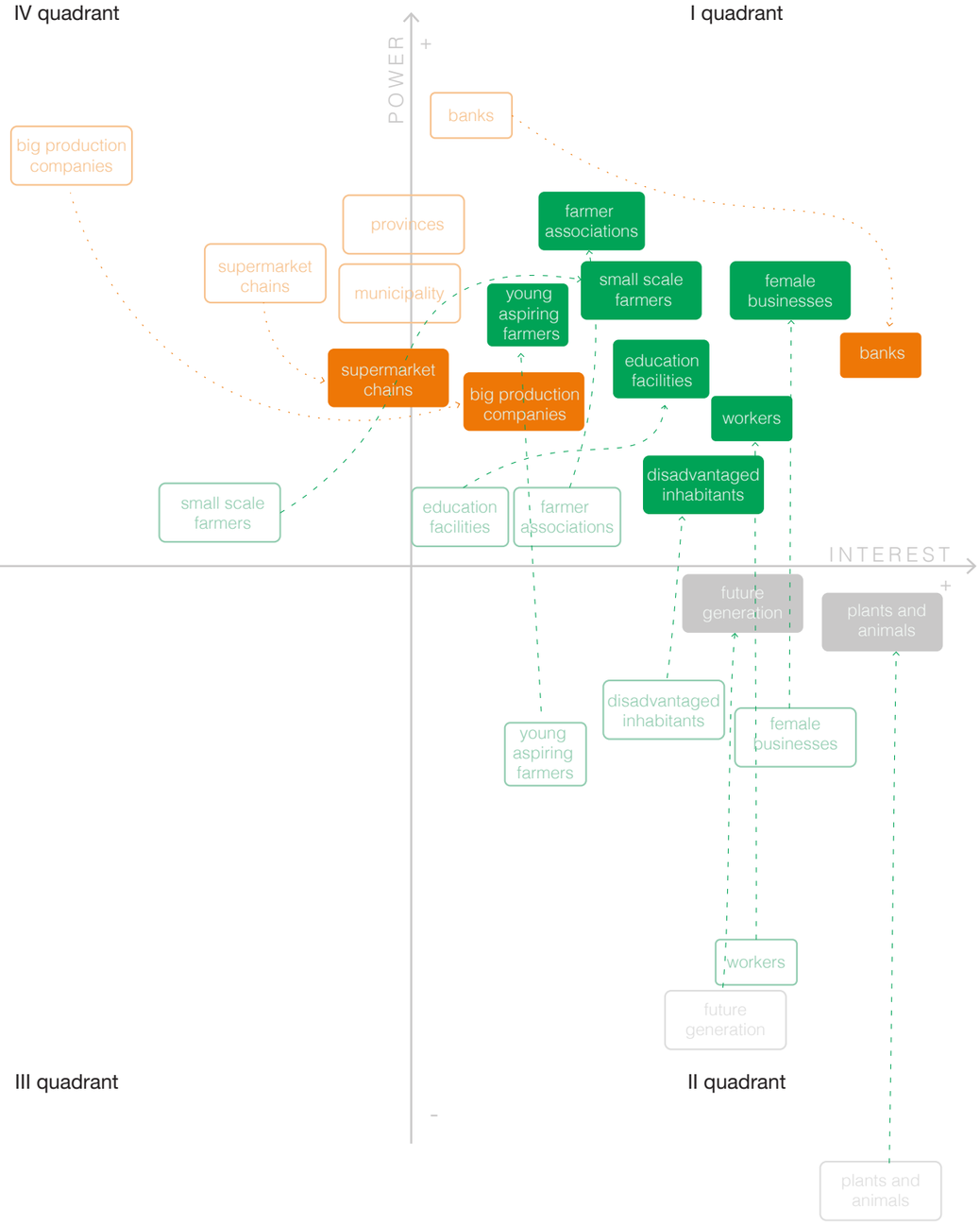
Plants and animals
Interest: Changing current practices to more environmental friendly to restore and revitalize the ecosystem

Workers
Interest: better working conditions in the agriculture industry, more support for housing and living conditions

Farmer associations
Interest: getting better subsidies for regenerative practices and other environmental friendly approaches

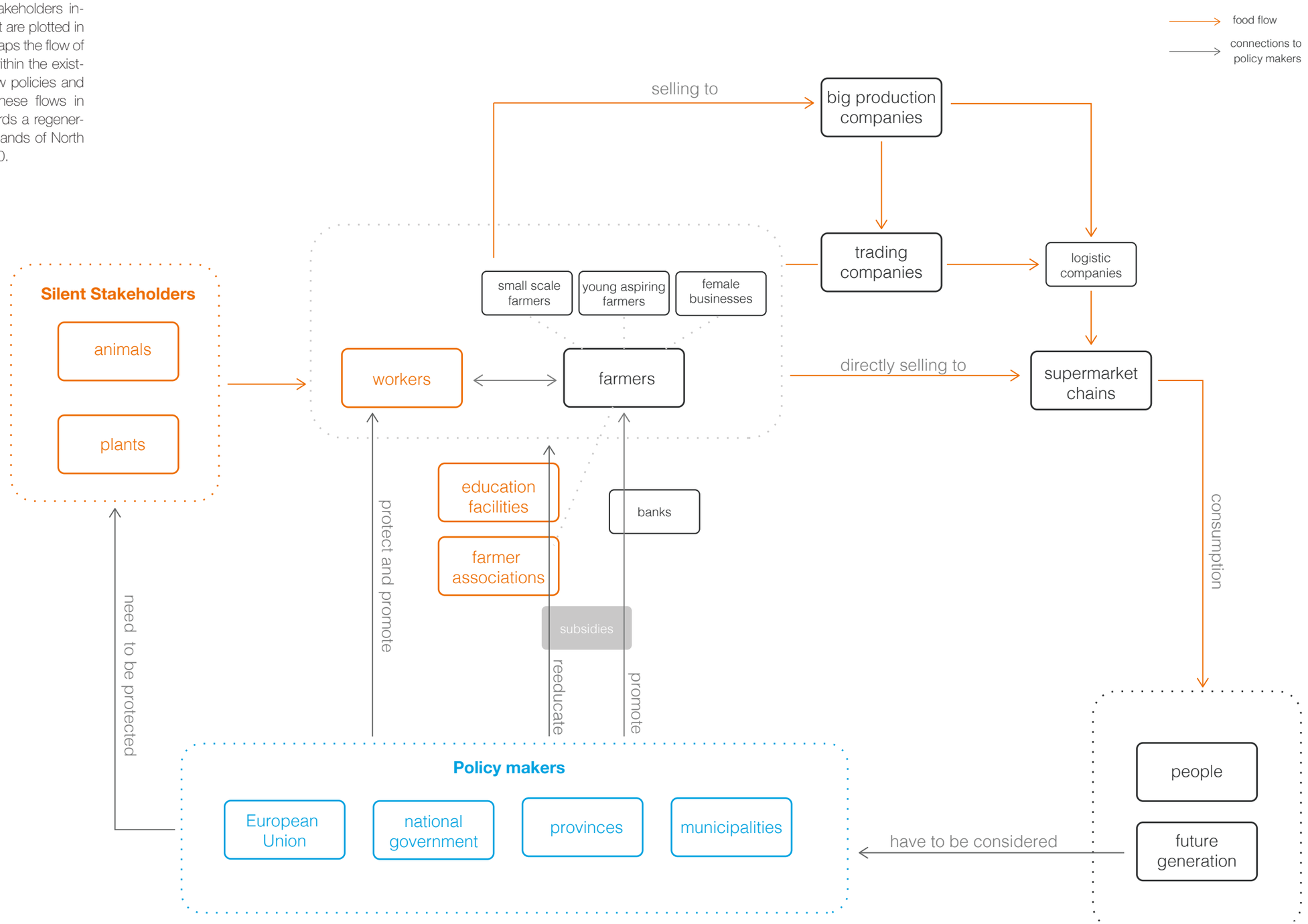
5.3.2 Power vs Interest

The follow graphs plots the various stakeholders in order of the degree to which we want to empower them as well as how much will they be interested in the initiatived proposed within our project framework. The stakeholders plotted within the Ist Quadrant are the ones whom we want to uplift through our vision of a regenertive future for the Lowlands of noeth Western Europe in 2100.



5.3.3 Stakeholder Network

The aforementioned stakeholders involved within the project are plotted in a flow diagram which maps the flow of food and agricultural within the existing ecosystem and how policies and actors can influence these flows in order to transition towards a regenerative future for the Lowlands of North Western Europe in 2100.



5.4 Spatial Phasing Lowlands

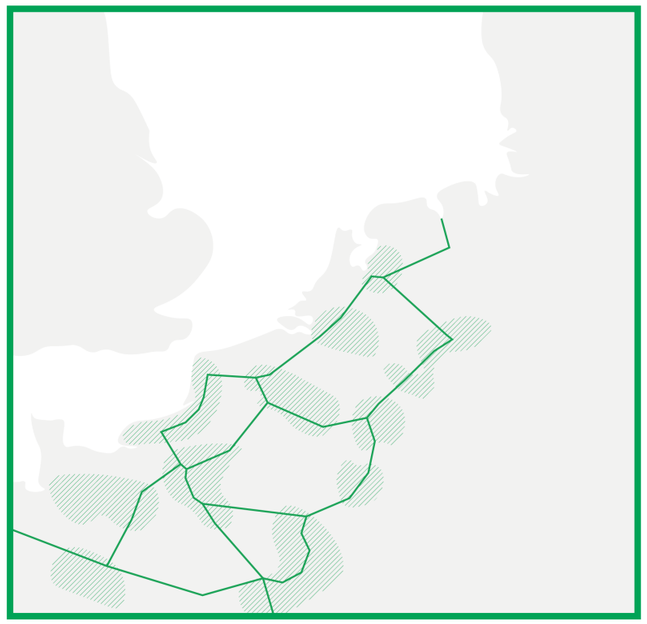
5.4.1 Ecosystem revitalization



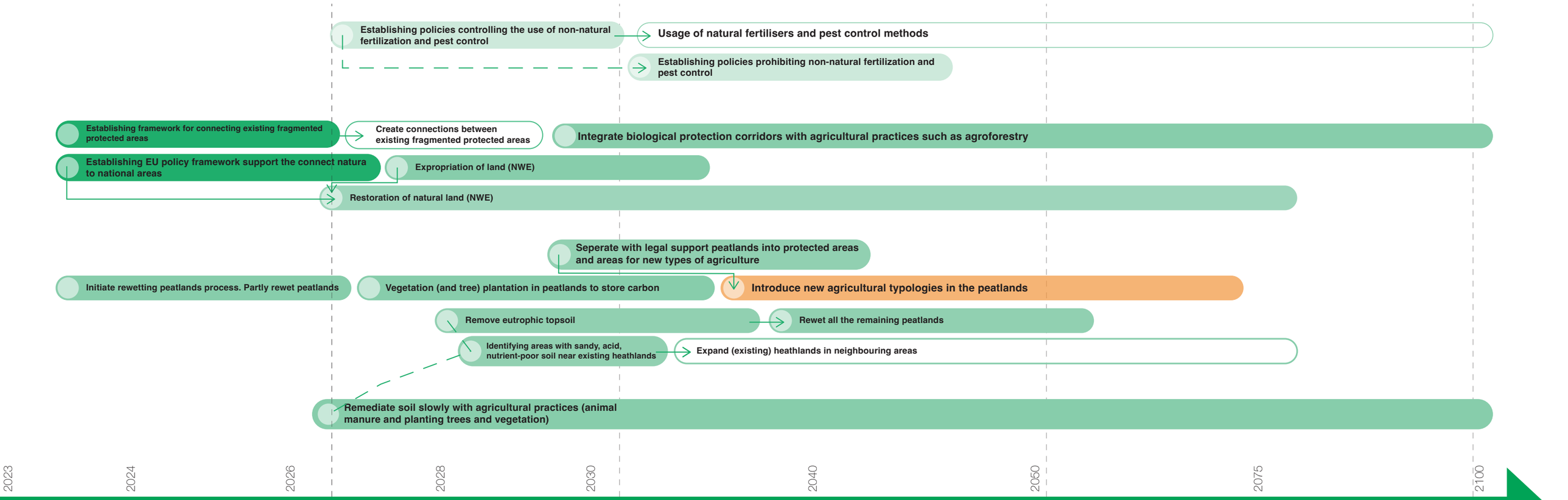
Phase 1: **Establishing a policy network**



Phase 2: **Formation of protected clusters**



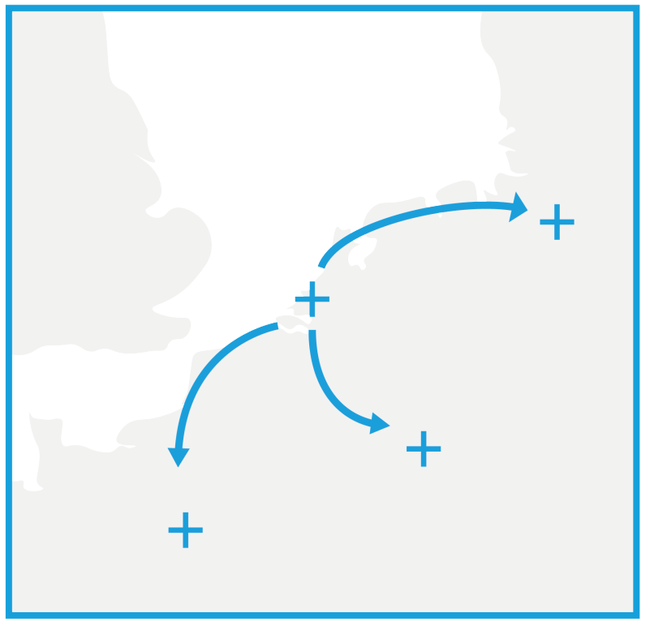
Phase 3: **Establilshing a Nature network**



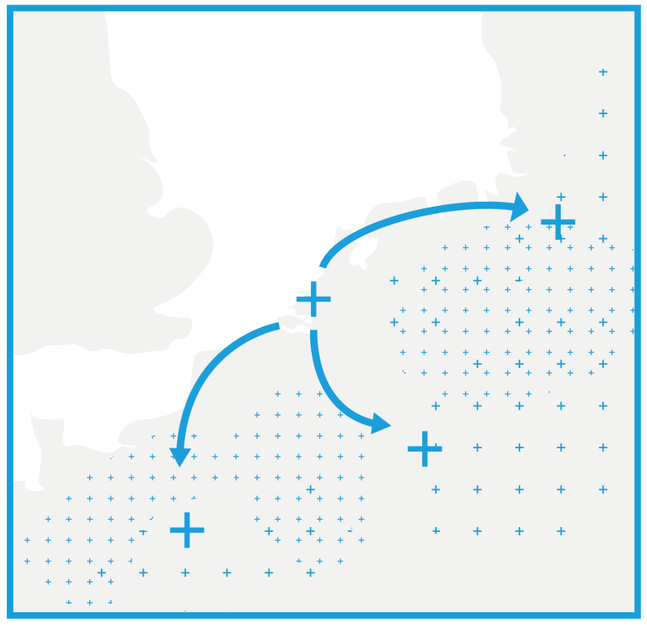
5.4.2 Sustainable Food Security



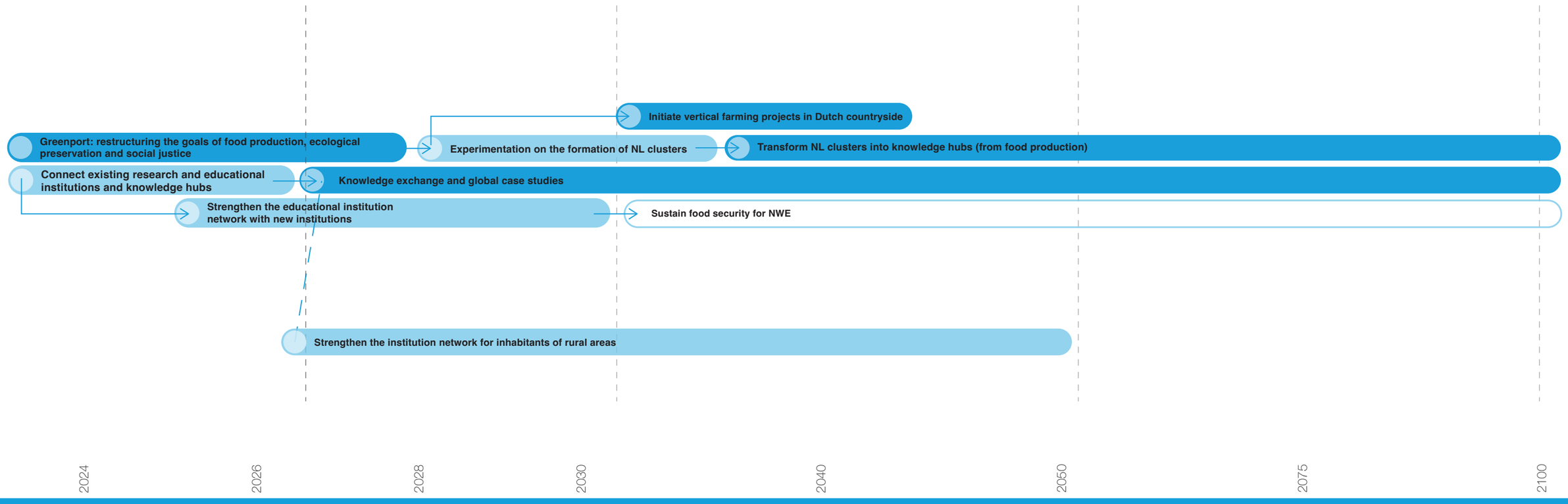
Phase 1: **Westland Knowledge Hub**



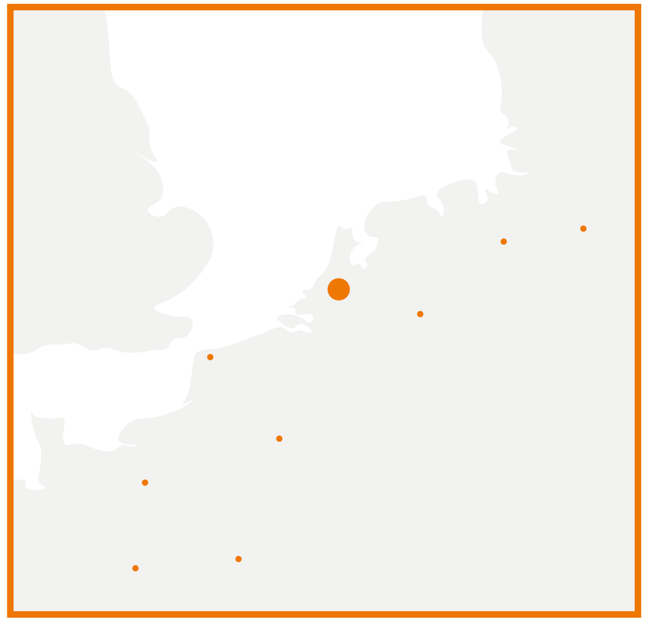
Phase 2: **Implementation around main urban centres**



Phase 3: **Implementation in the countryside**



5.4.3 Regenerative Agriculture



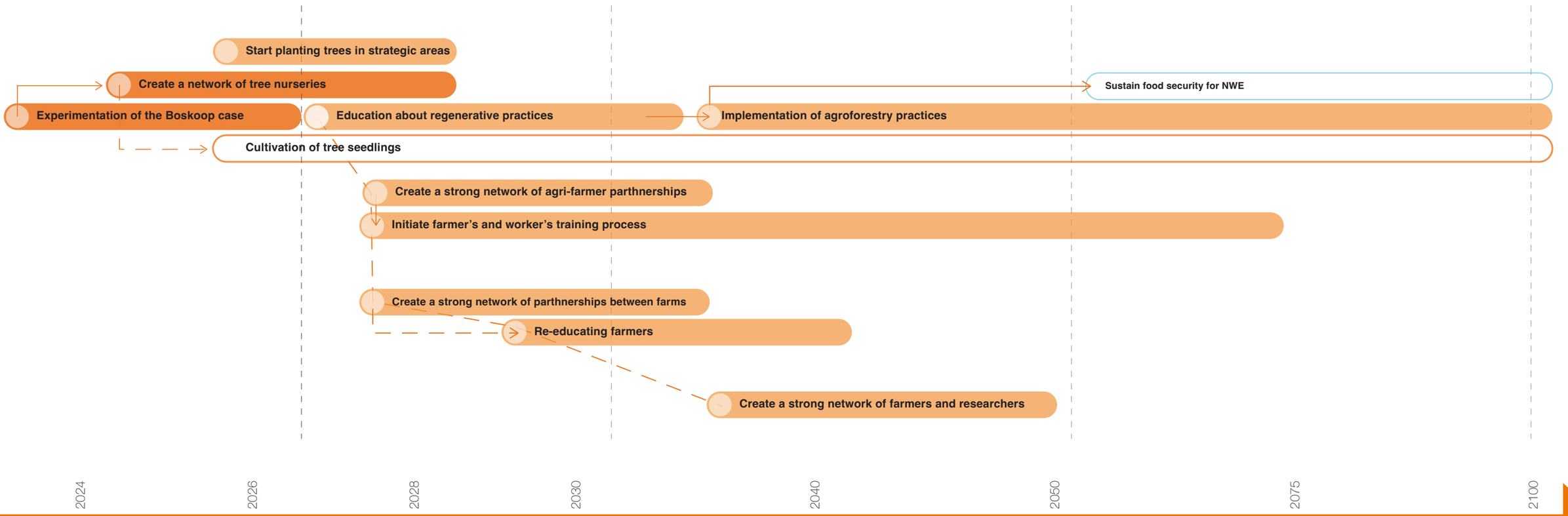
Phase 1: **Boskoop Knowledge Hub**



Phase 2: **Implementation at key areas**



Phase 3: **Integrated Regnerative Agriculture network**

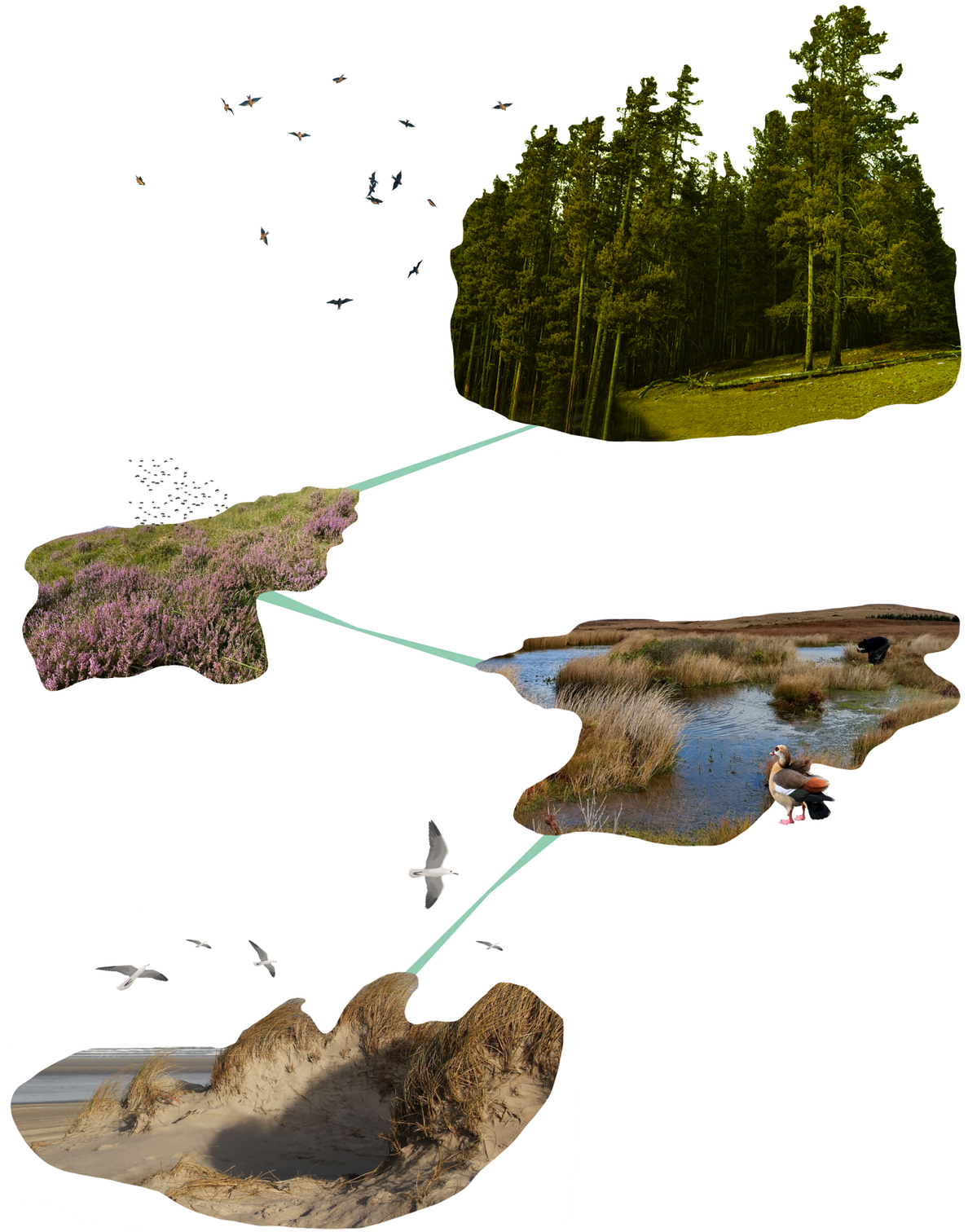


01

Strategic Intervention

Trans European Nature Network

5.5.1 Trans European Nature Network
5.5.1.1 Policy Goals
5.5.1.2 Existing policies
5.5.1.3 Proposed Policy Framework
5.5.1.4 Trans European Nature network
5.5.1.5 Policy Packages



5.5.1.1 Policy Goals

The fragmented European nature is facing a severe threat from human activities, including urbanization, transportation infrastructure, agriculture, and other forms of land use. This policy framework aims to protect and restore the fragmented European nature. The framework offers a top-down approach to restoring and reconnecting the fragmented nature patches throughout Europe. It does so by proposing spatial legislation, offering incentives, subsidies, investment schemes, regional corporations, and development opportunities beyond the scope of pure nature conservation.

Aims to protect & restore the fragmented European nature

Form a top-down approach to mitigation at the regional scale

Proposes spatial legislation, offering subsidies, investment schemes and regional corporation & development opportunities beyond the scope of nature conservation.

Establishes an intercontinental network of nature patches and corridors.

Allows for the migration of flora and fauna between the different ecological biotopes throughout Europe.

The network combines agriculture with natural protection and prosperity

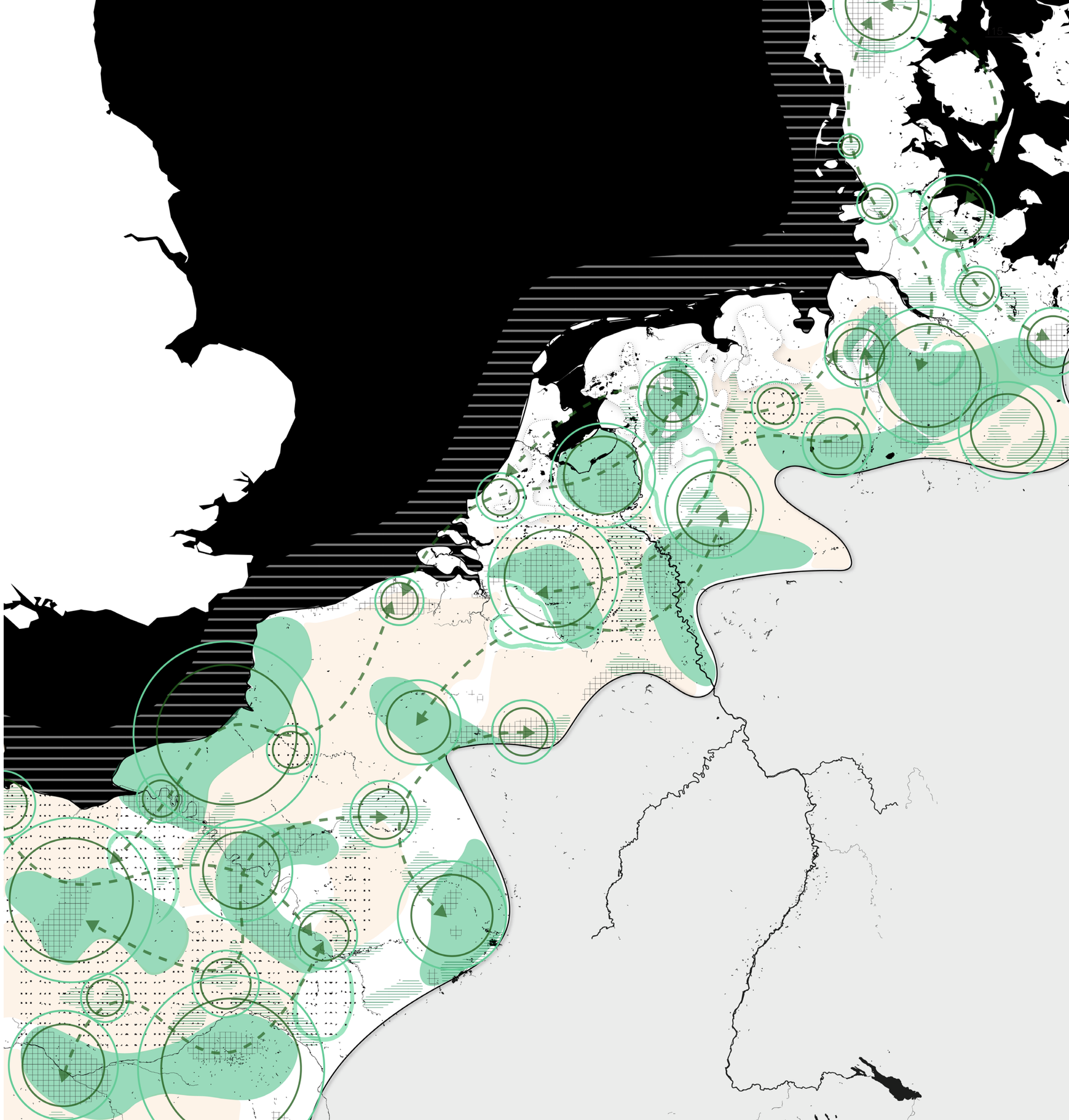
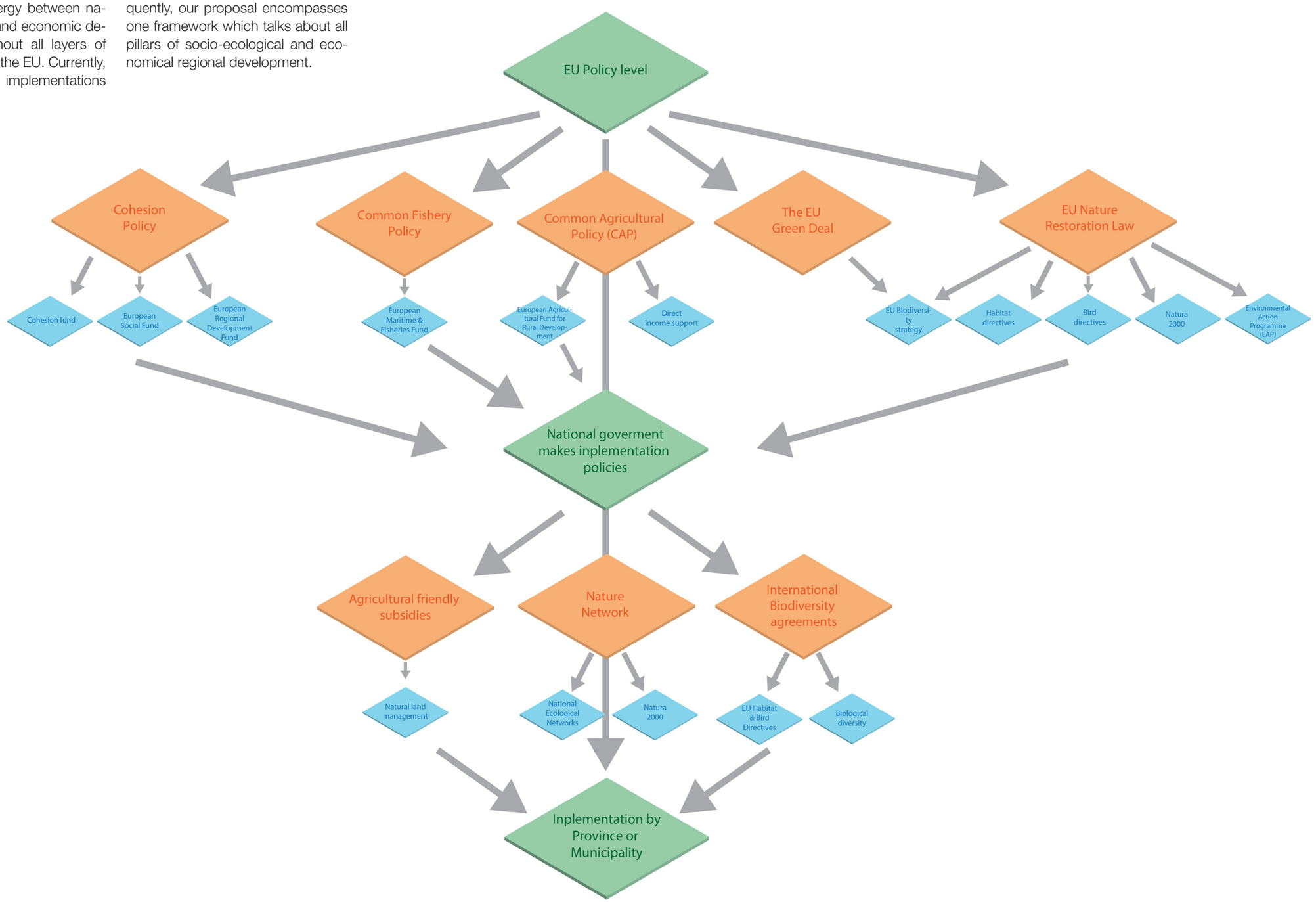


Fig 5.5.1 Trans-European Nature Network
The map above shows the spatial implications of the Trans European Nature Network.

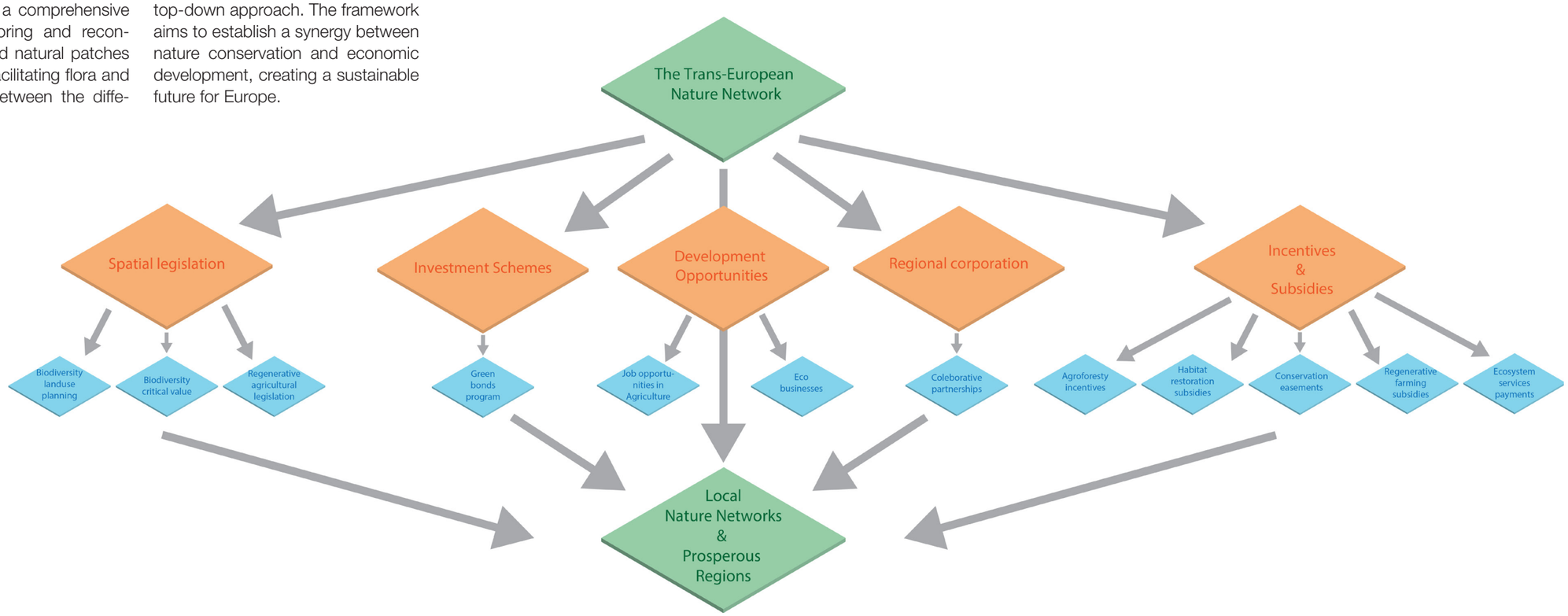
5.5.1.2 Existing Policies

The proposed Policy Framework, Trans-European Nature Network, is highly relevant in restoring and reconnecting fragmented natural patches throughout Europe due to that it creates a comprehensive approach to combing a synergy between nature conservation and economic development throughout all layers of government within the EU. Currently, the spatial policy implementations are scattered across multiple Eu programs and frameworks. Especially under the pillar of the Cohesion and Common Agricultural Policy many goals overlap but policies do not connect to one another. Subsequently, our proposal encompasses one framework which talks about all pillars of socio-ecological and economical regional development.



5.5.1.3 Proposed Policy Framework

The framework proposes the creation of the Trans-European Nature Network, which consists of a combination of protected biotope reserves with corridors combining agriculture with natural steppingstones in between. It offers a comprehensive approach to restoring and reconnecting fragmented natural patches through Europe, facilitating flora and fauna migration between the different ecological biotopes throughout Europe. The framework ensures a prosperous natural and rural area by integrating the proposed policies into national and regional policies and spatial projects from a top-down approach. The framework aims to establish a synergy between nature conservation and economic development, creating a sustainable future for Europe.



Spatial Legislation

The framework proposes the development of spatial legislation at the European level, which mandates the protection and restoration of fragmented natural patches. This legislation should integrate with national and regional policies and be implemented through local land-use planning. Moreover, it should have legally bounding goals with built-in assessment moments. Spatial legislation within the framework includes:

i. A requirement for the incorporation of biodiversity considerations into land-use planning and development decision-making processes. This legislation requires that all development projects which impact natural habitats or species must undergo a biodiversity impact assessment. The assessment identifies potential impacts on biodiversity and outlines measures to avoid, minimize or mitigate any negative effects.

ii. A requirement for the designation and protection of high biodiversity value as nature reserves or protected areas. Mandating the integration of nature corridors into transportation infrastructure planning, such as roads and railways, to facilitate the movement of wildlife.

iii. Legally mandating and requiring the adoption of nature-friendly farming practices, such as crop rotation, and reduced pesticide and fertilizer use, in areas adjacent to protected nature reserves and corridors. Which later expands towards covering the entire European Union.

These spatial legislations could be developed and implemented at the European level, and each country could adopt them into their national and regional policies and land-use planning processes.

Investment schemes

The framework establishes investment schemes for nature restoration and conservation. This includes the endowment of funds for habitat restoration, the creation of wildlife corridors and steppingstones across scales, and the reintroduction of endangered flora and fauna. Investment schemes include:

Green bonds programs: green bonds are financial instruments that are used to raise capital for projects that have environmental benefits. Green bonds could be used to finance projects that aim to restore and reconnect fragmented nature patches throughout Europe. For example, green bonds could be issued to finance the establishment of nature corridors along transportation infrastructure, the restoration of wetlands, grasslands, and forests, and the adoption of agroforestry practices. The proceeds from the green bonds could be used to fund nature conservation and restoration projects that might not otherwise receive sufficient funding, due to their long-term nature or the lack of profitable returns. The investment scheme could be designed to attract a wide range of investors, including institutional investors, pension funds, and retail investors, and could be marketed to investors in the future of Europe‘s natural heritage.

Development opportunities

The framework creates development opportunities beyond the room of nature conservation. This includes the promotion of sustainable tourism, the development of green infrastructure projects, and the creation of sustainable jobs in rural areas. Development opportunities include:

i. The establishment of new jobs and economic opportunities from the scope of regenerative agriculture: For example, agroforestry practices create new sources of income for farmers while also providing important habitats for wildlife and sequestering carbon. It is supported by providing funding and technical know-how.

ii. The establishment of eco-tourism and nature-based businesses in rural areas: Creating and developing regions offers opportunities for nature-based tourism and recreation, which can provide economic benefits to local communities while also promoting conservation and awareness of the natural environment. To support the development of such initiatives the framework offers funding and technical know-how.

By creating new economic opportunities in rural areas, the framework can help to reduce rural depopulation and promote more balanced regional development, while also supporting the conservation and restoration of fragmented European nature.

Regional Cooperation

The framework incorporates regional cooperation to promote the conservation and restoration of natural habitats, while additionally establishing a base for regenerative agricultural practices and regional prosperity. This includes the establishment of partnerships between local authorities, conservation organizations, farmers, landowners, dwellers, and other stakeholders. The regional corporation includes:

i. A collaborative partnership between local communities, landowners, and conservation organizations: The partnership should work together to develop and implement plans to achieve the restoration goals. The partnership could include representatives from local governments, farmers‘ organizations, conservation NGOs, and other relevant stakeholders The partnership could be funded through a combination of public and private sources, including grants, donations, and in-kind contributions. The partnership additionally works to engage local communities in nature conservation and restoration activities, through education programs, science projects, and volunteer opportunities.

By working collaboratively and leveraging the knowledge, resources, and expertise of all stakeholders, the regional corporation could help to achieve the shared goal of restoring and reconnecting fragmented European nature, while also fostering economic development and community engagement in rural areas.

Incentives & Subsidies

The framework offers incentives and subsidies to landowners and farmers who adopt regenerative practices. This includes promoting sustainable agriculture and forestry practices, such as agroforestry, conservation agriculture, integrated crops with livestock and the use of vertical farming systems. Incentives and subsidies should furthermore be provided to those who participate in nature restoration activities. Incentives and subsidies include:

i. Agroforestry incentives: Farmers who adopt agroforestry practices receive incentives and subsidies. The incentives include payments for the establishment and maintenance of agroforestry systems, as well as access to technical assistance and training.

ii. Habitat restoration subsidies: Landowners who participate in habitat restoration activities, such as the restoration of wetlands, grasslands, or forests, receive subsidies. The subsidies cover the costs of materials, labour, and technical assistance required for restoration activities.

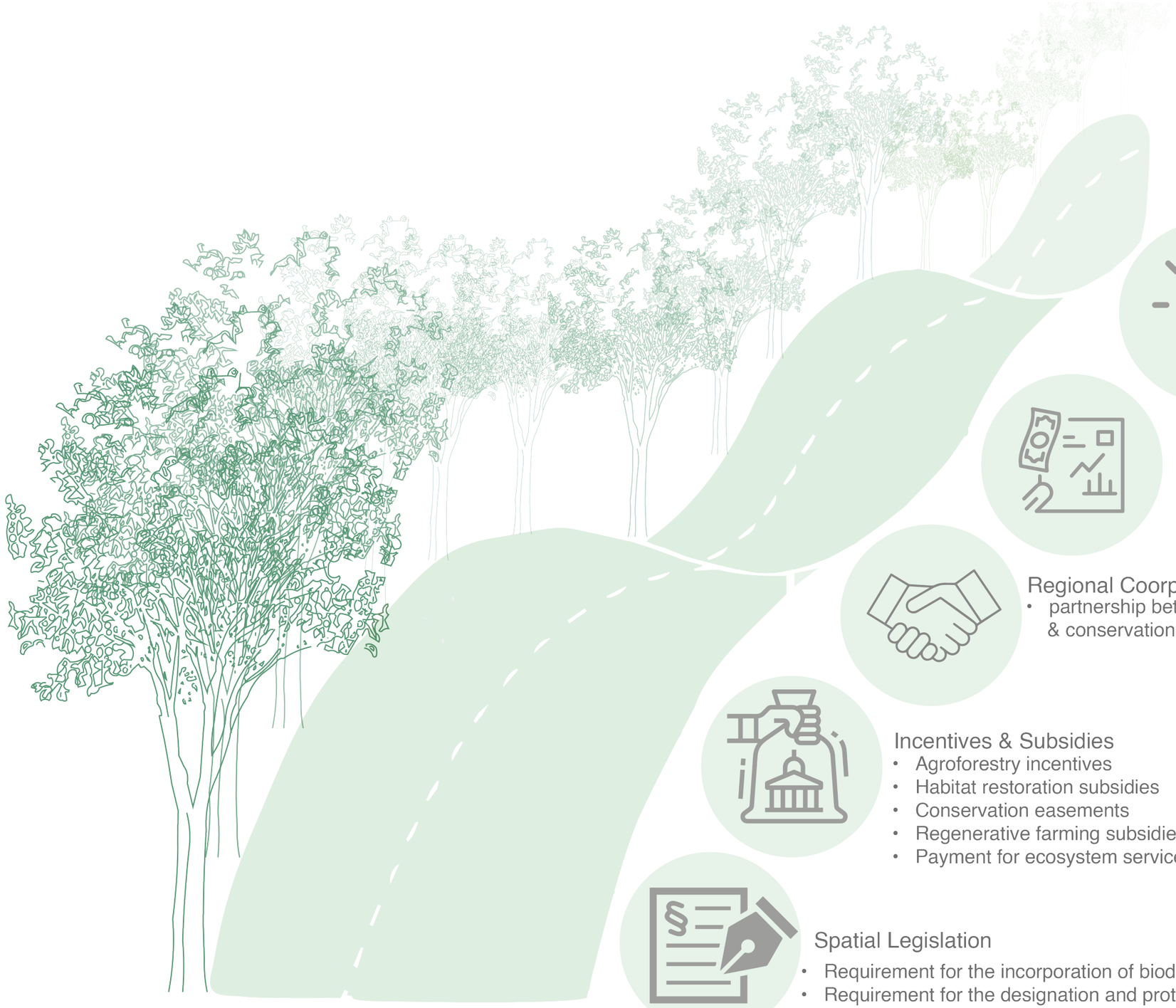
iii. Conservation easements: Conservation easements are legally binding agreements between landowners and conservation organizations that limit certain land uses to protect natural resources. Landowners who agree to place their land under conservation easements receive financial compen-

iv. Regenerative farming subsidies: Farmers who adopt regenerative practices, such as voluntarily reducing pesticide and fertilizer use, habitat restoration, and the maintenance of buffer strips and hedgerows, receive subsidies. The subsidies cover the costs of implementing and maintaining these practices.

v. Payment for ecosystem services: Involves paying landowners or giving them tax breaks for the services that their land provides, such as carbon sequestration, water purification, and wildlife habitat. PES schemes could be implemented to incentivize landowners to adopt nature-friendly practices and protect natural habitats. Additionally, an ecosystem services rights trading system could be established to limit the use of non-renewable resources.

These incentives and subsidies could be offered at the national and regional levels and could be funded through a combination of public and private funding sources. The subsidies and incentives could be tailored to the

5.5.1.4 Trans European Nature Network



Trans-European
Nature Network

Development
Opportunities

- The establishment of new jobs & economic opportunities from the scope of regenerative agriculture
- The establishment of eco-tourism & nature-based businesses in rural areas

Investment Schemes

- Green bonds programs

Regional Coorporation

- partnership between local communities, landowners, & conservation organizations

Incentives & Subsidies

- Agroforestry incentives
- Habitat restoration subsidies
- Conservation easements
- Regenerative farming subsidies
- Payment for ecosystem services

Spatial Legislation

- Requirement for the incorporation of biodiversity considerations
- Requirement for the designation and protection of high biodiversity value
- Legally mandating and requiring the adoption of nature-friendly farming practices

5.5.1.5 Policy Packages

Pillars	Policy package	Problems	Values	Guiding principles	Main interventions
Sustainable Food Security	Requirement for local production for local consumption before exporting or transporting far	Due to the relativly small internal market farmers often produce for the larger global or european merket then for the local market.	Circularity, regenerative, health, economic development, cliamte adaptation	Local consumptiom of food, trees and knowledge, promoting precision farming	Network between local shops and farmers
	Requirement for the implementation of vertical farming hubs near population centers	The current monocultural agricultural production asks for food to be transported over fast distances.	Circularity, health, economic development	Local consumptiom of food, trees and knowledge, promoting precision farming	Reperpasing former industrial zones to house vertical farms
	Requirement for the production of crops fitting to the common dietary wishes.	Currently, much agriculture produces for the market but not neccisarilly what is in demand. Conseqeuntly, much food is wasted.	Everything mentioned above + knowledge economy	Local consumptiom of food, trees and knowledge, promoting precision farming	Education hubs, sharing knowledge to farmers and comunity members
	Requirement for the implementation of agricultural and food related education hubs	Unhealthy diets, and lack of knowldge regardign a varied production landscape.	Circularity, regenerative, health, economic development, Social justice	Promoting precision farming, integrating systems, Local consumption of food, trees and knowledge	Education hubs, sharing knowledge to farmers and comunity members
Ecosystem revitalization	Requirement for the implementation of stepping stones throughout agricultural land	Monocultural agricultural landscape do not allow flora and faauna to migrate.or survive.	Biodiversity, health	Connecting and strenghtening ecological networks, ecological restouration.	Implementation of nature plots at agricultural boarders
	Requirement for the implementation of corridors to connect and formulature networks	Nature is currrenlty fragemented in small patches throughout the landscape.	Biodiversity, health	Connecting and strenghtening ecological networks, ecological restouration.	Expanding tree nurseries to produce enough trees for the network
	Requirement for the incorpaoration of biodiversity in spatial planning	Biodiversity loss resulting from monocultural agricultural landscapes.	Biodiversity, health, climate adaptation	Restore and preserve soil health, Connecting and strenghtening ecological network	Creating a network of knowledge hubs regarding ecological restouration
	Requirement for the protection of areas with high biodiversity value	Agricultural intensification and pollution threatens the scattered nature patches.	Biodiversity, health	Restore and preserve soil health, Connecting and strenghtening ecological network	Creating a network of knowledge hubs regarding ecological restouration
Regenerative Agricultural Practices	Requirement for the adaptation of regenerative practices there where possible	Current agricultural practices deteriorate the natural landscape.	Biodiversity, regenerative agriculture, circularity, economic development	Ecological restauration, restouring and preserving soil health, Local consumpti-om of food, trees and knowledge	The implementation of a form of agroforestry.
	Requirement for the prohabition of chemical fertilizer.	The use of chemical fertilizers pollute the soil and ground water.	Biodiveristy, health	Restoring an preserving soil health, adapting agriculture to climate change into a resilient system	The implementation of policies limiting the use of chemical vertilizer and subsidies towards natural ways
	Requirement for the adaptation of crop rotation	Abundence of highly specialized monocrop producing areas. Degrading the soils biological function.	Research about product's trades and flows	Restoring an preserving soil health, adapting agriculture to climate change into a resilient system	Creating a network of knowledge hubs to (re)educate farmers.
	Requirement for the implementation of lifestock quoatas	To much livestock in places which naturally can not sustain those population sizes.	Research about product's trades and flows	Restoring an preserving soil health, adapting agriculture to climate change into a resilient system	The implementation of policies limiting the amount of livestock per hectere.

02

Strategic Intervention

Sustainable Food Production & Knowledge Network

5.5.2 Sustainable Food Production & knowledge Network
5.5.2.1 Greenport Case Study
5.5.2.2 Exploring scales and typologies
5.5.2.3 Westland Existing
5.5.2.4 Goals + Systemic Organization
5.5.2.5 Spatial Transformation of Westland
5.5.2.6 Scaling up



5.5.2.1 Greenport case study

Greenport's Netherlands is a network of greenhouse clusters and agricultural businesses, including a total of nine horticultural regions in the Netherlands: Westland-Oostland, Boskoop, Duin & Bollenstreek, Aalsmeer, Noord-Holland, Gelderland, and Venlo. It was established by the Dutch government as a public-private partnership to support the horticulture sector by stimulating innovation, promoting sustainability, and improving international competitiveness. Specifically, Greenport West-Holland is one of the most important regions in the world with a concentration of state-of-the-art production, delivery, trade, distribution, and processing companies, all strongly interlinked.

The current goals of the Greenport agglomerate are in alignment with our strategy for creating a future of food security, as they especially stress the transition to fossil-free supply until 2050, emission-free cultivation of food, as well as reduction of the products' carbon footprint. Working within this structure, we emphasize the formation of experimentation clusters for the sharing of knowledge, and the production of food instead of flowers (as the industry also transitions towards medicinal herbs). Social issues regarding the need for housing and transparency on working situations need to be strengthened through policies, as well as examined through a spatial lens. The overall goal is the upscaling into a network of food security and knowledge through North-West Europe, and eventually the world.

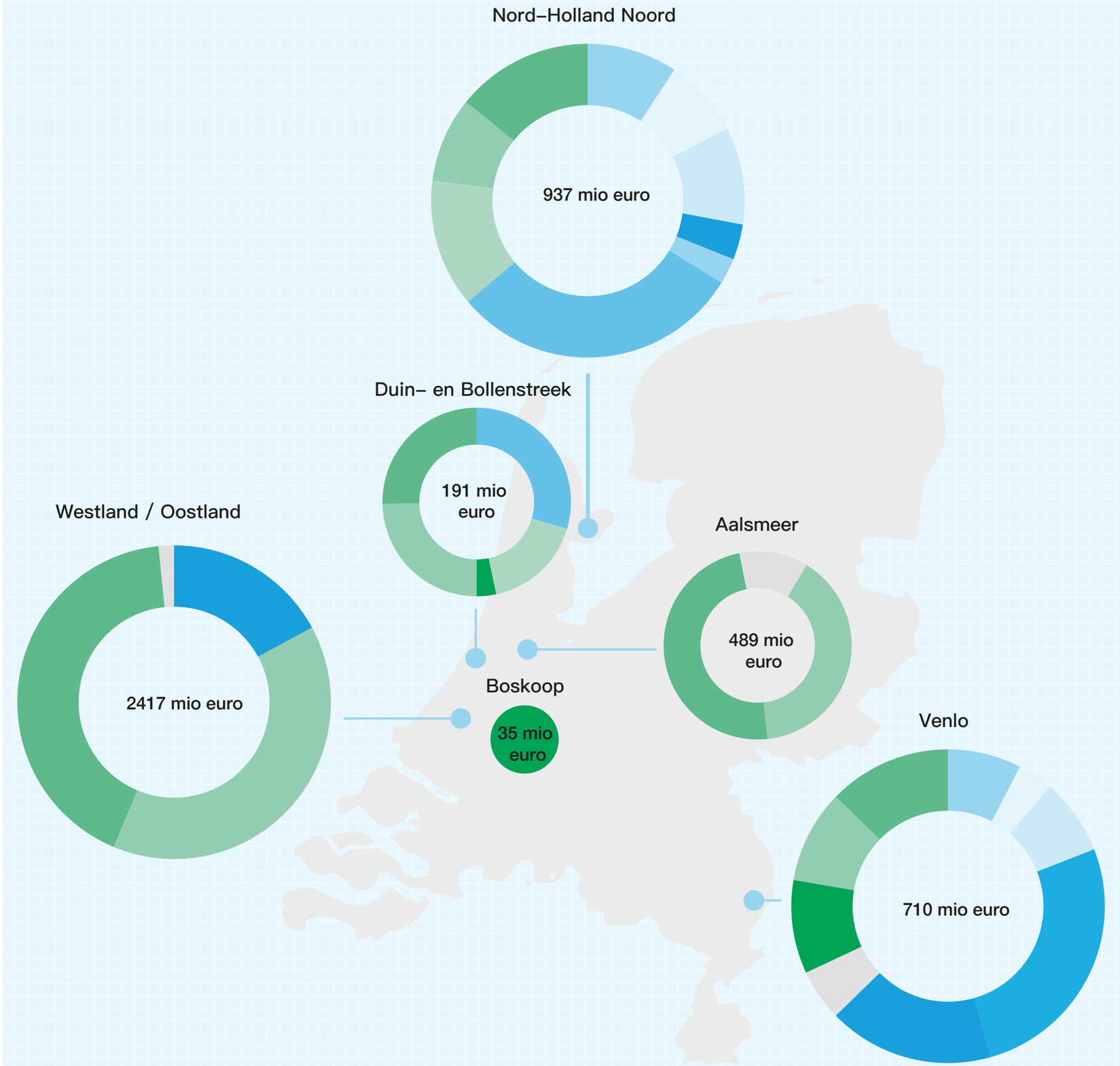


Fig 5.5.2.1 Greenport case study
The map above shows the food products produced and exported out of Greenport.

5.5.2.2 Exploring scales and typologies

After analysing the Greenport model and understanding its pros and cons, the various scales at which the greenhouse networks is spread across South Holland was further studied. 4 distinct typologies were discovered in the process which house varying facilities cater to different scales of areas and population:

1. XL : Metropolis cluster
2. L : Linear cluster
3. M: Unit cluster
3. S: Rural node cluster



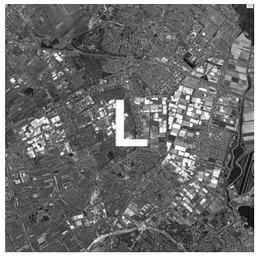




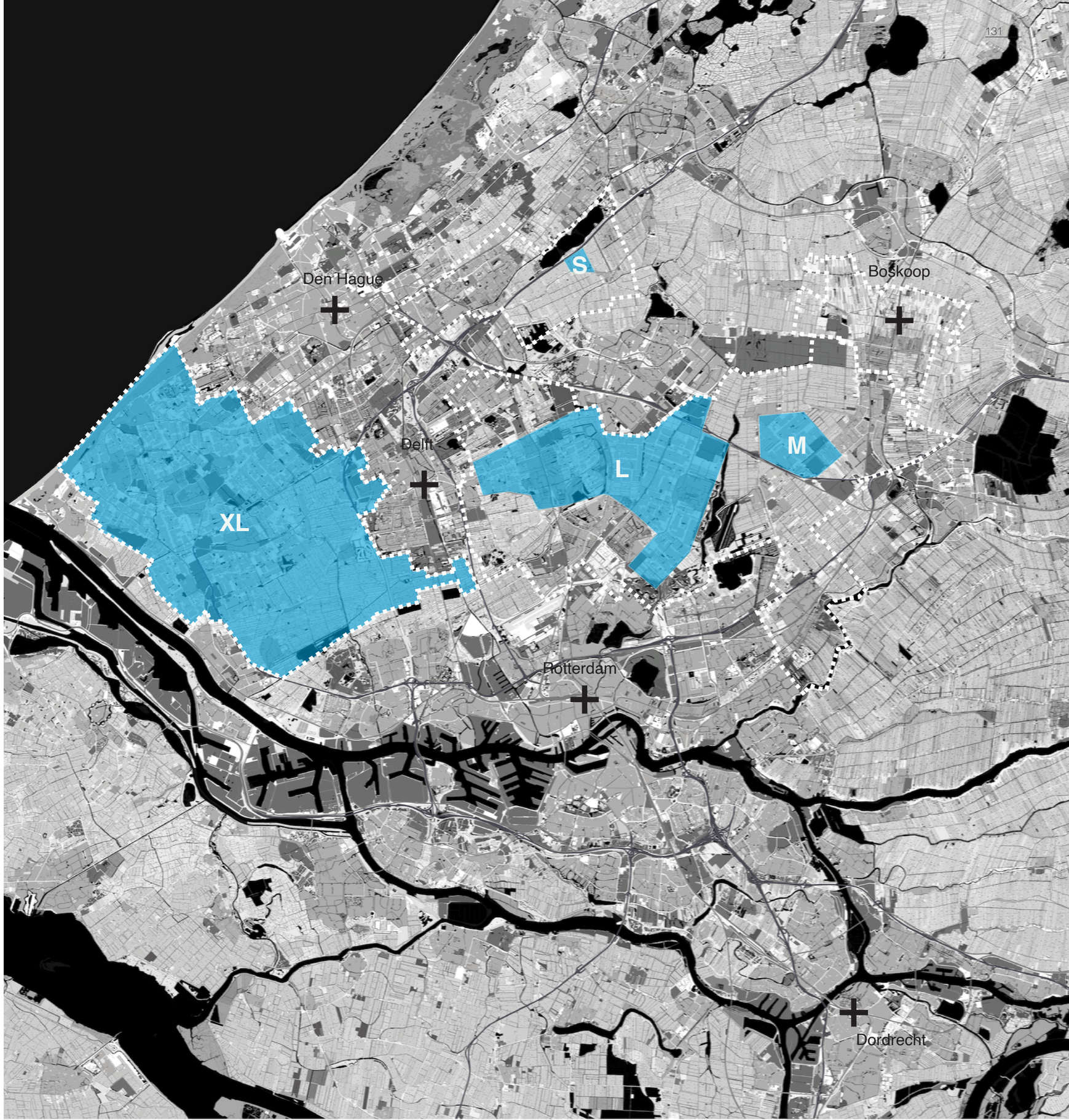


Fig 5.5.2.2 Greenhouse Network

The map above shows the greenhouse sprawl at various scales through South Holland.

Greenhouses
Main Urban Centres
Metropolitan Boundaries

2.5 km



5.5.2.3 Westland: Existing

The greenhouses of Westland are a distinct feature of the region, hence it jas earned the nickname of the Glass City. Westland houses a major portion of the country's greenhouses horticulture which has resulted in Netherlands being one of the wolrd's leading producers of vegetables, flowers and plants.

The Westland region is ideal for greenhouse horticulture due its climate, fertile soil and proximity to major transport centres such as the Rotterdam port which has made the horticulture industry a major economic driver within the region. However, amidst this profit driven industrial setup, the regional ecosystem as well as the rural community is exploited with little or no access to basic infrastructure facilities and working rights.

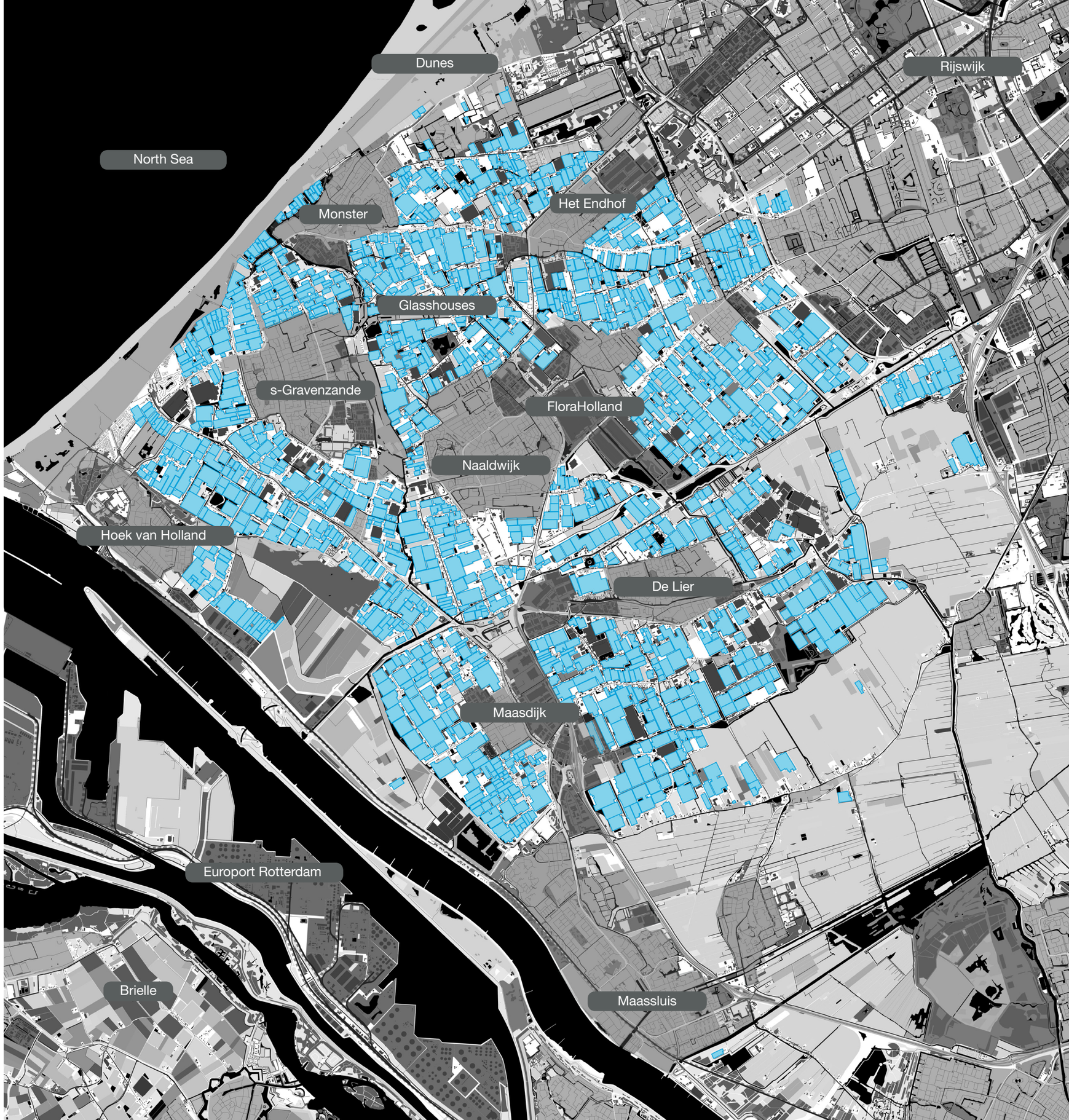


Fig 5.5.2.3 Greenhouses in Westland
The map above shows the greenhouse sprawl in Westland, Netherlands.

5.5.2.4 Systemic Framework

The food production landscape of Westland is studied and its key elemets are mapped along with the intra-systemic flows. Consequently a systemic framework is created which illustrates the existing as well as the potential elements which can be ingrated into the existing landscape in order to sustain food security and to transition towards a regenerative future.

A set of goals is defined to sustain food production in the countrside of North Western Europe in 2100 wherein the production landscape has adapted to the changed climate, increased population and other unforeseen variables that might arise.

Promote intensified nodes of food production.

Promote social involvement and participation in food production.

Ensure biodiversity and ecosystem connections.

Ensure quality living and working conditions.

Ensure food accessibility and affordability.

Prioritize sharing of knowledge and minimum use of resources.

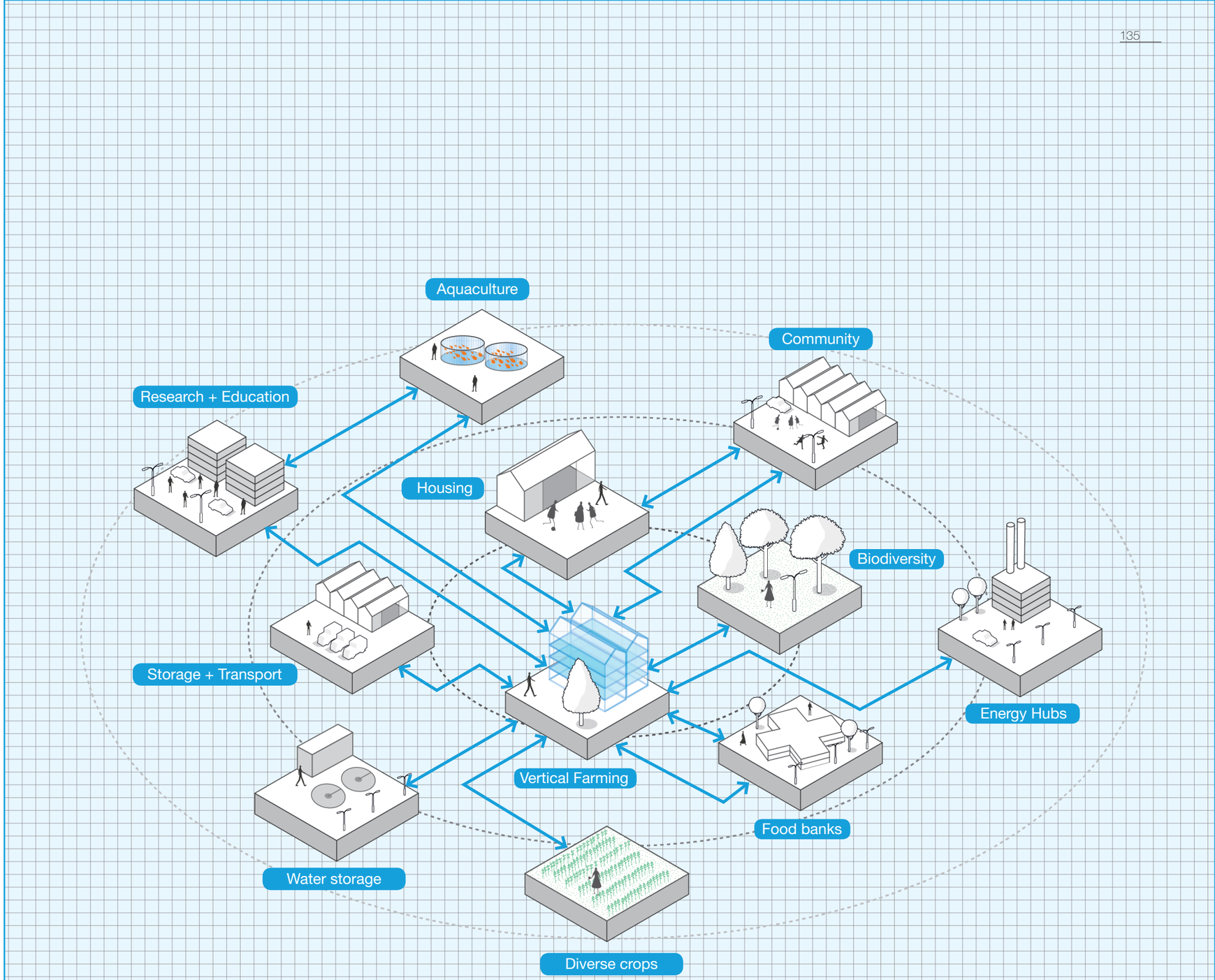


Fig 5.5.2.4 Systemic Framework

The map above shows the various key elements which comprise a Sustainable Food production hub. the concentric circles represent the differenet scales upto which this nodal hub can expand as per need.

5.5.2.5 Spatial transformation of Westland 2100

The greenhouses of Westland are stacked one on top of the other to form Vertical farms which practise Precision Farming. The freed up space on the ground is used for creating public goods such as open greens spaces and housing for workers. In order tomake the system of producing food more circular, water and energy hubs are created in the area to create independent and localised food production units. Taking into consideration the scanario of sea level rise, the watrer based practises of aquaculture and sustainable mariculture are also promoted in the regenerative future of NWE Lowlands in 2100.

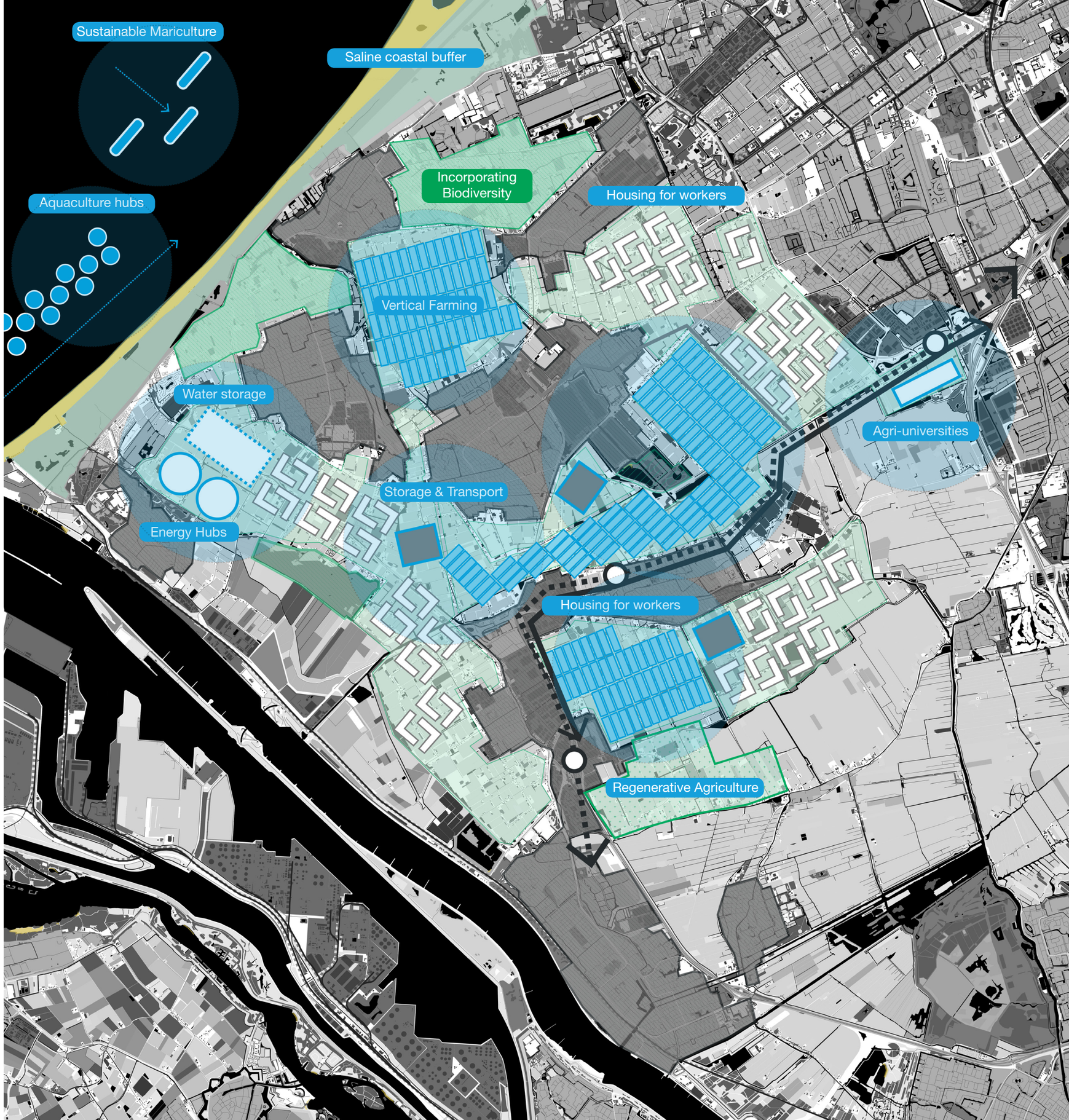


Fig 5.5.2.5 Greenhouses in Westland

The map above shows the spatial transformation of Westland, Netherlands.

Vertical farms
Water
Open Greens
Regenerative Agriculture
Road connection
Rail connection

1 km

5.5.2.6 Scaling up to Lowlands

This is our proposal for the network in the scale of the Lowlands where we will need those important elements to achieve our vision for the future.

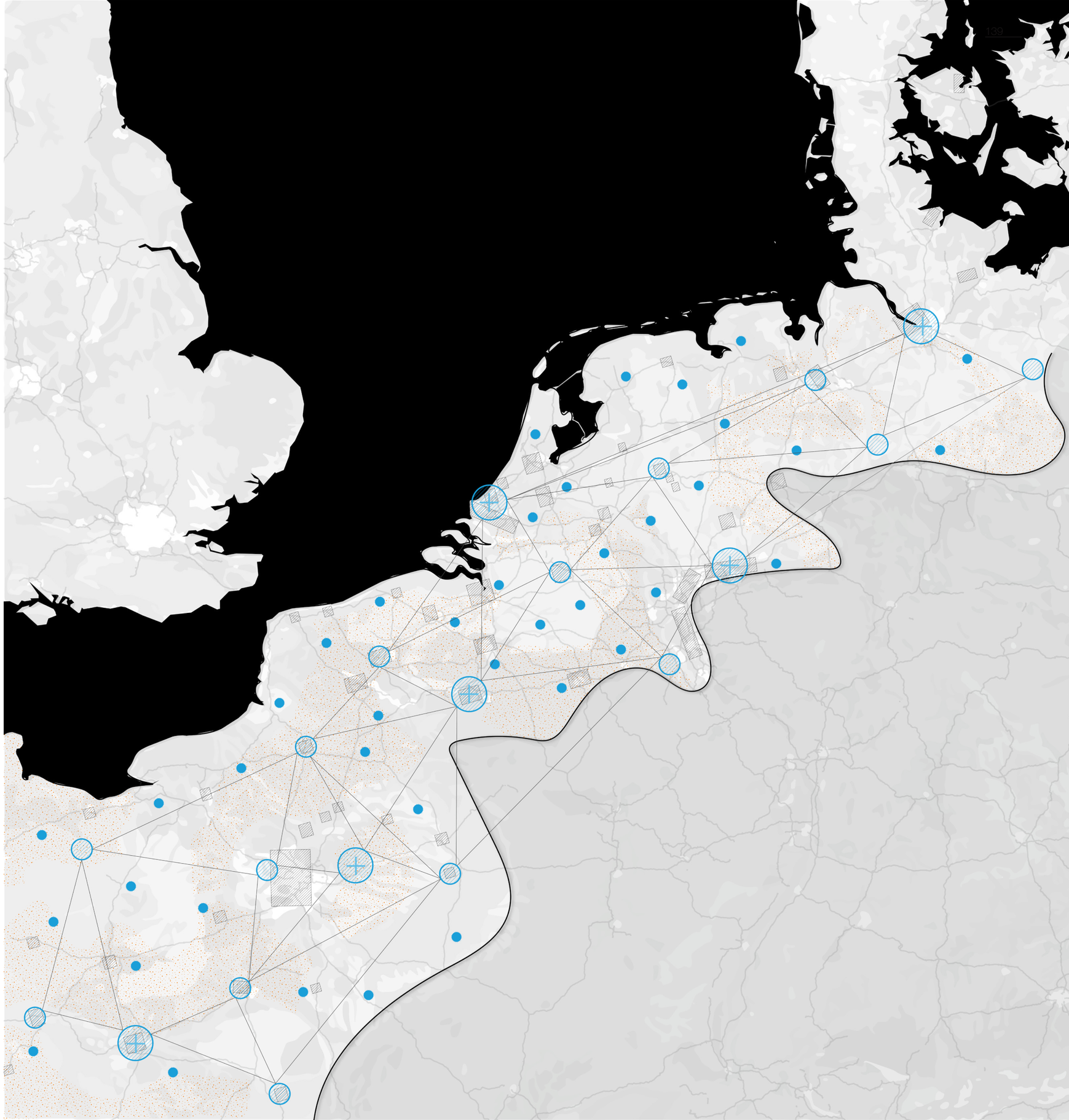


Fig 5.5.2.6 Scaling up

The map above shows the scaling up of the food production hubs network

03

Strategic Intervention

Network for Regenerative Agricultural Practices

5.5.3 Network for Regenerative Agricultural practices
5.5.3.1 How many trees do we need?
5.5.3.2 Spatial transformation of Boskoop
5.5.3.3 Systemic Framework
5.5.3.4 Stakeholders of Boskoop
5.5.3.5 Systemic Section of Boskoop
5.5.3.6 Scaling up



5.5.3.1 How many trees do we need?

The greenhouses of Westland are a distinct feature of the region, hence it jas earned the nickname of the Glass City. Westland houses a major portion of the country's greenhouses horticulture which has resulted in Netherlands being one of the wolrd's leading producers of vegetables, flowers and plants.

The Westland region is ideal for greenhouse horticulture due its climate, fertile soil and proximity to major transport centres such as the Rotterdam port which has made the horticulture industry a major economic driver within the region. However, amidst this profit driven industrial setup, the regional ecosystem as well as the rural community is exploited with little or no access to basic infrastructure facilities and working rights.

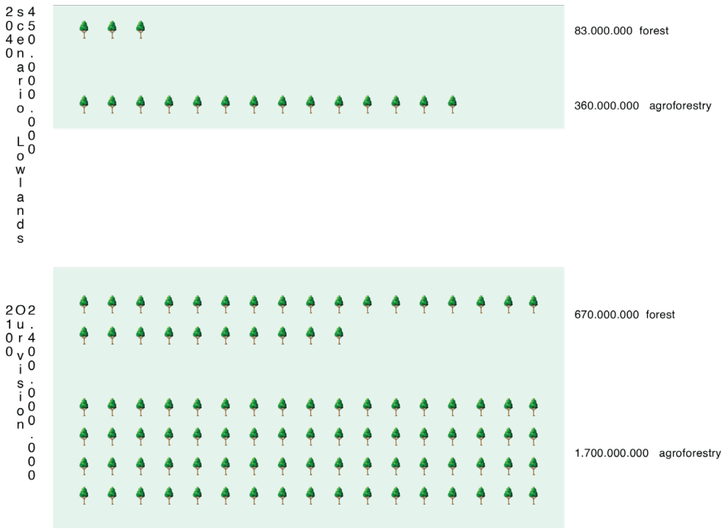


Fig 5.5.3.1 How many trees do we need?
The map above shows the area requirements for trees required for different practices,

25000 Trees
Agroforestry
Forests

100 km

module of 15.625 km^2

5.5.3.2 Spatial Transformation of Boskoop

Our main intention is to create knowledge, experimentation and production hubs that are going to be spread throughout the Nortwestern European Lowlands, creating a network of knowledge exchange, considering as a starting point Boskoop case in the Netherlands which is known for their tree export-trade activity (almost 90% of its products to be exported all over the world, especially to Great Britain, West Germany, France, Belgium and Canada) and they are leading innovation in production technology in the horticulture sector. However, these innovations and knowledge have mainly remained within the companies borders. The strategic intervention aims to exchange this knowledge and spread it throughout Europe. More specifically, within Boskoop experimental hub's we are proposing the creation of smaller hubs specialized in regenerative agricultural practices, peatland restoration as well as education and research centers for farmers, workers and inhabitants in general that they could support and assist on achieving our vision.

The goals of these experimental nursery hubs are to provide trees for reforestation, green coastal protection zones and agroforestry while securing tree and tree seedling's diversity in tree nurseries. At the same time, this model will introduce a more local tree seedlings production, to reduce transportation of trees securing a way to track seedlings and increasing tree nurseries. Another essential aspect of the intervention is to promote biodiversity and climate adaptive trees together with integrating different and sometimes missing services within the tree nursery or functions such as bee habitats together with diverse native plants. Nurseries therefore provide unique opportunities for ecosystem management, because they offer the opportunity to not only preserve, but actually increase biodiversity levels. Finally the project is inextricable with the people that live or work in these areas, so it is important to engage inhabitants with tours, workshops so they can learn how the trees are produced and get to know the benefits of the regenerative agriculture practices. (Teamworks, 2020)

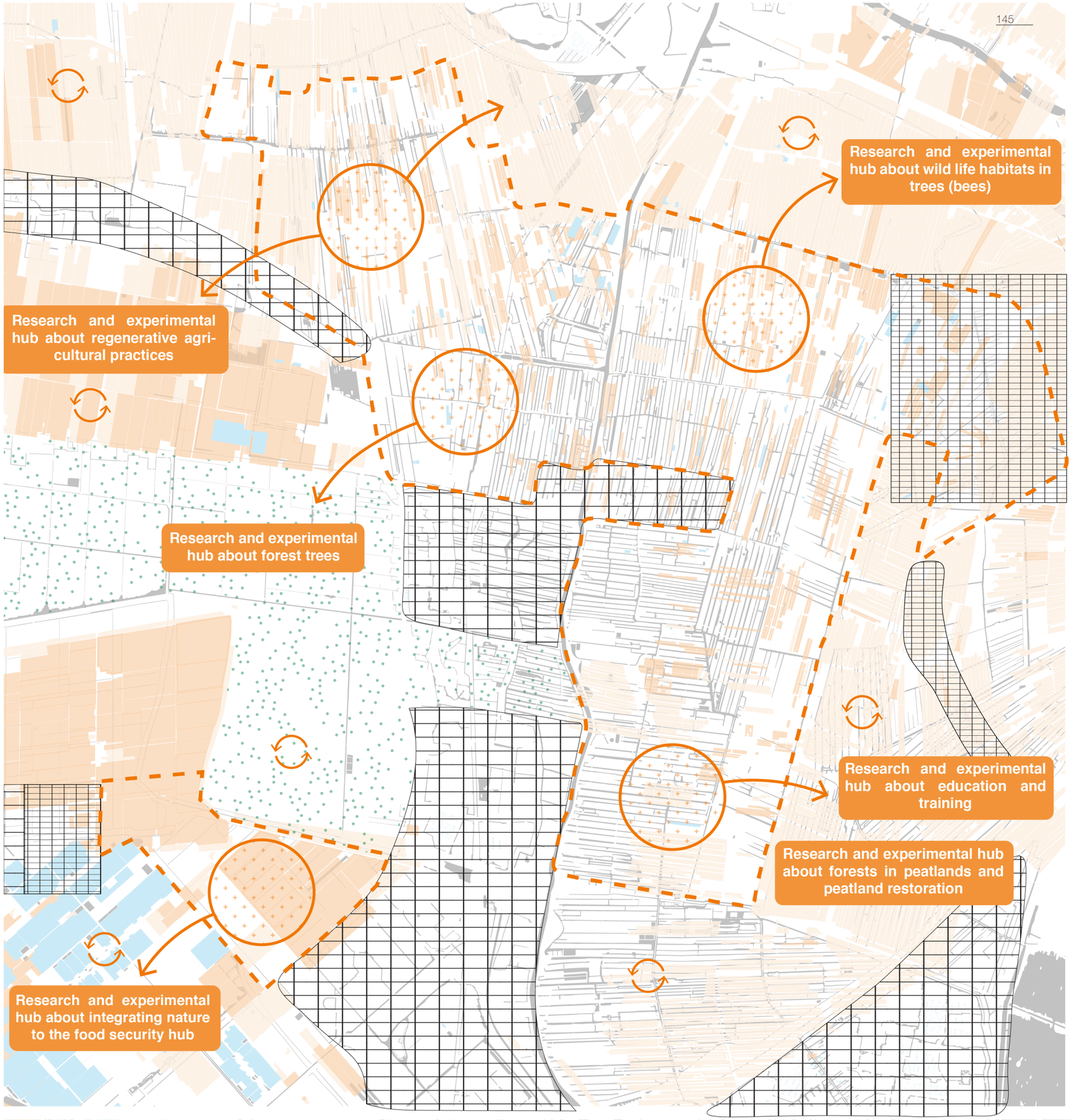


Fig 5.5.3.2 Tree nurseries in Boskoop
The map above shows the tree nursery network in Boskoop, Netherlands.

5.5.3.3 Systemic Framework

In order to make our strategic intervention stronger, we would need to support it with infrastructure and create connections between them. The main key components are the supporting resources (Energy, water center, storage facility), the research and education facilities (institutions) and the tree growing areas (increased) that will be connected with all of them. To support further our projects we are introducing more waste processing center, better transportation infrastructure, tree seedling processing center, trade center, food banks. In the end, the hubs about regenerative agricultural practices and tree nurseries will provide community centers to strengthen the surrounding communities. The end goal is to provide trees for reforestation, peatlands (enhance biodiversity, achieve C02 storage with restoration) and agroforestry and knowledge together with creating a more local production system. This intervention could also support the previous project about sustaining food security (Westland case study) and create collaborations between them.

Important part in our project is that of the actions and policies that need to be taken to support our project. We are proposing expansion of the existing tree nursery hubs and integrate them with our regenerative agricultural practices knowledge and experimental hubs. This will support the establishment of regional management t strategies for reforestation while establishing a national seed certification program. Furthermore, we improve transportation and storage facilities to maintain seedling quality and expand workforce and develop training programs to assist farmers and workers on the transition phase. Finally, we are planning on developing research programs and establishing funding and financing mechanisms set up partnerships among state, federal, industrial, private, university and non-profit organizations. In that sense, it is important to outline the importance of nurseries with a biodiverse approach in biodiversity-friendly afforestation and reforestation projects. Their role in promoting the production of native species and local ecotypes in different biogeographical contexts should also be highlighted. It is also very important to strengthen the implementation of existing regulations on trade in FRM nationally and internationally and to harmonize data collection across the EU. On the move – forest tree seeds and seedlings in trade. (Euforgen, 2019)

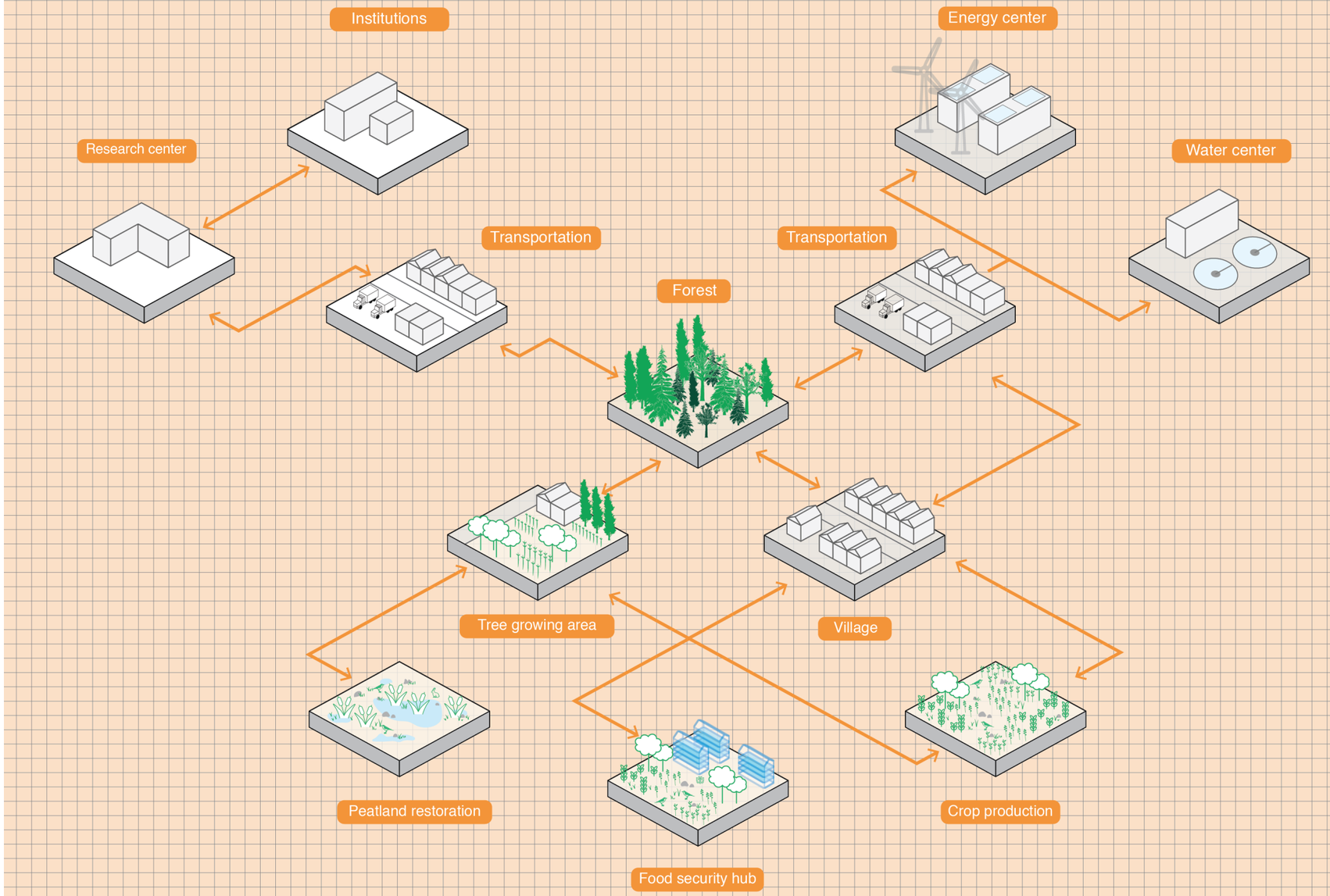


Fig 5.5.3.3 Systemic Framework
The map above shows the various key elements which comprise a Regenerative Agricultural hub.

5.5.3.3 Spatial organization of Stakehoders

At the same time, we identified the key stakeholders and their roles in the project so the implementation and the proposed strategic interventions to be more effective. We also identified that the main stakeholders that will need to be involved in our strategy often with conflicting interests are land owners, farmers, inhabitants and workers that need to establish partnerships and create a unified network. Moreover, significant role to our strategic interventions will Organizations for reforestation, afforestation, European Union and trading companies. Our project intents to generate awareness to raise consideration of European experimental Nurseries as a preferred provider, implementing and sustaining educational and training programs for farmers, workers and inhabitants. Also, to promote European Tree Nurseries and more local production and distribution as well as educate farmers and workers for regenerative agricultural practices and proper way of treating trees. (Teamworks, 2020).

Consequently, we identified the key stakeholders and their roles in the project so the implementation and the proposed strategic interventions to be more effective. We also identified that the main stakeholders that will need to be involved in our strategy often with conflicting interests are land owners, farmers, inhabitants and workers that need to cooperate and create a unified network. Moreover, significant role to our strategic interventions will Organizations for reforestation, afforestation, European Union and trading companies. Other stakeholders are logistic companies, waste management companies, companies (that will be part of a network), processing companies, farmers that will use the trees, provinces and also the silence stakeholders such as nature and animals.

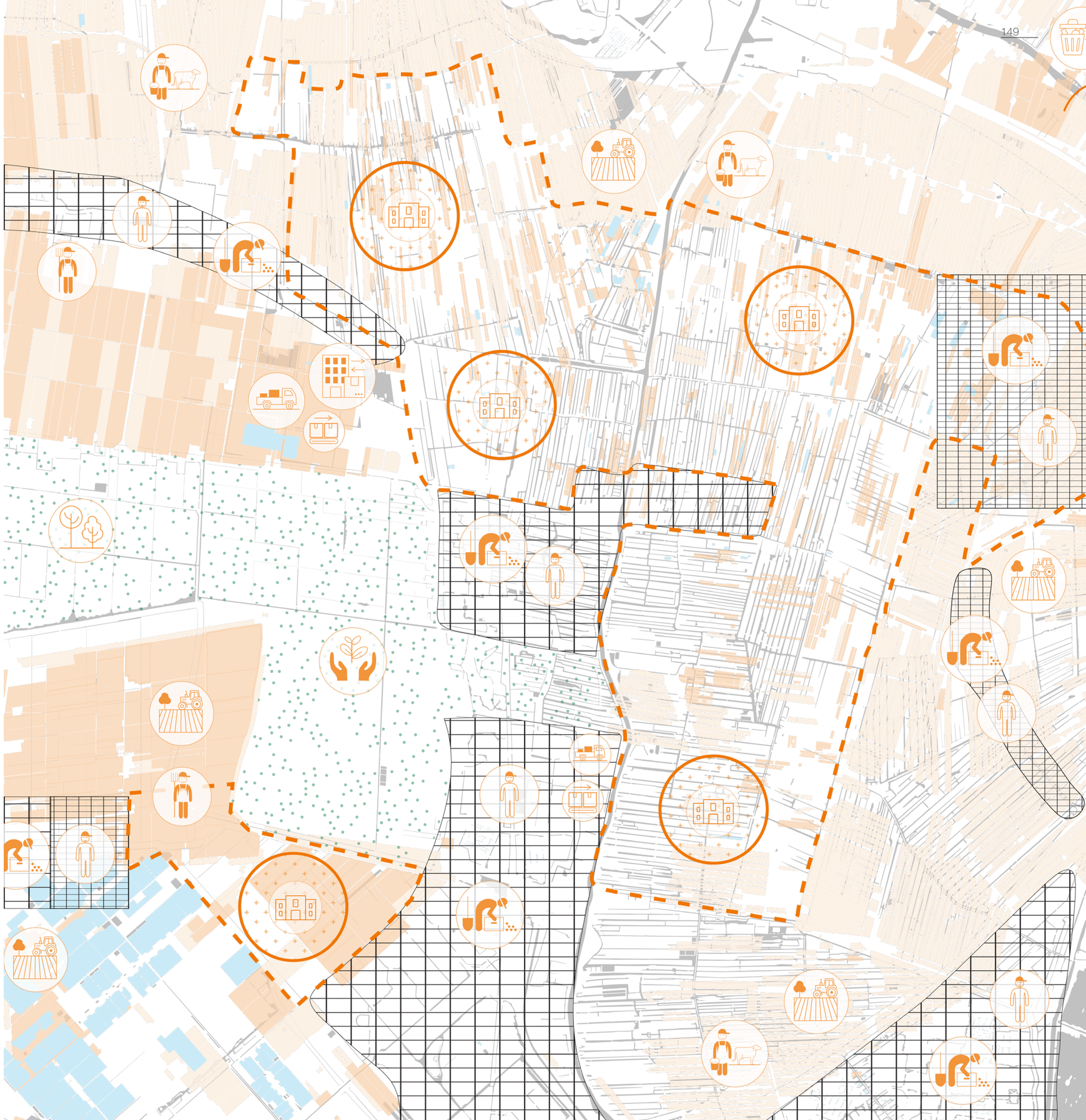
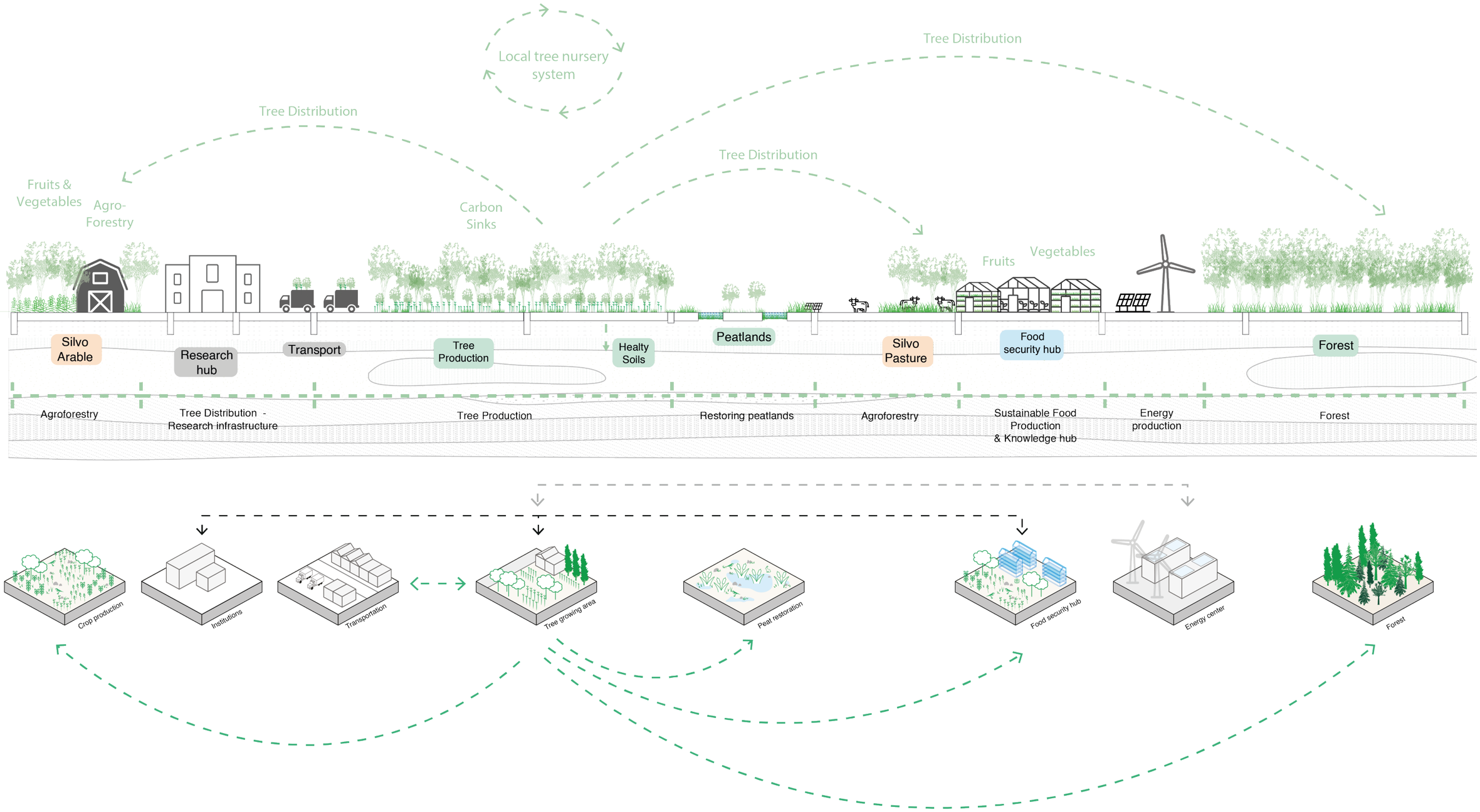


Fig 5.5.3.3 Stakeholders in Boskoop

The map above shows the tree nursery network in Boskoop, Netherlands.

5.5.3.4 Systemic Section of Boskoop



5.5.3.5 Scaling up to lowlands

This is our proposal for the network in the scale of the Lowlands where we will need those important elements to achieve our vision for the future.



Fig 5.5.2.6 Scaling up

The map above shows the scaling up of the food production hubs network

5.5.4 Overlaying the Networks

The networks for the 3 Strategic interventions of Sustainable Food Security, ecosystem revitalization Zones and Regenerative agriculture hubs are overlayed and projected onto the Lowlands of North western Europe in 2100.

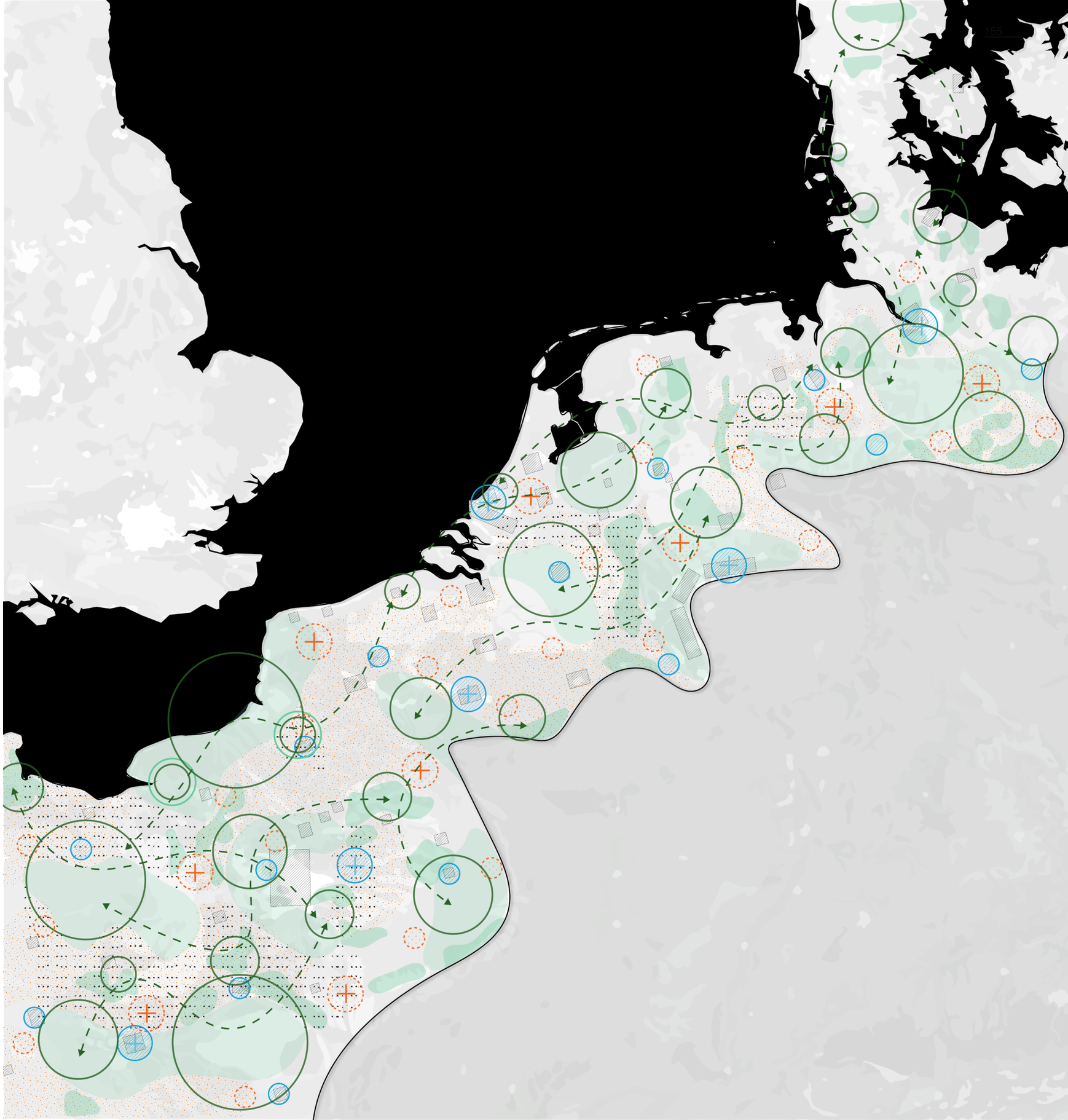


Fig 5.5.2.6 Scaling up

The networks for the 3 key projects are overlayed and projected onto the Lowlands of North western Europe.

5.6 South Holland(M)

The strategic interventions come together in the form of a series of overlayed networks at the M frame for South Holland. The coastal areas which are vulnerable to sea level rise and salinization have adapted to the changed climatic and environmental conditions by having saline species growing within them. Furthermore, the intensive monofunctional croplands and astures have transitioned towards practising regenerative agriculture in the form of silvoarable and silvopastures. The regions protected under Natura 2000 have been expanded and interconnected through a series ecological corridors and riparia buffers have been created along the river edges. Peatlands have also been restotred to revitalize the ecosystem. A highly resilient and integrated network of sustainable food security hubs, ecosystem revitalization zones and regenerative agriculture and knowledge hubs is interspersed throughout the regenerative countryside of South Holland in 2100.

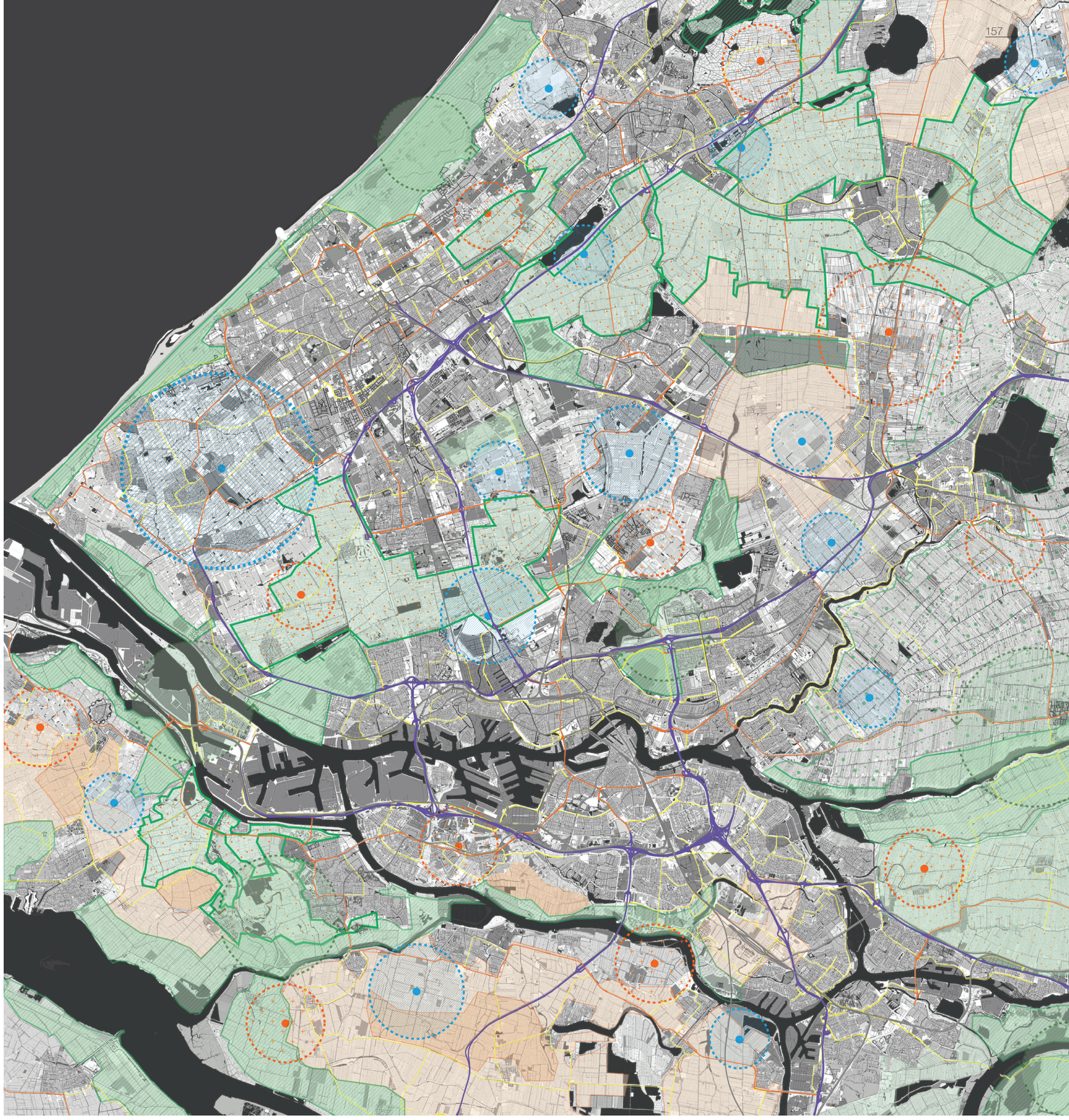


Fig 5.6 South Holland M Frame

The following maps shows the regional transformation of a regenerative South Holland which is an integral part of the NWE Lowlands in 2100.

5.7.1 North Paris (M)

The strategic interventions are thereafter projected onto an entirely culturally and geographically different region in the North Paris. The riverine valleys are transformed into a series of ecological corridrs and forests whereas the pre-existing intensive croplands have transitioned towards a regenerative approach by adopting conservation agriculture, agroforestry and so on. On comparing this region with South Holland, it is observed that intrinsically this area has a way higher percentage of forests and green cover with a low percentage of urbanised centres. Thus, the protected areas are conserved and expanded as well in north paris and edfined as ecosystem revitalization zones under the Trans European nature network.

Fig 5.7.1 North Paris M Frame

The following maps shows the regional transformation of a regenerative North Paris which is an integral part of the NWE Lowlands in 2100.

- Integrated Crops with Livestock
- Natural forests
- Silvoarable
- Silvopastures
- Riparian Buffer
- Conservation Agriculture
- Water
- urban
- Regeneratives Agriculture hubs
- Ecosystem Revitalization zones
- Food Security Hubs
- Motorways
- Primary Roads

10 km

5.7.2 North Paris (S)

On further zooming into the North Paris, the small peri urban settlement of Gisors is analysed and reenvisioned itowards a regenerative future within the NWE Lowlands in 2100.

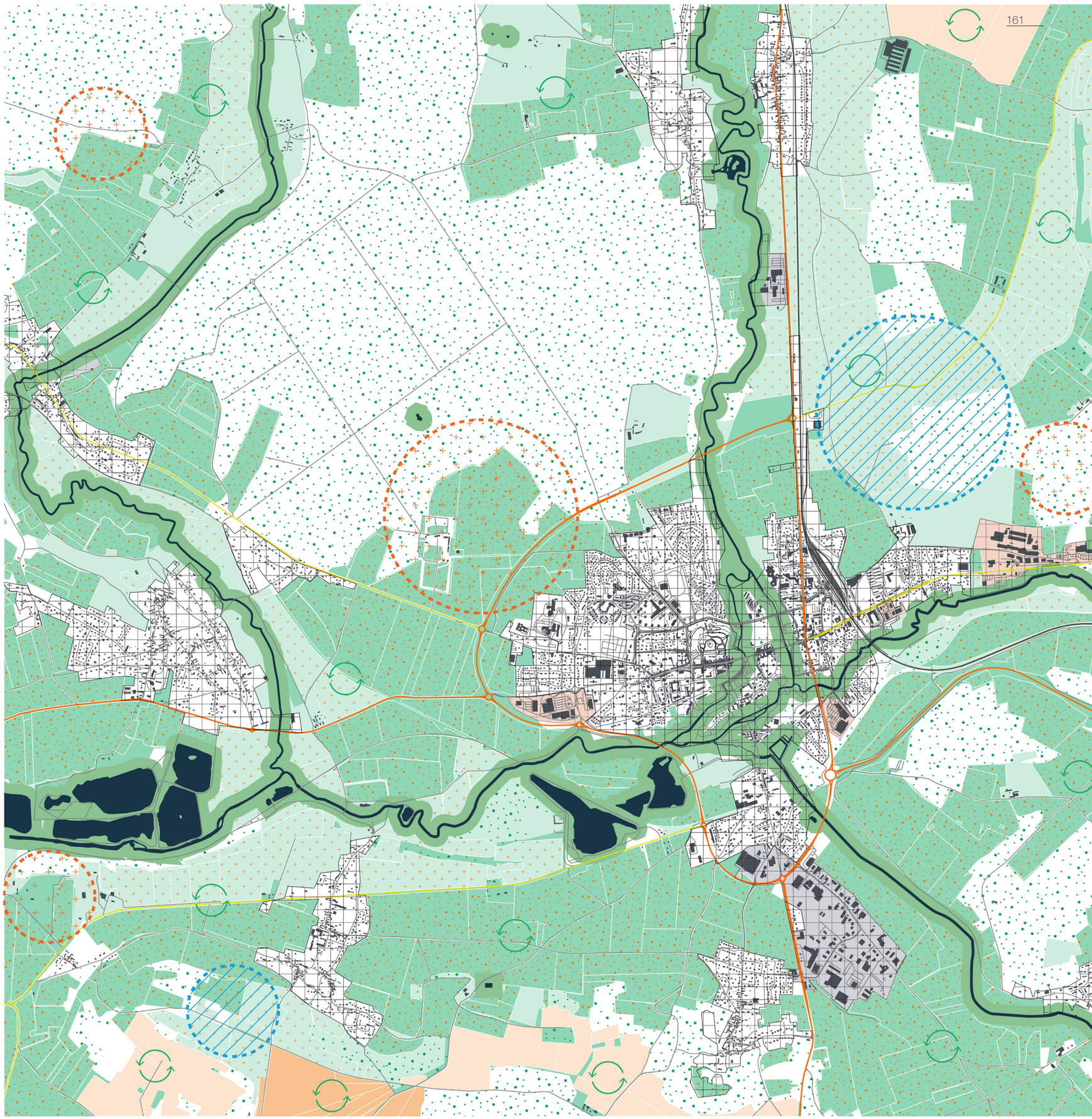
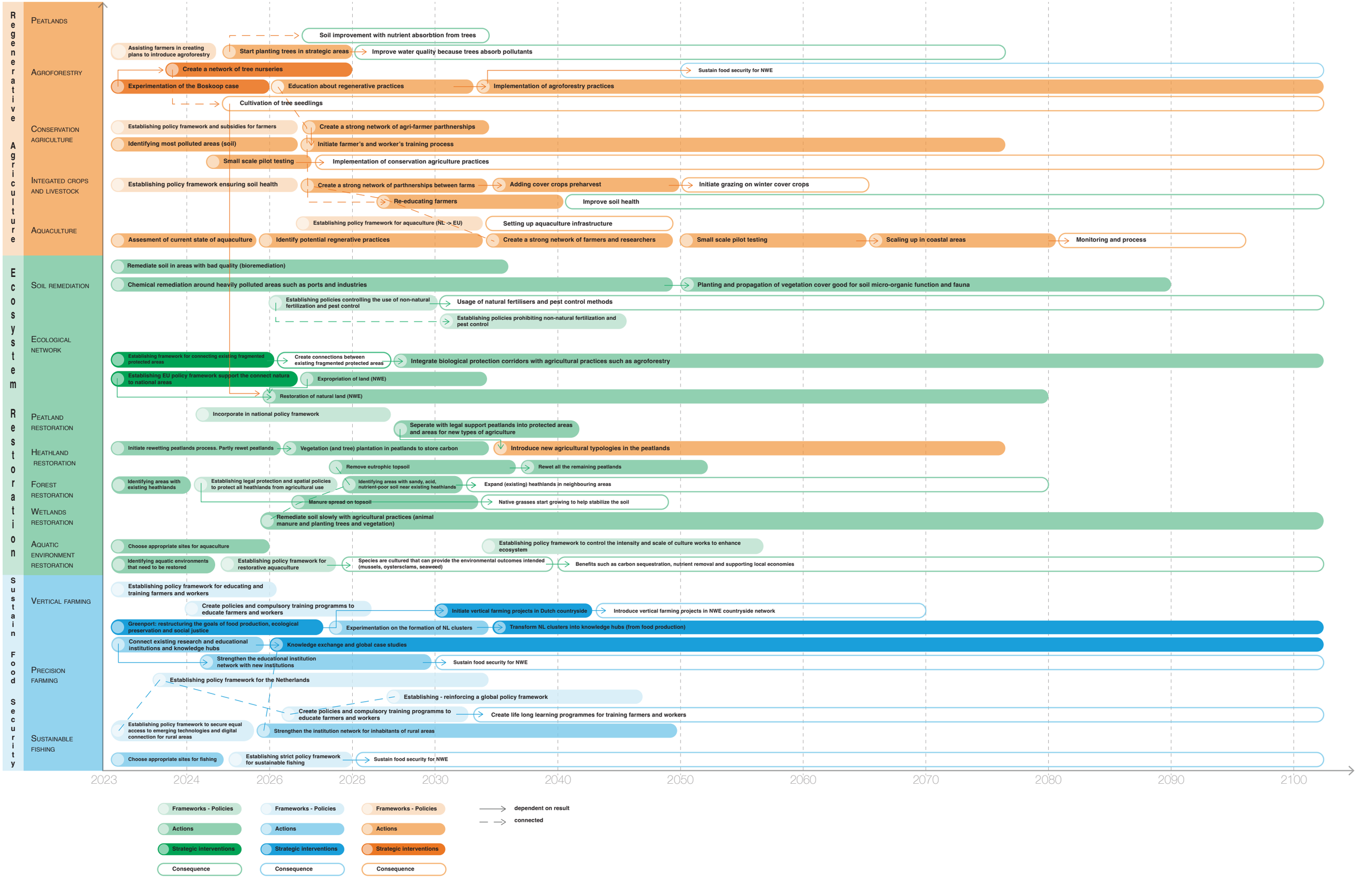


Fig 5.7.1 Gisors S Frame

The following maps shows the regional transformation of Gisors in North Paris which is a part of the NWE Lowlands in 2100.

5.8 Detailed Phasing Timeline



06

conclusion

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6.6.2 Bas Kramer
6.6.3 Georgia Kokolaki
6.6.4 Giorgos Xanthopoulos
6.6.5 Wanda Wahl Mertes

6.1 Team Reflection

This report highlights the concept of regenerative landscapes and their implementation on a regional European scale. The need for such landscapes arises from the degradation of productive landscapes in Northwestern Europe. Although the agricultural landscapes in the Lowlands are major contributors to European food production and export, they face social and environmental problems, involving division between inhabitants, landscapes, and food production, biodiversity loss, and greenhouse gas emissions. Despite this, the European farming sector continues to prioritize mass production for export and the provision of affordable food, hindering spatial development due to landscape use lock-in. As society transforms towards a regenerative landscape, the implementation of such landscapes can bring positive economic, social, and environmental effects.

Subsequently, the research question arose, How can the degraded countryside of North-western Europe transition to a socio-ecological regenerative future?

Consequently, the project outlines a three-pillar framework enabling the establishment of a synergy between lands' agricultural production capacity, nature conservation and rural development. By proposing the integration of regenerative agriculture practices with the concepts of ecosystem revitalization and food security through a combination of key interventions and spatial policies the path to a regenerative agricultural future arrives. The goal was however not to meet but to exceed expectations of what is possible with existing techniques. In a time of climate crisis and growing social separation this project finds connections to improve human, economic and environmental qualities with regenerative practices. Ensuring a prosperous socio-ecological regenerative countryside and future.

6.2 Discussion & recommendations

The project demonstrates that regenerative landscapes' poses potential, moreover, it emphasises the importance of integrating people with nature in their own region for regenerative development. The layer approach demonstrated to be a good method for analyzing such a large area and summarizing it to the core of the problem. This approach separates the different parts of a landscape, into easy-to-understand sub-subjects, which allow for the generalization of the area. Something which is needed to grasp and identify the problem at the scale of Northwest Europe. However, the pitfall with this approach is the danger of oversimplification leading to disregarding the regional and cultural differences within the area.

Besides, the scale also results in that the concept of regenerative agriculture should first be tested at smaller scales before being implemented at such a large scale. In theory, regenerative agriculture should work on the scale of Northwestern Europe, only since it has never been applied on a similar scale this can't be said with certainty. Successively, future research is necessary to access the feasibility of the proposed strategy.

One pitiful the project did fall victim to was the negligence towards the transportation part in the regenerative system. This is the case due to that the project primarily focused on the production landscape. Subsequently, the research disregards other flows and does not find synergies. However, in future research, these flows should be included to see if the regenerative future is still comprehensible.
Another pitfall was the lack of data available covering the living and working conditions of the seasonal workers. Consequently, a knowledge gap arose. Subsequently, it was hard to conclude the social part regarding migrant workers and implement their take into the report. Subsequently, a regenerative countryside still holds a promise for the future.

6.3 Scientific Relevance

The theoretical framework reflects that the project employs a wide body of theories. Subsequently, the degraded landscape serves as an overarching guide. Moreover, both the vision and the S strategy heavily utilize the principles of the transition theory. Subsequently, throughout the project it became evident that to transform towards a regenerative future, firstly the phases of sustainability and restoration need to be achieved.

Wahl (2019) and Ekins (1993) argue that sustainable development can be restrictive and may hinder development. In contrast, regenerative development offers the potential for landscapes to regenerate, enabling continuous development. This makes regenerative development, specifically applied as “regenerative landscapes,” a more appealing alternative, as it does not limit societal development (Wahl, 2019; Ekins, 1993). This is particularly crucial when the system is highly developed and environmental constraints are close such as is the case for Northwestern Europe.

By making regenerative development the central theory of the project, the narrative fostered a collaborative relationship between people and landscapes, leading to a landscape-oriented spatial justice approach. The narrative gave the project a practical yet comprehendible consistency to address the complex socio-economic issue of the misalignment between evolving cultural values and the conservative and exploitative use of the production landscape. Subsequently, the project emphasises the significance of transitioning towards a regenerative future. However, the notion of scale is relevant due to that, to our knowledge, the project represents an unprecedented exploration of regenerative development at such a large scale.

Moreover, the transition theory has served throughout the report as a tool for enabling change, providing a framework for transitioning to a new future that may be difficult to achieve due to the entrenchment of the current system. It emphasises the potential for small initiatives to effect systemic change, provided they are supported by the socio-technical landscape, through spatial policies. To support the need for change, a range of tools was applied in the analysis, including extensive data analysis, spatial analysis, and stakeholder analysis, examining both environmental and societal issues, this research forms the foundation of the project.
Consequently, the theoretical framework and analysis underpin the project and provided a valuable perspective. Providing the foundation to devise a strategy that we consider highly pertinent to the field of sustainable development.

6.4 Social Relevance

The project’s social relevance is interwoven with landscape restoration, which involves undoing the environmental damage caused by production landscapes and rebuilding the connections between people, nature, and the landscape. This is achieved by establishing productive regenerative food landscapes, serving as a model for sustainable agricultural practices while simultaneously contributing to the well-being of society.

1. Sustainable Food Security

SDG 3, entails good health and well-being (United Nations, 2020), meaning taking care of nature by reducing pollution and contamination, which, enables people to utilize nature for healthy food production and social activities that promote healthy lifestyles. Moreover, the pilar entails diversifying the current monocultural landscape and creating new job opportunities. Subsequently, the pilar improves the environmental and socio-economic situation as well. Thus contributing to SDG 7, 8, 9, 10, 11, and 17 (United Nations, 2020).

2.Ecosystem revitalization

Due to the project’s focus on ecological restoration and the creation of a European-wide natural network including the creation of areas which will act as carbon sinks, it focuses furthermore on natural preservation and on moving towards a carbon-neutral future. Subsequently, SDGs 13, 14, 15 and 17 are in line with the pillar of ecosystem revitalization (United Nations, 2020).

3. Regenerative agriculte practices

Even though the project implements the principles of regenerative agricultural practices it still operates within a globalised world. Subsequently, within the scope, the emphasis is on local food production, however, it does not exclude trade. Rather it is generally understood that the world is currently so globalised that the agricultural production capacity of North-western Europe will be continuing to be needed to combat hunger. Consequently, it is in line with SDG: 2 Zero Hunger (United Nations, 2020). Other SDG’s the project aligns with are 3, 4, 3, 4, 5, 6, 7, 13, 14, and 17 (United Nations, 2020).

6.5 Ethical Considerations

Within the regenerative countryside scope, the meaning or value of the landscape, rural landscape or rural countryside is very much apparent. Consequently, due to the inherent cultural relationships to the landscapes, they are for the greater good, public goods. Subsequently, the project values the importance of including all stakeholders in decisions regarding their landscapes. This is encompassed by the inclusion of regional knowledge hubs within the three pillars. Each hub functions as a place for networking and sharing knowledge, forming the early fundament of spatial interventions within the landscape. Simultaneously, these hubs aggregate the public-private relationships within the countryside.

However, In the long run, it is inevitable for farmers to adapt their practices to align with society's growing emphasis towards regenerative farming practices. To facilitate this transition, farmers are empowered by provided education and encouraged to collaborate through hubs and incentives. Additionally, the project recognises the earth itself is also a critical stakeholder that deserves attention. Throughout the scales and strategy, climate change is the golden threat outlining the mitigation efforts.
Ultimately, the goal of the project is to maximize equality by facilitating stakeholder participation at various levels, fostering collaboration among stakeholders to form community networks, Nevertheless, the group most likely to be disadvantaged by the transition are those farmers who lose their land to nature. Consequently, the regenerative countryside offers a range of job opportunities beyond farming, including positions in nature preservation, agrotourism, or education. Accordingly, farmers can potentially transition into these new roles and continue to contribute to their communities.

Additionally, the project recognises the earth itself is also a critical stakeholder that deserves attention. Throughout the scales and strategy, climate change is the golden threat outlining the mitigation efforts.

Ultimately, the goal of the project is to maximize equality by facilitating stakeholder participation at various levels, fostering collaboration among stakeholders to form community networks, and creating new opportunities for underprivileged groups. Subsequently, the strategy will yield benefits for everyone, including future generations and the environment.

6.6 Individual Reflections

6.6.1 Anmol Bhargava

As the 2022-23 edition of the Spatial Strategies for the Global Metropolis studio comes to conclusion, it is an interesting exercise to reflect upon the learnings and takeaways as well as the questions I got to ask myself through the course of this project. From reimagining Lijnbaan in the heart of Rotterdam in the second quarter, the scale of the project jumped through multiple 'Powers of Ten' and the project brief was centred around understanding the spatial organization concepts and approaches beyond the urban (Balz & Katsikis, 2023).

During one of the Capita Selecta lectures titled 'Multiple Transitions, Circularity and the Countryside' by Dr Alexander Wandl, I was particularly intrigued by the concept of circularity and regenerative design. Thereafter, during our field excursions through the countryside South Holland, we were drawn towards the context of agricultural production practices and the landscapes that they entail. With the ongoing Nitrogen crisis and the farmer protests being all over the national news, I was interested in applying the concepts of a circular, regenerative system over the current degrading profit-driven agricultural practices within North-western Europe through understanding and analysing the inter-regional relations, spatial claims, and sustainability transitions.

As a team we analysed the degraded countryside based on the pillars of ecology, economy and society and came up with a unified vision for the 'Northwest European' Lowlands in the year 2100 as an intra-regional, climate-resilient, cross border spatial network which aims to sustain food security, revitalise the natural ecosystems and promote regenerative agricultural practices within the region. We translated our vision into a series of strategic interventions, catalysed through three diverse key projects which are multiscalar.

"Visioning is more than painting an idealistic picture of the future - it is a process of evaluating present conditions, identifying problem areas and bringing about a community wide consensus on how to overcome existing problems and manage change." (Sandler, 2000)

Through the course of this studio, I understood the importance of vision in design and planning projects as it becomes a guiding principle in decision-making and helps in prioritising the aspirations, goals and values of the project. With a clearly defined vision, the stakeholders are aligned to work towards a common goal and collaborations between spatial planners, designers and the architects can be made more effective as they are in sync with the political will of the majority. A similar scenario is simulated in our studio groups through a series of intense debates, discussions, and compromises to finally formulate a unified vision.

Being trained as an architect, the large scale of North-western Europe was daunting at first but over time, I got acclimated to the diverse agricultural landscapes and practices within this region which are very different from the ones found in India, where I come from. I also got to learn key principles of circular regional spatial development and how to think analytically in systems, for instance, via systemic sections. Last but not the least, the studio discussions with the mentors, methodology course and working in a diverse team added their own share of valuable learnings and experiences which will prove out to useful in my future endeavours.

6.6.2 Bas Kramer

The Architect, Urban Designer and Spatial planner are tasked with translating political convictions to the future into tangible spatial visions, strategies, and plans. Within them, the designers' moral values, aesthetics and meaning are subjected to the political will of the majority. Consequently, any decision the designer takes is a carefully weighted decision between their morals and politics, it is especially hard for spatial visions, 'plans setting out an image of a desirable and plausible regional future' (Balz, 2023). Since they outline the long-term future for a large area consisting of many stakeholders with different beliefs. The course reflects this character by inviting debates, discussions, and compromises within the group to form the vision.

Yet, within the span of an ever faster urbanizing world, changing climate, and increasing regional and economic inequality (Florida, 2018), seeking compromises was a challenge. The challenge was overcome by an intensive debate session in which the definitions of key aspects of the vision were set in stone. This allowed us to tackle the challenging regional design scale in conjunction with the implementation of a regenerative agricultural system. Especially the vastness of the subject matter remained a challenge throughout the project. The complex world of regenerative systems and the techniques of conducting agriculture appeared to be endlessly unfolding.

Thus, in the vision phase of the project, we endeavoured to identify the dominant ways the countryside was degraded. Due to me being the GIS expert in the group, the task of visualizing and analysing the vast amounts of datasets added to the confusion of the large scale. By entering the vision of 'from degradation to regenerative NWE Lowlands' an equilibrium between restoring natural functions, food security and working within the planet's limitations, we proposed a future where social, economic, and environmental benefits go hand in hand. The vision allowed us to shape this future and to build awareness for this drastic change, we illustrated how various land uses and stakeholders could engage with nature in a regenerative approach, rather than in an exploitative one.

The strategy, 'an identification of concrete actions to be taken in the light of a vision' (Balz, 2023), further elaborates in a timely manner through the communication of key spatial interventions on how the regenerative NWE Lowlands could be formed. At the same time, it establishes the foundation for considering stakeholder incentives and leveraging the interconnections between systems across all scales.

As a former Landscape Architecture student from Wageningen University & Research, regional design, and spatial issues in the Dutch context are not new. The spatial friction between farmers and their environmental impact has been a guiding theme throughout. However, by integrating them into the scope of regional development for 'areas beyond the urban' (Balz & Katsikis, 2023), the scale of South Holland as a part of an NWE system (Balz & Katsikis, 2023), and the comprehensive group work the course offered challenges, at times difficulties but overall, a platform to broaden my knowledge. Especially the lecture series of the Capita Selecta, Spatial Development Strategies (SDS), tutor feedback and the accompanying Methodology course gave me new insights and methods for regional design from an urbanist's perspective.

6.6.3 Georgia Kokolaki

The context of this quarter turned out to be extremely demanding but fascinating and inspiring for me at the same time since I consider myself a visionary architect and I am always trying to envision a more positive and just future for people. Since the beginning, my group aimed very high and decided to challenge ourselves by choosing to research the future of agriculture and how it can be shaped to regenerate the degraded natural and social systems in the countryside. While exploring the different possible pathways, we concluded that we need a deep transition to achieve ecological sustainability and it is necessary to rethink agriculture, urban planning, transportation, resource use, forestry cover, and our cultural values (Orr, 1992, p. 24).

During this intensive course, we challenged ourselves with trying to imagine ways that the future agriculture complex system would regenerate the biosphere while at the same time securing people's health and adequate living and working conditions. Combining our powers as people with different strengths and backgrounds we managed to create a powerful and unified vision of a more connected and resilient rural network in Northwestern Europe which will encourage the formation of an adaptive and flexible environment to climate-changing conditions and future threats through strong natural system. Moreover, we are envisioning that the regenerative agricultural landscapes will facilitate the revitalization of the countryside, ensuring a just transition process towards a more inclusive future regarding social, economic, and environmental aspects.

I consider the vision, the most crucial part of the process of regional planning because it sets the guidelines and provides a purpose for which people are willing to fight while envisioning a desirable future. The most effective way to initiate large-scale changes is through regional planning since it enables and engages actors of action that are required to achieve the future. (Fred Hobma, 2023). Another essential part of our project was to generate a vision that aligns and connects a region, while at the same time taking into consideration their different landscape and cultural identities. A comprehensive vision can assist in creating a regenerative agriculture system that is sustainable, resilient, and beneficial to all stakeholders.

Therefore, through our project, we tried to identify what are or will be the influences of important current and future challenges such as climate change the system to find ways to protect and restructure systems to make them more easily adaptive, so they can withstand changes and still reach a new equilibrium. We tried to do that by identifying the different stakeholders and the conflicts that would arise in our future and how we can influence those conflicts through our design.

After shaping our vision and projecting how we envision the Lowlands of North-West Europe being regenerated into a spatially, socially, and ecologically just countryside, we started to experiment with how the vision can influence and guide the development strategy, first by defining objectives which will help us to achieve the vision reflecting on our values which, taken as a whole, express how we together achieve our vision. Consequently, we identified the key stakeholders and their roles in the project so the implementation and the proposed strategic interventions to be more effective.

After the end of this quarter, I realized we attempted to envision and make a comprehensive strategy about how we can control the complex and dynamic way that the agriculture is shaping the countryside. Another significant personal realisation during the studio and methodology courses was how to incorporate design, as an exploration of desirable spatial futures, in order to enhance the comprehensiveness of plans, to moderate political agendas and improve the efficiency and rightfulness of planning. (Balz & Katsikis, 2023)

6.6.4 Giorgos Xanthopoulos

Our project was structured on the pillar of degradation, which was researched in a multi-faceted approach through the lenses of ecology, economy, and society – in an attempt to examine both broadly and deeply the impacts of the food production and distribution system, from the globe to the local context. In many ways, our conceptual design thinking - that followed this - was aimed at reversing the issues of degradation that had been illuminated. Thus, in a generalized and abstract scale, our research had a very linear structure between research and design, with the analytical part that was conducted mainly on the first half of the quarter being reversed and translated into design principles in the second. However, throughout our entire process there has been a continuous loop of research, design, experimentation, and evaluation. For example, after broadly defining the key concepts that would provide the backbone of our operational strategy, we had to revisit our previous research as well as look for new knowledge to support our arguments. Through making conceptual sketches and testing out schemes, discussing within the group and the tutors, the key projects transformed into initiators for the unfolding of the strategy.

Coming from an architectural background, research and design were usually separate concepts, only intermingling in a much more superficial way. The different components of a project were also much easier to map, develop, detail, finish and compartmentalize. During this quarter I have consciously attempted to dissolve such notions and explore new ways of perceiving the relationship between research and design. The need to go back-and-forth from research and design, or from scale to scale had already become evident from working on the small-scale of the Lijnbaan in Q2 or the city-scale of Q1. Quick design options had to be explored in the small scale, and then evaluated on the effects caused to the large scale, and vice versa. However, in this quarter the different decisions that had to be taken would, in reality, affect millions of people and involved much more complicated economic and ecological processes. The back-and-forth that was happening before regarding specific spatial qualities transcended to conceptual thinking and discourse. Thinking in such a large scale really forced me to consider social issues and implication in a much more substantial way than before, hence why I attempted to research the livelihoods of small-scale farmers, migrant workers and countryside dwellers – broadening to topics of housing, policies, subsidies, incentives, heritage, culture…The speed of decision taking and forming a clear narrative are aspects that really enjoyed developing alongside my group mates and tutors, and hope to explore even further in my involvement to Urbanism.

6.6.5 Wanda Wahl Mertes

The human relationship with nature has drastically changed since the industrial revolution. Our liability when taking a closer look at the causes of the climate crisis is undeniable. Our consumption and lifestyle is leading to the global exploitation of ecosystems, animals and people. With the current and more prominent becoming climate crisis in mind, it is hard for me to not see us humans and our individual behavior as the drivers of these issues. Researching deeper into potential pathways concerning our global warming I see the urgency for more large scale strategies. To address this urgent issue, large-scale strategies are needed that involve cooperation across borders and continents. Looking at the metropolitan scale of North-West Europe has been an interesting opportunity to produce a meaningful concept for the transitions our production and consumption has to go through to keep global warming to a minimum.

Focusing on regenerative agriculture was specifically interesting because it is about making more of an effort than being neutral, but creating something positive for the environment. Translating this to social issues we analyzed through our field trips and research has been a challenge. How can you not just improve but add positivity to the social wellbeing of rural communities? Having a clear vision for our future was an important step in finding our story line and strategy concept. Transitioning towards an inclusive, just future countryside, considering policies that support our strategy, and identifying stakeholders and potential conflicts that may arise.

A critical aspect of effective strategies is their adaptability. We have to envision what we want the future to be, which is an important part of a strategy, but we cannot for-see what will actually happen. Therefore, a strategy has to be flexible and able to change with future challenges or opportunities. To create real change, we also had to identify the tipping points and small-scale interventions necessary for larger transitions to occur. With our key projects I believe we have found vital projects that can start the transition and be upscaled across borders.

Looking back, I realized that our work required us to look beyond our immediate context and consider different scales, borders, and cultural identities. We had to learn to compromise, let go, and trust others in order to work together towards our common goal. Rapid and ambitious change requires international cooperation to transform production and consumption. Overall, this experience has deepened my understanding of the need for collaborative, adaptable solutions to address complex sustainability challenges, and I'm excited to continue refining my strategic thinking skills in the future.

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7.2 Data Sources

INTRODUCTION

Fig. 1.1: Context Map for NEW

Fig 1.2 - 1.4 photos taken by authors

Fig. 1.6 The monocultural pasture landscape of Gouda, filled with protesting flags by the author, 2023.

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ANALYSIS

3.1 Global degradation

Fig 3.1.1 Global land cover – map based on data from grip arenal (2006) retrieved April 11, 2023, from https://www.grida.no/resources/5531

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3.2 Ecological degradation

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Fig 3.2.3.3 clouds-cloudiness-industry-ruhr-area-. (n.d.). hippopx.com. https://i0.hippopx.com/photos/616/673/97/clouds-cloudiness-industry-ruhr-area-preview.jpg

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Fig 3.2.6.2 Expected absolute precipitation change % for 2050 IPCC/RCP 2.6, Europe: Berg, P., Photiadou, C., Bartosova, A., Biermann, J., Capell, R., Chinyoka, S., Fahlesson, T., Franssen, W., Hundecha, Y., Isberg, K., Ludwig, F., Mook, R., Muzuusa, J., Nauta, L., Rosberg, J., Simonsson, L., Sjökvist, E., Thuresson, J., and van der Linden, E., (2021): Hydrology related climate impact indicators from 1970 to 2100 derived from bias adjusted European climate projections. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.73237ad6

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3.3 Economic degradation

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VISION

4.1 Vision Collage

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4.2.1 Sustainable Food Security

4.2.1.1.: Vertical Farming
https://www.independent.co.uk/climate-change/news/vertical-farming-solution-food-security-hydroponics-aquaponics-urban-agriculture-a8547561.html

4.2.1.2.: Aquaculture
https://regeneration.org/nexus/ocean-farming

4.2.1.3.: Precision Farming
(Source: https://www.konicaminolta.eu/eu-en/rethink-work/business/digital-agriculture-how-dutch-farmers-use-precision-farming-for-floriculture)

4.2.1 Ecosystem Revitalization

Fig 4.2.2.1 Restoring Peatlands
https://northseablog.eu/peatland-farming-could-help-safeguard-vital-carbon-sink/

Fig 4.2.2.2 Restoring Heathlands
https://www.newforestnpa.gov.uk/discover/natural-beauty/heathland/

Fig 4.2.2.3 Afforestation
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Base maps for NWE: based on data from
Geofabrik Download Server. (2023, April) http://download.geofabrik.de/

STRATEGY

Fig 5: basemaps for M & S frames
based on data from Geofabrik Download Server. (2023, April) http://download.geofabrik.de/

APPENDIX:

Fig 8.1 climate:

Fig 8.2 pollution:

Fig 8.3 Pollution conclusion: Industrial Reporting under the Industrial Emissions Directive 2010/75/EU and European Pollutant Release and Transfer Register Regulation (EC) No 166/2006. (n.d.). European Environment Agency. https://www.eea.europa.eu/data-and-maps/data/industrial-reporting-under-the-industrial-6

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Fig 8.4, Nitrogen pollution in water: Concentrations of nitrogen and phosphorus in European agricultural soils. (n.d.). European Environment Agency. https://www.eea.europa.eu/data-and-maps/data/concentrations-of-nitrogen-and-phosphorus
Fig 8.4, Nitrogen pollution in air: Concentrations of nitrogen and phosphorus in European agricultural soils. (n.d.). European Environment Agency. https://www.eea.europa.eu/data-and-maps/data/concentrations-of-nitrogen-and-phosphorus

Fig 8.5 crop type map:
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Fig 8.6. Soil map, Panagos, P., Van Liedekerke, M., Borrelli, P., Köninger, J., Ballabio, C., Orgiazzi, A., Lugato, E., Liakos, L., Hervas, J., Jones, A. Montanarella, L. 2022. European Soil Data Centre 2.0: Soil data and knowledge in support of the EU policies. European Journal of Soil Science, 73(6), e13315. DOI: 10.1111/ejss.13315
And
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Fig 8.7. Soil degradation, Panagos, P., Van Liedekerke, M., Borrelli, P., Köninger, J., Ballabio, C., Orgiazzi, A., Lugato, E., Liakos, L., Hervas, J., Jones, A. Montanarella, L. 2022. European Soil Data Centre 2.0: Soil data and knowledge in support of the EU policies. European Journal of Soil Science, 73(6), e13315. DOI: 10.1111/ejss.13315
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Fig 8.8. Expected absolute precipitation change % for 2050 IPCC/RCP 2.6, Europe: Berg, P., Photiadou, C., Bartosova, A., Biermann, J., Capell, R., Chinyoka, S., Fahlesson, T., Franssen, W., Hundecha, Y., Isberg, K., Ludwig, F., Mook, R., Muzuusa, J., Nauta, L., Rosberg, J., Simonsson, L., Sjökvist, E., Thuresson, J., and van der Linden, E., (2021): Hydrology related climate impact indicators from 1970 to 2100 derived from bias adjusted European climate projections. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.73237ad6

Fig 8.9. Expected absolute temperature incease for 2050 IPCC/RCP 8.5, Europe: Sandstad, M., Schwingshackl, C., Iles, C., (2022): Climate extreme indices and heat stress indicators derived from CMIP6 global climate projections. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.776e08bd

Fig 8.10. Expected absolute precipitation change % for 2050 IPCC/RCP 2.6, NEW: Berg, P., Photiadou, C., Bartosova, A., Biermann, J., Capell, R., Chinyoka, S., Fahlesson, T., Franssen, W., Hundecha, Y., Isberg, K., Ludwig, F., Mook, R., Muzuusa, J., Nauta, L., Rosberg, J., Simonsson, L., Sjökvist, E., Thuresson, J., and van der Linden, E., (2021): Hydrology related climate impact indicators from 1970 to 2100 derived from bias adjusted European climate projections. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.73237ad6

Fig 8.11 Expected absolute temperature incease for 2050 IPCC/RCP 8.5, NWE: Sandstad, M., Schwingshackl, C., Iles, C., (2022): Climate extreme indices and heat stress indicators derived from CMIP6 global climate projections. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.776e08bd

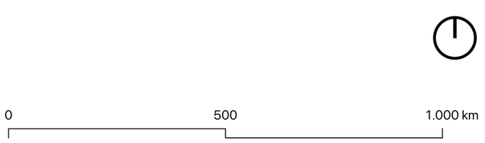
08 appendix

Impact Climate Change on Percipitation

Expected absolute percipitation change
(increase or decrease (%)) for 2050
Following (RCP 2.6/IPCC scenario)
Data collection periode 1900-2050



Fig 8.1



Impact Climate Change on Temperature

Expected absolute temperature change (increase) for 2050
Following (RCP 8.5/IPCC scenario)
Data collection periode 1900–2050



Fig 8.2

0 500 1.000 km

199

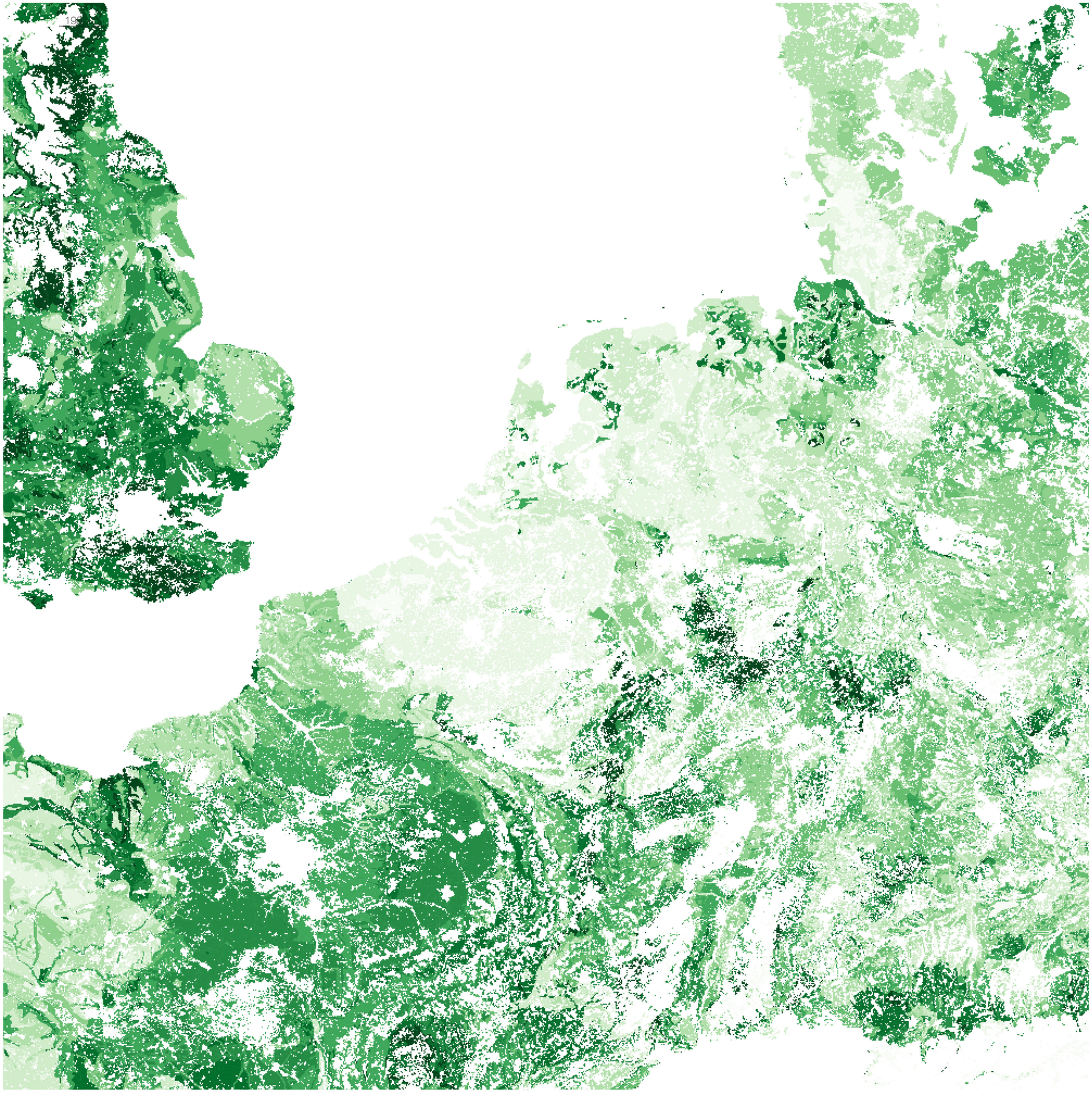
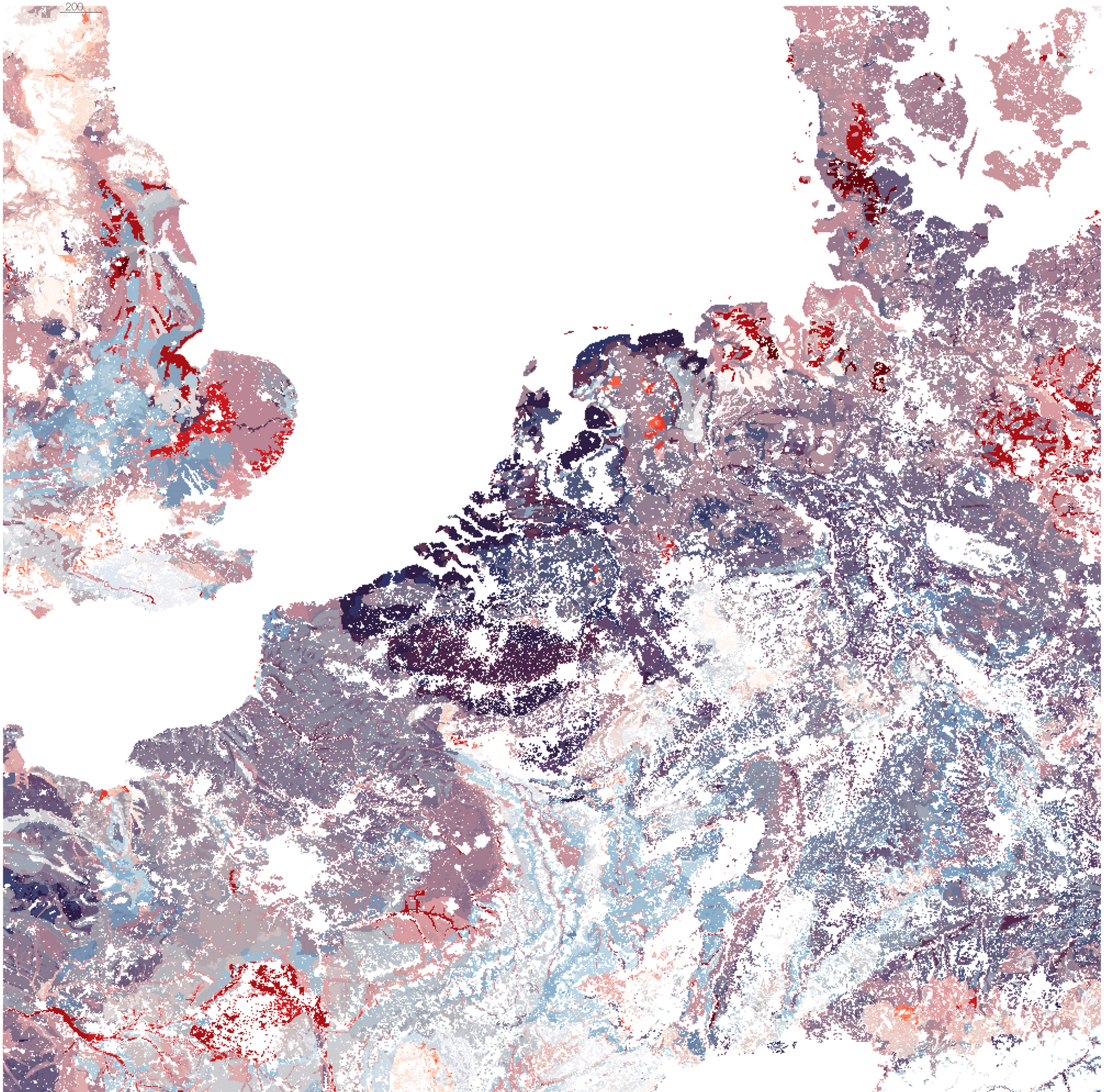

Efficency use of Nitrogen in Nordwest Europe
N efficency use in Northwest Europe (kg N/ha/yr)
0 - 0,44
0,44 - 0,56
0,56 - 0,62
0,62 - 0,65
0,65 - 0,67
0,67 - 0,69
0,69 - 0,72
0,72 - 0,75
0,75 - 0,8
0,8 - 0,97
0
100
200 km

Fig 8.3



Leaching to water of Nitrogen
in Nordwest Europe

N leaching to surfacewater (kg N/ha/yr)
- 0 - 3,7
- 3,7 - 5,6
- 5,6 - 7,2
- 7,2 - 8,8
- 8,8 - 10,5
- 10,5 - 12,2
- 12,2 - 14
- 14 - 15,9
- 15,9 - 19,7
- 19,7 - 71,8

N leaching to groundwater (kg N/ha/yr)
- 0 - 1,4
- 1,4 - 2,5
- 2,5 - 3,7
- 3,7 - 5,2
- 5,2 - 6,6
- 6,6 - 8,5
- 8,5 - 11,7
- 11,7 - 15,7
- 15,7 - 22,3
- 22,3 - 90,2

Fig 8.4

0 100 200 km



Land Use Intensity

Land Use Intensity
- Land Use Intensity
- Non-agricultural use
- Extensive arable
- Moderately intensive arable
- Very intensive arable
- Extensive grassland
- Intensive grassland

Fig 8.5

0 100 200 km

Landscape Relief map

DEM

Elevation

1.100

-10

Fig 8.6

0 100 200 km

Landscape Top Soil

Top Soil
- Town
- Soil disturbed by man
- Water body
- Marsh
- Glacier
- Rock outcrops
- Gleyic Albeluvisol
- Haplic Albeluvisol
- Humic Acrisol
- Haplic Arenosol
- Calcic Chernozem
- Haplic Chernozem
- Calcaric Cambisol
- Chromic Cambisol
- Dystric Cambisol
- Eutric Cambisol
- Gleyic Cambisol
- Mollic Cambisol
- Vertic Cambisol
- Calcaric Fluvisol
- Dystric Fluvisol
- Eutric Fluvisol
- Gleyic Fluvisol
- Dystric Gleysol
- Eutric Gleysol
- Haplic Gleysol
- Humic Gleysol
- Mollic Gleysol
- Thionic Gleysol
- Dystric Histosol
- Eutric Histosol
- Calcaric Leptosol
- Dystric Leptosol
- Haplic Leptosol
- Rendzic Leptosol
- Albic Luvisol
- Arenic Luvisol
- Chromic Luvisol
- Gleyic Luvisol
- Haplic Luvisol
- Haplic Phaeozem
- Luvic Phaeozem
- Dystric Planosol
- Gleyic Podzol
- Haplic Podzol
- Lamellic Podzol
- Placic Podzol
- Umbric Podzol
- Calcaric Regosol
- Dystric Regosol
- Eutric Regosol
- Pellic Vertisol
- No information

Fig 8.7

0 100 200 km



Soil quality

Threat to soil biological functions
In %
0,945848
0,028177

Landscape
Crop production
Pastures
Threath to soil fauna

Fig 8.8

0 100 200 km

Modelled potential for reusing water for agricultural irrigation in the EU

Modelled potential for reusing water for agricultureal irrigation in the EU in M^3/year

1.550.000

0

Fig 8.9

0 100 200 km

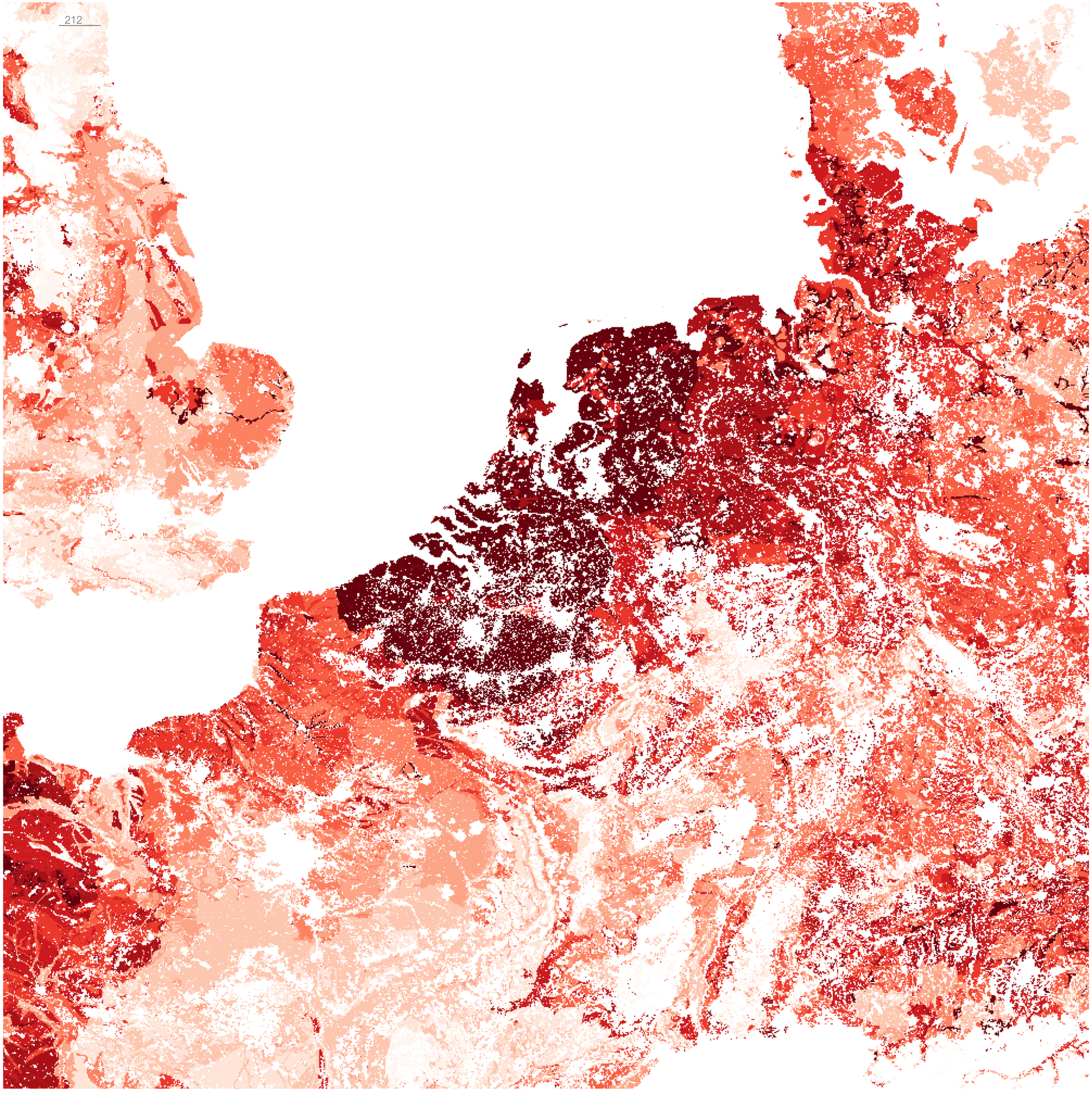
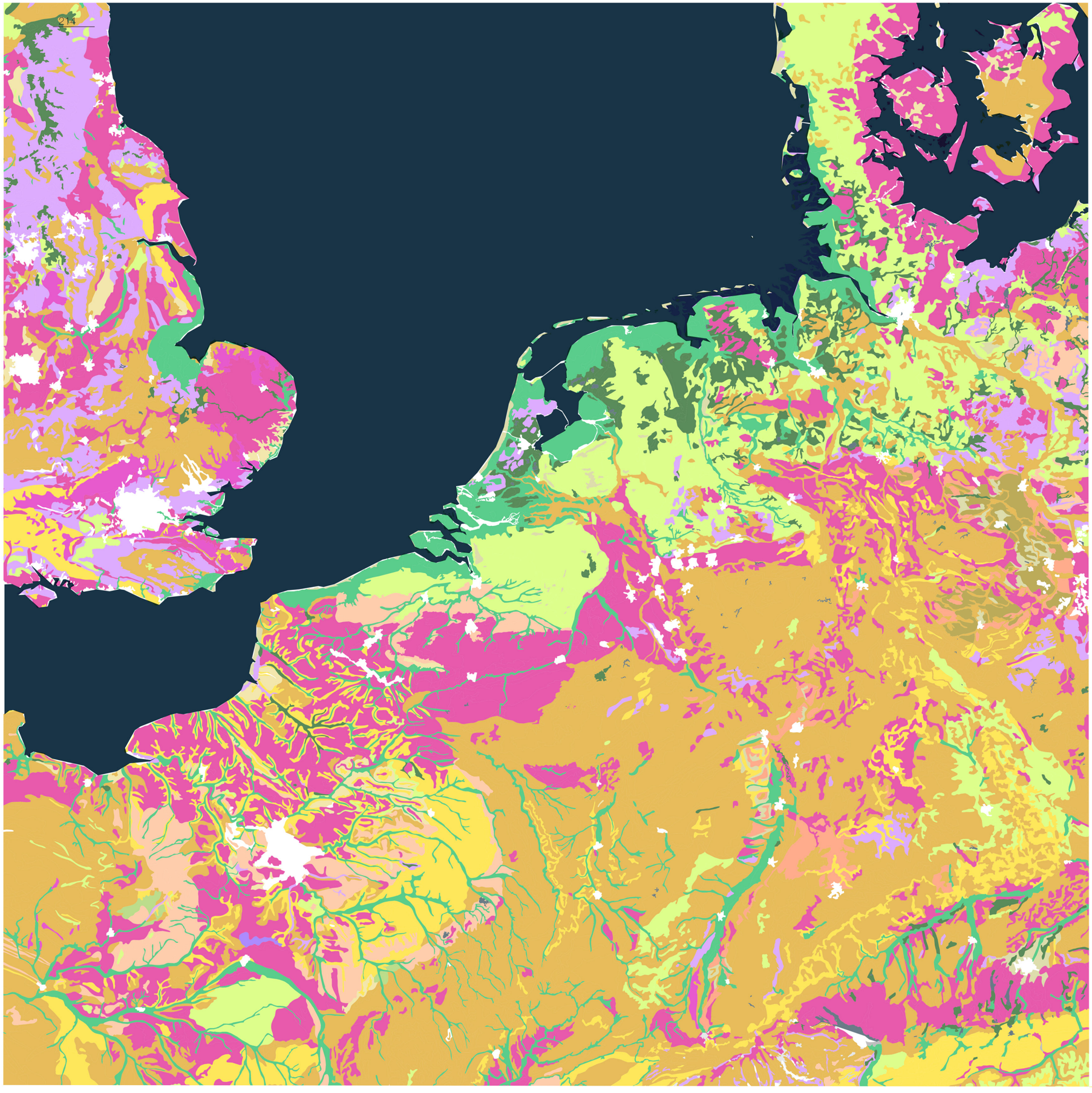

Pollution of Nitrogen in Nordwest Europe
N surplus in Northwest Europe (kg N/ha/yr)
0 - 28,1
28,1 - 38,1
38,1 - 46,9
46,9 - 54,4
54,4 - 60,4
60,4 - 66,8
66,8 - 75,4
75,4 - 91
91 - 135,4
135,4 - 650,4
0
100
200 km

Fig 8.9

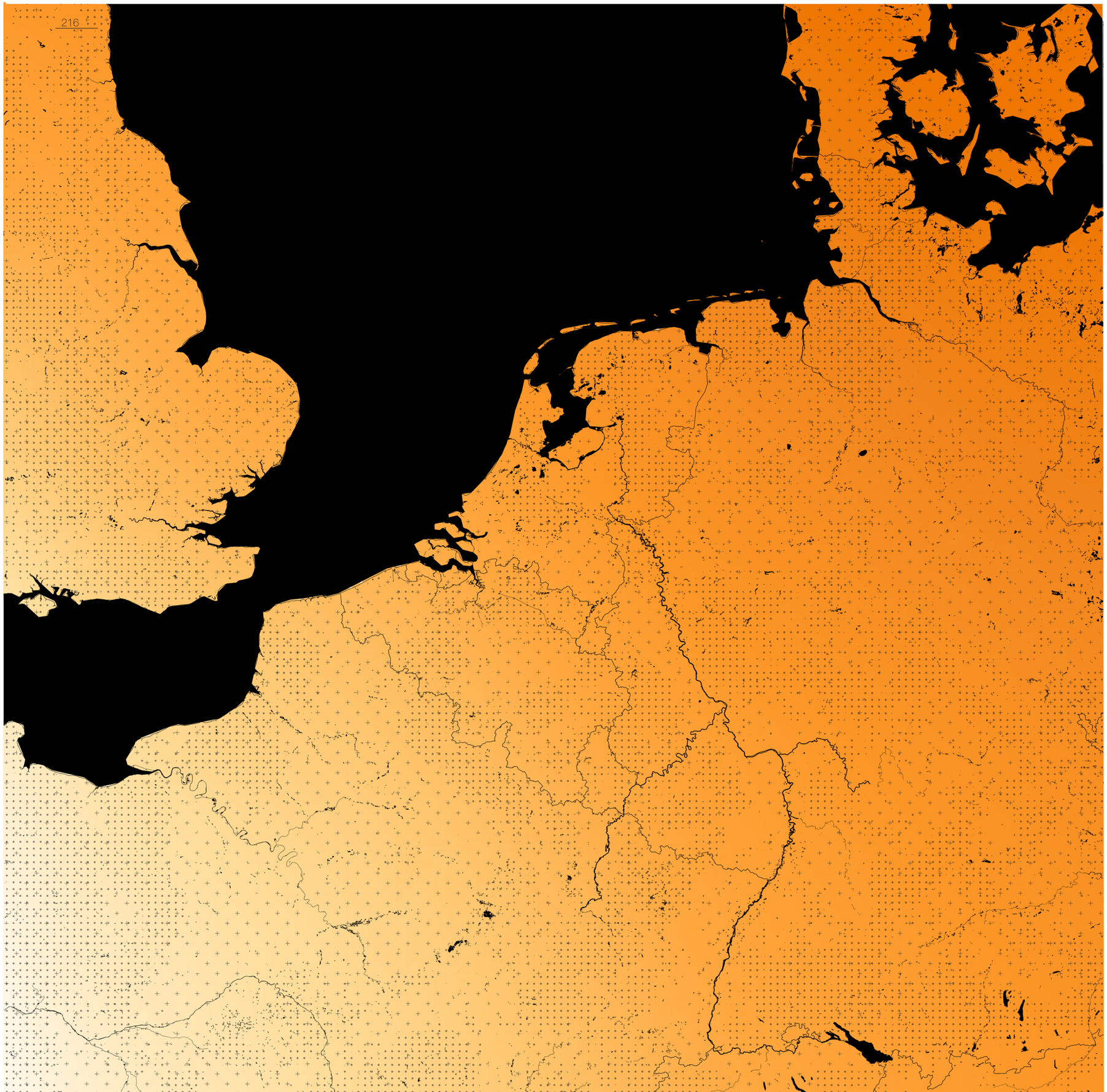


Landscape Top Soil

Soil
- Town
- Soil disturbed by man
- Water body
- Marsh
- Glacier
- Rock outcrops
- Arenosol
- Chernozem
- Cambisol
- Fluvisol
- Gleysol
- Histosol
- Leptosol
- Luvisol
- Phaeozem
- Planosol
- Podzol
- Regosol
- Vertisol

Fig 8.10

0 100 200 km



Impact Climate Change on Temperature

Expected absolute temperture change (increase) for 2050
Following (RCP 8.5/ IPCC scenario)
Data collection periode 1900-2050

2,67 °C

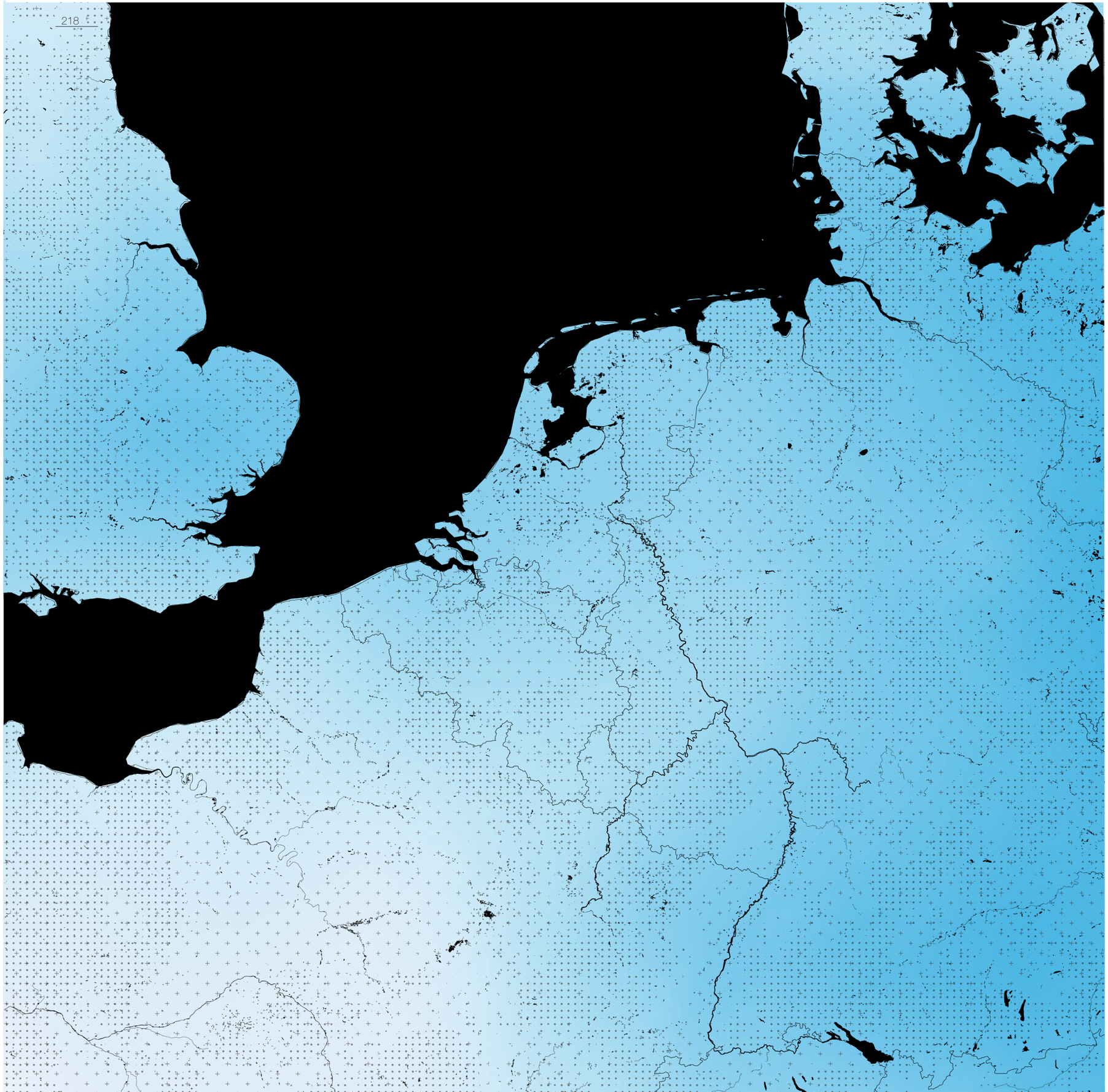
1,60 °C

Type of landscape

- Crop production
- Pastures

Fig 8.11

0 100 200 km



Impact Climate Change on Percipitation

Expected absolute percipitation change (increase or decrease (%)) for 2050 Following (RCP 2.6/ IPCC scenario)
Data collection periode 1900-2050

9,739197

-1,658317

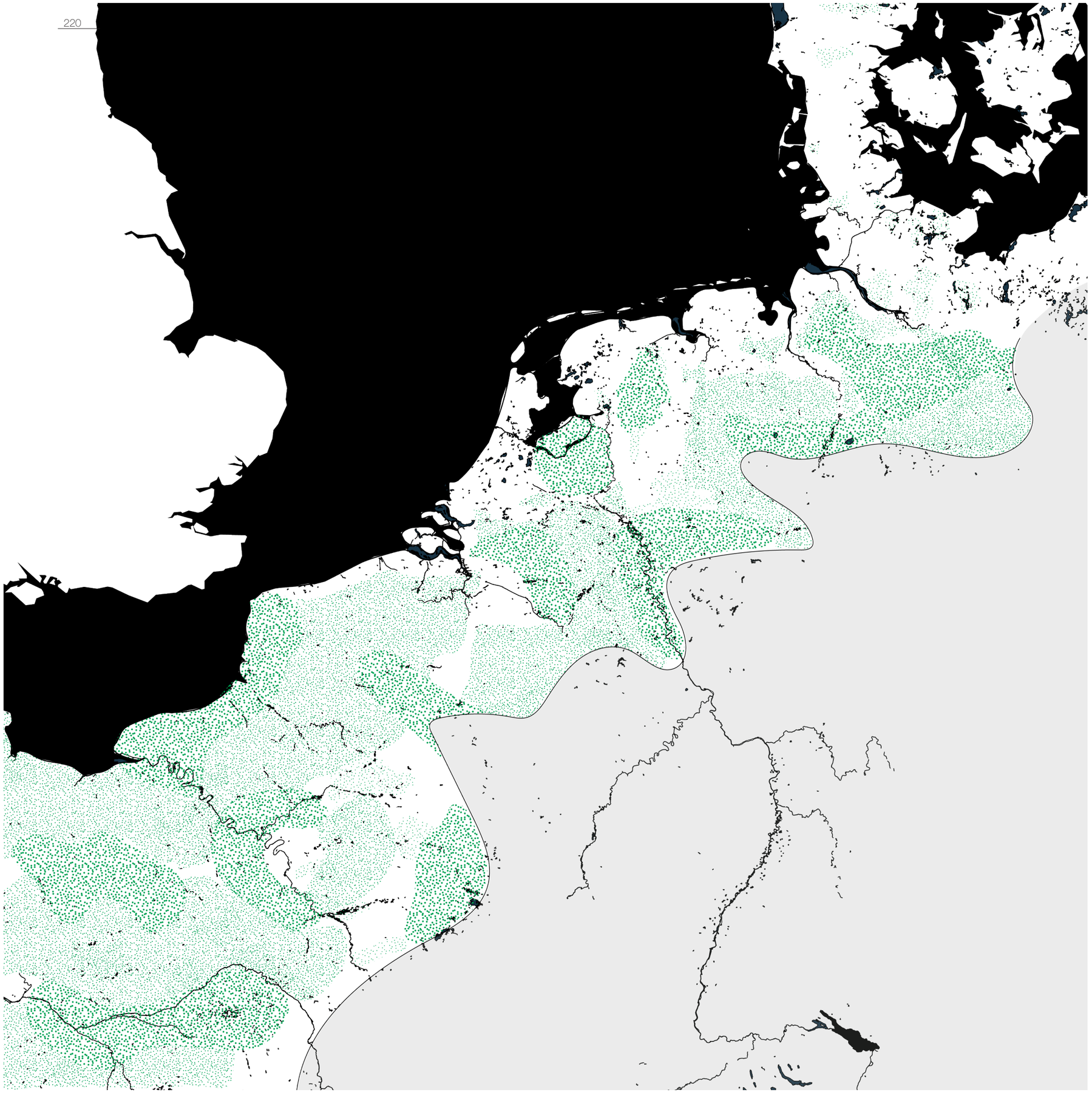
Type of landscape

Crop production

Pastures

Fig 8.12

0 100 200 km



Forests
Agroforestry

Fig 8.12 Tree Density Map

0 100 200 km



Revitalizing the socio-ecological agricultural landscapes of North-West European Lowlands