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TOPIA

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AR2U086 R and D Studio: Spatial Strategies for
the Global Metropolis (2023/24 Q3)
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Colophon

NITROTOPIA

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Abstract

Nitrogen is an essential element of planetary life. Yet, human actions create such a surplus of its derivatives like ammonia (NH3) and nitrogen oxides (NOx) that the naturally occurring amounts doubled, causing a cascade of environmental and societal problems.

Our research studies dairy farming in North-West Europe with a focus on the Netherlands, as this industry is responsible for most nitrogen-related problems. The starting point of the project is the parliamentary letter 'Nationaal Programma Landelijk Gebied' (National Rural Area Program), which offers the alternatives of quitting, transforming or relocating dairy farms in areas where the nitrogen surplus exceeds critical loads. We reevaluated this approach using the methods of extreme scenarios, in-depth stakeholder analysis, as well as layering and clustering areas with high nitrogen deposition, pasture lands and socio-geopolitical issues. This led us to the realisation that a substantial spatial and societal transition is needed in order to reach balance again. The goal of this study is therefore to recalibrate the nitrogen cycle by radically changing current dairy production practices. We created a gradient from quitting to transforming farms and pastures, based on the theories of transitional landscapes and socially just transitions, resulting in a toolbox of eight strategic interventions, as well as a thorough policy framework. We choose a multi-scalar approach to test the new typologies, starting from the Netherlands, looking at the Groningen - Friesland - Drenthe region, further zooming in on the municipality of Ooststellingwerf, showing the phasing of the strategy from a human perspective. Essential lessons learned are the importance of collaboration on all scales, as well as the flexibility and openness towards change, whether it is technological or societal. Finally, based on these findings we extended our zoom to the scale of North-West Europe, giving suggestions to regions with similar problems.

This project describes a possible future based on our interpretation of the parliamentary letter, giving an intriguing input to decision makers on what their policies could mean, hoping to change the discourse regarding nitrogen, shifting its perception from pollution to a valuable resource. Welcome to Nitrotopia!

Keywords: recalibrated nitrogen cycle, transitional landscapes, socially just transition, quitting, transforming, dairy farming, Friesland-Drenthe-Groningen, Ooststellingwerf

Content

1
Introduction

Since the beginning of 2024, several farmers' protests have taken place in countries such as Greece, Spain, Belgium, France and Italy. Many of them are "pointing their tractors" in the direction of local governments and the European Union. Yet, farming protests are nothing new in the Netherlands. Since 2019, there have been a lot of concerns about the nitrogen crisis, and farmers are outraged by the government's new energy transition measures in order to reduce the nitrogen surplus (Dorresteijn, 2024). As the nitrogen issue affects human and planetary health, it is vital to make a drastic change that does not put in disadvantage those directly affected by the transition. This was the driving force behind our research and design process.
Throughout the process, we touch upon the main topics of nature, farming and socio-geopolitics connected to nitrogen. To be able to tell a cohesive story, we created three characters symbolising them: the planet, the cow and the farmer. Let them introduce themselves with a statement in figure 1 below.

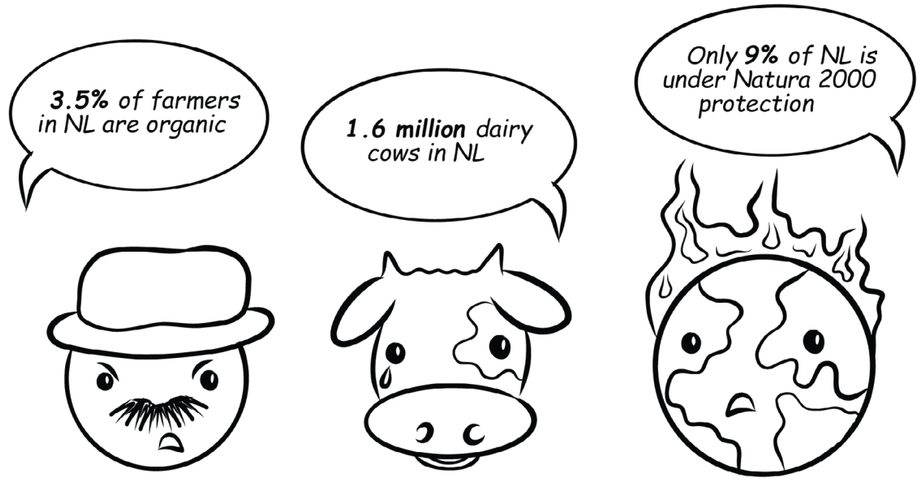


Figure 1: Statements

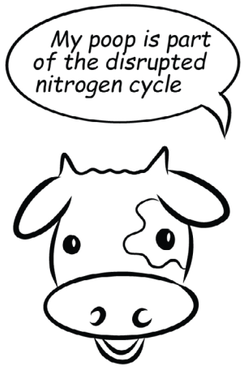
Problem statement

Nitrogen is a natural element of the environment, so referring to it as pollution is misleading. However, the surplus of its products such as ammonia (NH3) and nitrogen oxides (NOx) have harmful effects on planetary health. Fertiliser production, industrial combustion, and the import of nitrogen in various products are the three leading causes of nitrogen surplus in the European Union, negatively impacting water, soil and air quality (Galloway et al., 2008). This disrupted cycle affects both nature and humans, and therefore needs to be recalibrated.

This problem is especially relevant in the Netherlands, as two thirds of the country consists of agricultural land, while the few remaining natural areas are under threat of biodiversity loss due to the nitrogen crisis. The measures that have already been taken focus on minimising nitrogen emissions by limiting agricultural activity. However, the enforced policies do not attack the problem at the source, just try to mitigate it, simultaneously exasperating a large part of the Dutch population, which resulted in intense political and societal conflicts.

Consequently, the project aims to explore possible ways of reducing the nitrogen surplus in North-West Europe, on the example of the Netherlands, by transitioning towards a new, economically viable, environmentally sustainable, and socially just (agricultural) model - focusing mostly on dairy farming. Our starting point is a Normative Political Agenda, namely the Nationaal Programma Landelijk Gebied (National Rural Area Program in English, 2022). In this parliamentary letter the government details the strategies of quitting, transforming, and relocating existing dairy farms to mitigate the harmful effects caused by the abundance of nitrogen. We set out to test and reevaluate these concepts, with the overall goal of finding the right balance and creating a “hybrid” through designing transitional landscapes and implementing transitional practices.

The disrupted nitrogen cycle



To be able to understand the roots of this complex problem surrounding a tiny atom, we first need to look at the natural nitrogen cycle and its flows. 78% of the air around us consists of nitrogen atoms (N2). Plants need nitrogen for their biochemical processes, which they can only use in its reactive form. Therefore, they live in symbiosis with bacteria that can transform the un-reactive molecules to ammonia (NH3) and ammonium (NH4+), then through nitrification to nitrites (NO2-) and nitrates (NO3-), which can be utilised by the plants. This is called **biological nitrogen fixation.** The same process happens when dead animals and plants decompose. Naturally, the nitrates not used are denitrified by another bacterium, and are released back to the air in their atmospheric form (N2) (Fowler et al., 2013).

Since the industrial revolution, nitrogen compounds have been emitted into the air, soil and water through anthropogenic practices (Rockström et al., 2009). This creates a surplus of ammonia, nitrates and nitrogen-oxides, which disrupts the healthy cycle, threatening planetary health. **Human activities are responsible for more than half of the global nitrogen fixation** (413 Tg N / year), contributing with approximately 210 Tg of reactive nitrogen per year (Fowler et al., 2013). According to van Egmond et al. (2002), the three main causes of the exceedance are fertiliser production (14 million tonnes of nitrogen per year), fossil fuel combustion combined with other industrial processes (3,3 million tonnes of nitrogen per year) and import of nitrogen in various products (7,6 million tonnes of nitrogen per year) in the European Union. Based on the gross nitrogen balance indicator (Eurostat, 2017), the nitrogen input stagnated around these same values, without significant decrease visible. The disrupted nitrogen cycle is shown in figure 3, highlighting with red colours the human-related elements.

Throughout our project we aim to reduce the nitrogen surplus below the critical load of 60 Tg of nitrogen per year, defined by the planetary boundaries framework (Richardson et al., 2023), and to restore the balance of the cycle. Steps have already been taken EU-wise, and also in the Netherlands to mitigate the crisis through policies and regulations. This caused distress in many groups of society, especially among farmers.

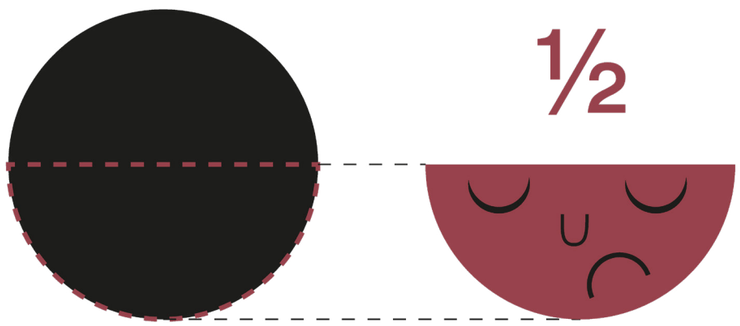
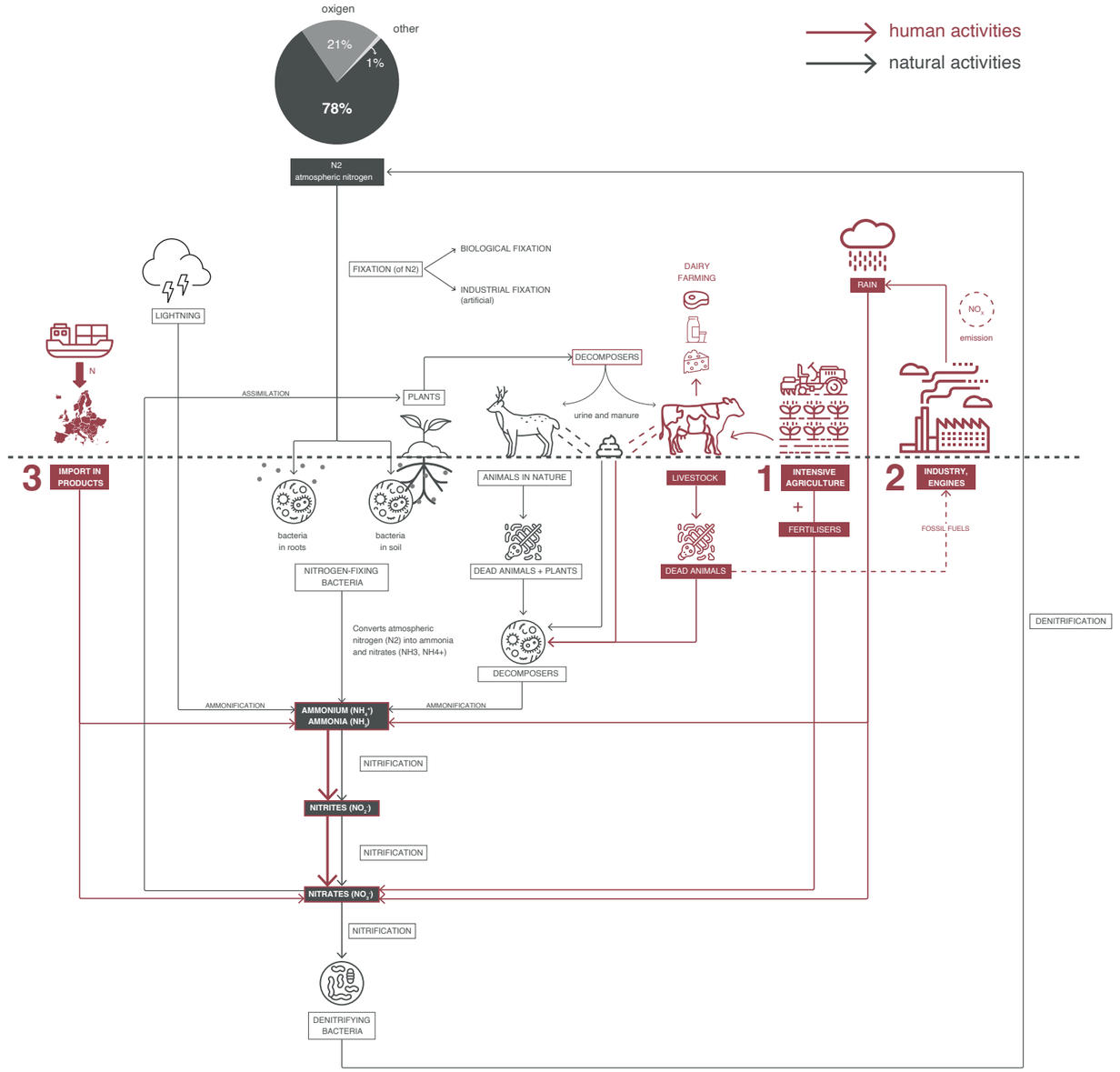


Figure 2: Human share in the nitrogen crisis

Figure 3: The disrupted nitrogen cycle

EU MAIN CAUSES OF NITROGEN SURPLUS:

1. **FERTILISER PRODUCTION**
   14 million tonnes of N / year
2. **FOSSIL FUEL COMBUSTION + OTHER INDUSTRIES**
   3,3 million tonnes of N / year
3. **IMPORT OF NITROGEN IN VARIOUS PRODUCTS**
   7,6 million tonnes of N / year

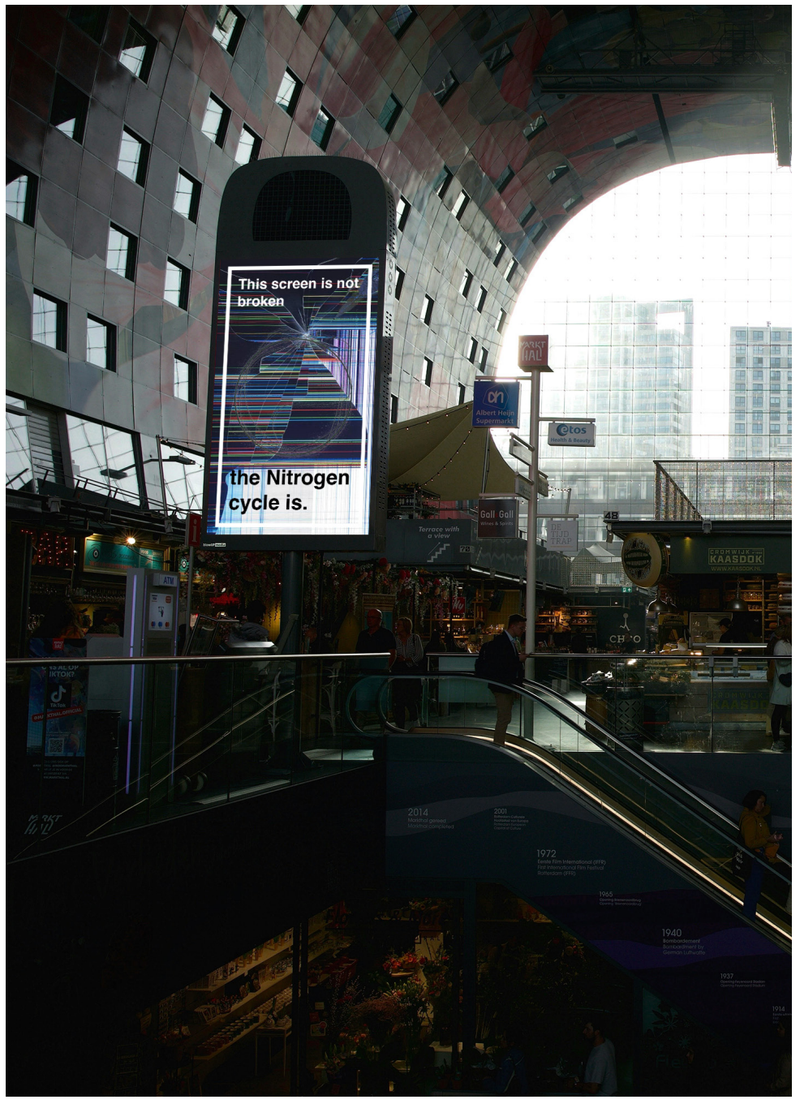


Awareness campaign

Our focus centres on addressing the critical issue of reducing nitrogen emissions to re-balance the nitrogen cycle and prevent further environmental damage caused by the nitrogen surplus. Recognising the urgency and significance of this issue, as well as to bring it closer to the people, we designed a bold information campaign to raise attention in public spaces. It's essential to note that this campaign is just the beginning; later initiatives will provide more comprehensive information, including details on products, to inform consumers about their choices and their impact on nitrogen emissions.

The main purpose of this campaign is to make the issue of the nitrogen crisis visible and prominent for the society, which is currently not a well known topic like CO2 for example. Similar to the impactful warning signs found on cigarette packages, our campaign seeks to grab attention and provoke thought on the consequences of unchecked nitrogen emissions. By prominently displaying our campaign on billboards on the Rijksmuseum in Amsterdam, or in the famous Markthal in Rotterdam, we aim to engage and educate the public, encouraging them to consider their collective impact on the environment. Through bold visuals and compelling messaging, we hope to spark conversations, inspire action, and drive positive change towards a more sustainable future.

Figure 4: Billboards



History timeline

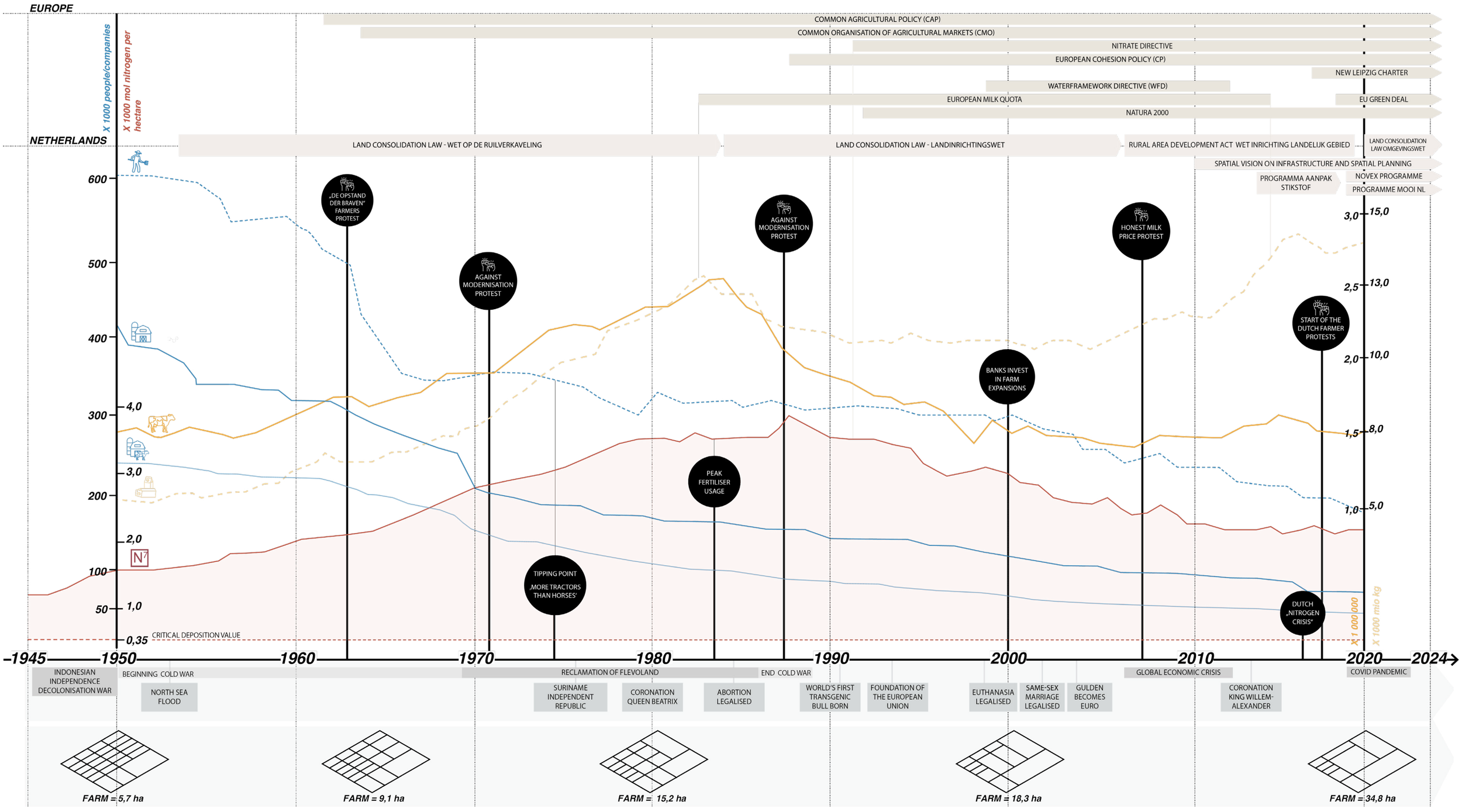


Figure 5: History timeline

History timeline

To be able to create a viable future, we first have to look at the past. Figure 5 shows the interrelation of policies, nitrogen and farming in a time period between 1950 and 2024. Certain connections can be made between policy making, historical events and the modernisation of farming. For instance, during the European “milk quota”, a drop can be seen in the production of milk (European Commision, 2015). After the regulations were dropped, the production increased until the Dutch government introduced the policy “Programma Stikstof aanpak” (Ministerie van waterstaten en infrastructuur, 2017).

In the late 1980’s, Dutch nitrogen deposition was at its peak (Clo, 2019; Shellenberger, 2022). One of the reasons for this is the use of fertilisers, which climaxed during the mid 1980’s (Bieleman, 2008). In the same time period, the European Union started introducing policies like the “Nitrate Directive” and the “European Cohesion Policy (European Commision, 2023; Department of Public Expenditure and Reform, 2020). From this point on the nitrogen deposition started to slowly decrease.

After the second world war, the Dutch government had to rebuild its country. In order to expand the economy of agriculture, the policy “Land consolidation law” (Wet op de Ruilverkaveling) was introduced to give farmers the opportunity to expand their parcels by trading with neighbouring farmers (Ministerie van Waterschappen en infrastructuur, 2024). Since then, the average parcel of a farmer has been growing (Centraal Bureau voor de Statistiek, 2017a). Due to modernisation, land tradings and investments of the farmerbanks like the Rabobank, the 1950’s farm from the 1950’s is no longer comparable to the high efficiency of the farms of today. A farmer nowadays owns almost 6 times more hectares of farmland compared to the 1950’s. They also produce 2,5 times more milk a year with the same amount of cows (Centraal Bureau voor de Statistiek, 2017b). This was made possible because of better milk techniques, better equipment and the introduction of the American Holstein cow during the 1980’s (Bieleman, 2008). As times have changed, so has the agricultural labourforce, since compared to 1950, only 1 in 6 famer works in the agricultural sector. The amount of agricultural companies has decreased by 4 times compared to seventy years ago (Centraal Bureau voor de Statistiek, 2023).

There has been an increased number of farmer protests since the beginning of 2019, where farmers have been protesting for better rights, higher incomes and more job opportunities (NPO Radio 1, 2022).

Figure 6: Grazing cows

Values and Sustainable Development Goals

The overall goal of our project is to recalibrate the disrupted nitrogen cycle by completely transforming the dairy farming industry in North-Western Europe. Subsequently, this transition should lead to a more viable agricultural economic model and aim for environmental sustainability and biodiversity preservation, while also simultaneously focusing on how to make this transition socially just for all the directly involved parties. These are summarised at figure 7 as the main values of our project.

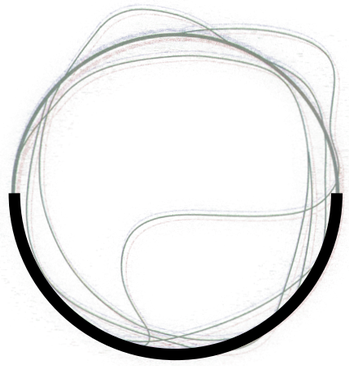
These values are aligned with the already existing Sustainable Development Goals (SDG's), which were developed and adopted by the United Nations in 2015, as part of the 2030 Agenda of Sustainable Development (United Nations, 2024). The main SDGs addressed in our work are no. 8 "Decent Work and Economic Growth", no. 15 "Life on Land" and no. 12 "Responsible Consumption and Production".

"Decent Work and Economic Growth" strives for sustained economic and production growth while ensuring decent employment. This ties to our aim of the Netherlands remaining competitive in the global dairy market while following more sustainable practices. Other goals related to these objectives are goal no. 9 "Industry, Innovation and Infrastructure" which promotes technological innovation and alternative approaches to industrialisation, as well as goal no. 10 "Reduced inequalities". Our project aims for the simultaneous de-industrialisation and concentration of the dairy industry in order to bridge the economic disparity gap between the East and West of the Netherlands, as well as regulate the dairy products' import and export relations with the neighbouring countries.

"Life on Land" focuses on restoring existing ecosystems, as well as preventing biodiversity loss, which is also closely related to our project's objectives of preserving existing natural habitats and unifying them into one complete network under protection status. Goal no. 13 "Climate Action" which stresses the importance of combating climate change is also part of our general objectives since our aim is to reduce the harmful nitrogen emissions in order to enhance biodiversity and consequently ensure planetary health.

"Responsible Consumption and Production" is more geared towards the socially just transition part of our project since it implies the behavioural shift needed to embrace the ethical production and consumption not only of dairy products but also of alternatives. Goal no.2 "Zero Hunger" also plays a significant role as it promotes sustainable agriculture practices and ensures food security for all. However, it is important that these goals also function in tandem with the SDGs for economic viability, guaranteeing a fair transition for the people working in the agricultural – and specifically dairy – sector.

Other SDGs that are touched upon but are not the focus of our project are goal no. 1 "No Poverty", goal no. 11 "Sustainable Cities and Communities", and finally goal no. 17 "Partnership for the Goals".



Recalibrating the Nitrogen Cycle

Transitioning Dairy Farming

Economic Viability

Environmental Sustainability

Socially Just Transition

Figure 7: Values and goals

Figure 8: SDGs addressed

2
Methodology

Methodology framework (Roadmap)

This roadmap illustrates how our project developed throughout the quarter, connected to the methods that were used. An important aspect to mention is the multi-scalar nature of our study, which served as a guideline to build our narrative. The practice of hand-drawing is highlighted, as this was a crucial element of the way we internalised and understood complex spatial and social situations. The switch from white to black symbolises the change from analysis to vision and strategy, visually representing the line between now and then, reality and utopia. The starting point of the project was the 'National Rural Area Program' parliamentary letter (2022), which we reevaluated and used as the base of our experiment.

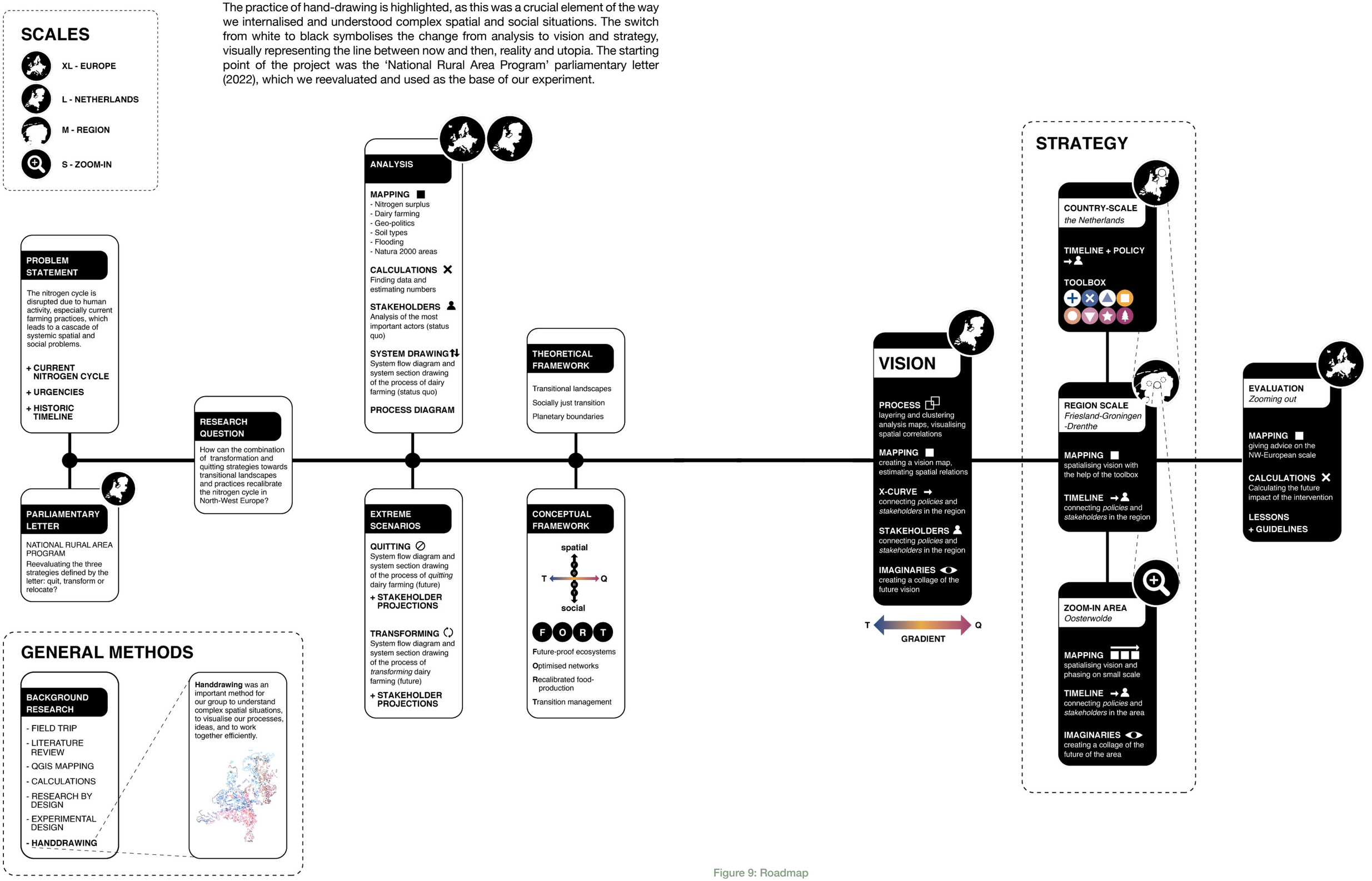


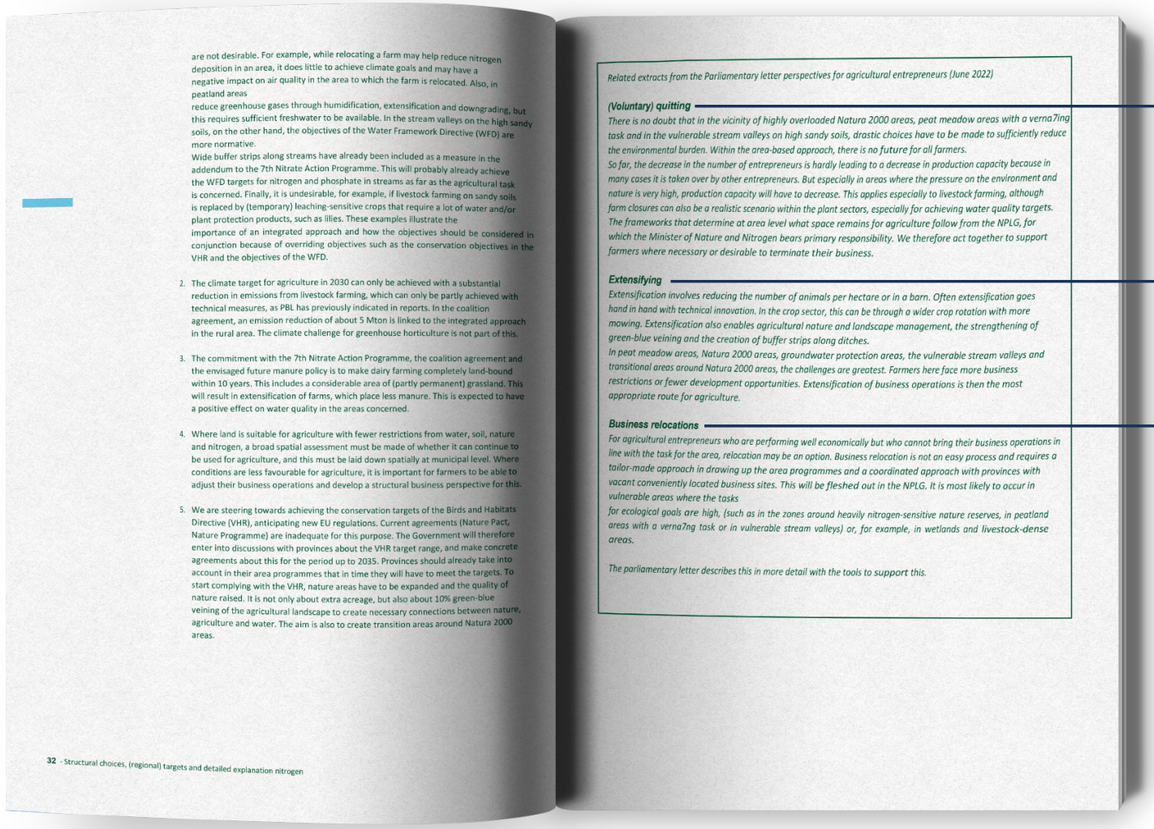
Figure 9: Roadmap

Parliamentary Letter

According to the Ministry of Agriculture, Nature and Food Quality, Ministry of Infrastructure and Water Management, and Ministry of the Interior and Kingdom Relations (2022), the initial memorandum NPLG initiates the development of key nature objectives (including addressing nitrogen concerns), water management, and climate initiatives at the regional level, while also considering their interplay with agriculture. These serve as the foundation for the comprehensive provincial area programs. Furthermore, the memorandum outlines the initial spatial implications of these objectives and structural decisions. As an EU member state, there is a legal obligation in The Netherlands to act in accordance with these goals. However, achieving these objectives fundamentally revolves around creating a sustainable framework that benefits the well-being of communities, businesses, and the environment. Additionally, these goals are closely intertwined with other responsibilities and interests within the rural landscape.

The main negative effects of nitrogen surplus are: less variety of plants in terrestrial areas and excessive growth of algae in water bodies, causing oxygen-deprived 'dead zones' due to nitrogen-induced eutrophication and acidification, and health issues for people due to higher levels of nitrogen dioxide, ozone from nitrogen oxides, and particulate matter caused by nitrogen (de Vries, 2021).

Efforts towards the nitrogen approach within the National Rural Area Programme (NPLG) have been supported by the use of a detailed map commissioned by the national government, which provides a spatial framework for elaborating regional nitrogen targets (Ministry of Agriculture, Nature and Food Quality, Ministry of Infrastructure and Water Management, & Ministry of the Interior and Kingdom Relations, 2022).



are not desirable. For example, while relocating a farm may help reduce nitrogen deposition in an area, it does little to achieve climate goals and may have a negative impact on air quality in the area to which the farm is relocated. Also, in peatland areas
reduce greenhouse gases through humidification, extensification and downgrading, but this requires sufficient freshwater to be available. In the stream valleys on the high sandy soils, on the other hand, the objectives of the Water Framework Directive (WFD) are more normative.
Wide buffer strips along streams have already been included as a measure in the addendum to the 7th Nitrate Action Programme. This will probably already achieve the WFD targets for nitrogen and phosphate in streams as far as the agricultural task is concerned. Finally, it is undesirable, for example, if livestock farming on sandy soils is replaced by (temporary) leaching-sensitive crops that require a lot of water and/or plant protection products, such as lilies. These examples illustrate the importance of an integrated approach and how the objectives should be considered in conjunction because of overriding objectives such as the conservation objectives in the VHR and the objectives of the WFD.

2. The climate target for agriculture in 2030 can only be achieved with a substantial reduction in emissions from livestock farming, which can only be partly achieved with technical measures, as PBL has previously indicated in reports. In the coalition agreement, an emission reduction of about 5 Mton is linked to the integrated approach in the rural area. The climate challenge for greenhouse horticulture is not part of this.

3. The commitment with the 7th Nitrate Action Programme, the coalition agreement and the envisaged future manure policy is to make dairy farming completely land-bound within 10 years. This includes a considerable area of (partly permanent) grassland. This will result in extensification of farms, which place less manure. This is expected to have a positive effect on water quality in the areas concerned.

4. Where land is suitable for agriculture with fewer restrictions from water, soil, nature and nitrogen, a broad spatial assessment must be made of whether it can continue to be used for agriculture, and this must be laid down spatially at municipal level. Where conditions are less favourable for agriculture, it is important for farmers to be able to adjust their business operations and develop a structural business perspective for this.

5. We are steering towards achieving the conservation targets of the Birds and Habitats Directive (VHR), anticipating new EU regulations. Current agreements (Nature Pact, Nature Programme) are inadequate for this purpose. The Government will therefore enter into discussions with provinces about the VHR target range, and make concrete agreements about this for the period up to 2035. Provinces should already take into account in their area programmes that in time they will have to meet the targets. To start complying with the VHR, nature areas have to be expanded and the quality of nature raised. It is not only about extra acreage, but also about 10% green-blue veining of the agricultural landscape to create necessary connections between nature, agriculture and water. The aim is also to create transition areas around Natura 2000 areas.

32 · Structural choices, (regional) targets and detailed explanation nitrogen

Related extracts from the Parliamentary letter perspectives for agricultural entrepreneurs (June 2022)

(Voluntary) quitting
There is no doubt that in the vicinity of highly overloaded Natura 2000 areas, peat meadow areas with a verna7ing task and in the vulnerable stream valleys on high sandy soils, drastic choices have to be made to sufficiently reduce the environmental burden. Within the area-based approach, there is no future for all farmers.
So far, the decrease in the number of entrepreneurs is hardly leading to a decrease in production capacity because in many cases it is taken over by other entrepreneurs. But especially in areas where the pressure on the environment and nature is very high, production capacity will have to decrease. This applies especially to livestock farming, although farm closures can also be a realistic scenario within the plant sectors, especially for achieving water quality targets. The frameworks that determine at area level what space remains for agriculture follow from the NPLG, for which the Minister of Nature and Nitrogen bears primary responsibility. We therefore act together to support farmers where necessary or desirable to terminate their business.

Extensifying
Extensification involves reducing the number of animals per hectare or in a barn. Often extensification goes hand in hand with technical innovation. In the crop sector, this can be through a wider crop rotation with more mowing. Extensification also enables agricultural nature and landscape management, the strengthening of green-blue veining and the creation of buffer strips along ditches.
In peat meadow areas, Natura 2000 areas, groundwater protection areas, the vulnerable stream valleys and transitional areas around Natura 2000 areas, the challenges are greatest. Farmers here face more business restrictions or fewer development opportunities. Extensification of business operations is then the most appropriate route for agriculture.

Business relocations
For agricultural entrepreneurs who are performing well economically but who cannot bring their business operations in line with the task for the area, relocation may be an option. Business relocation is not an easy process and requires a tailor-made approach in drawing up the area programmes and a coordinated approach with provinces with vacant conveniently located business sites. This will be fleshed out in the NPLG. It is most likely to occur in vulnerable areas where the tasks
for ecological goals are high, (such as in the zones around heavily nitrogen-sensitive nature reserves, in peatland areas with a verna7ng task or in vulnerable stream valleys) or, for example, in wetlands and livestock-dense areas.

The parliamentary letter describes this in more detail with the tools to support this.

Figure 10:
Parliamentary letter

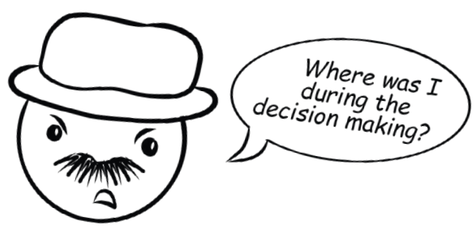
As outlined in the 2022 report by the Ministry of Agriculture, Nature and Food Quality, Ministry of Infrastructure and Water Management, and Ministry of the Interior and Kingdom Relations (p. 33), a parliamentary letter describing perspectives for agricultural entrepreneurs was released concurrently with the NPLG memorandum on June 10th, 2022. This letter describes strategies for addressing environmental burdens in areas surrounding Natura 2000 sites, peat meadows with ecological tasks, and vulnerable stream valleys on high sandy soils. It acknowledges that within an area-based approach, not all farmers will have a viable future, particularly in regions facing significant pressure on the environment and nature. The comprehensive approach outlined introduces three key strategies: **quitting** farming operations, implementing **transformation** measures to reduce environmental impacts, and facilitating business **relocations** for farms unable to meet area-specific tasks.

In the upcoming chapters of our project, we decided to continue working with the two strategies of **transformation** and **quitting**, and defined them as starting points of our narrative. This can be explained by the fact that for us, the option of relocation is already included when talking about transformation. In the event of a possible relocation of a farm, technical adaptation and adjustment must also take place at a new location to meet the requirements of the guidelines. Therefore, in our view, this strategy can be integrated into the category of **"transformation"**.

Quitting

Transforming

Relocating



Research question and sub-questions

How can the ***combination*** of **transformation and quitting** strategies towards **transitional landscapes and practices** recalibrate the **nitrogen cycle** in N-W Europe?

What **overall hotspots** of nitrogen surplus and the dairy industry can be found, while also considering the flood risk and existing protected natural areas? How do they differ in character, and - therefore - **management**?

In which areas do we **quit** and in which areas do we **transform** cow farming and with what criteria? Is there an overlap, and if so, how is that **transition** handled?

Which involved parties are **affected** the most in each case? How do we ensure that the transition is **socially just?**

How can this transition be put into **practice** in a specific **spatial context?** What lessons can be learned in order to be implemented at a **European level?**

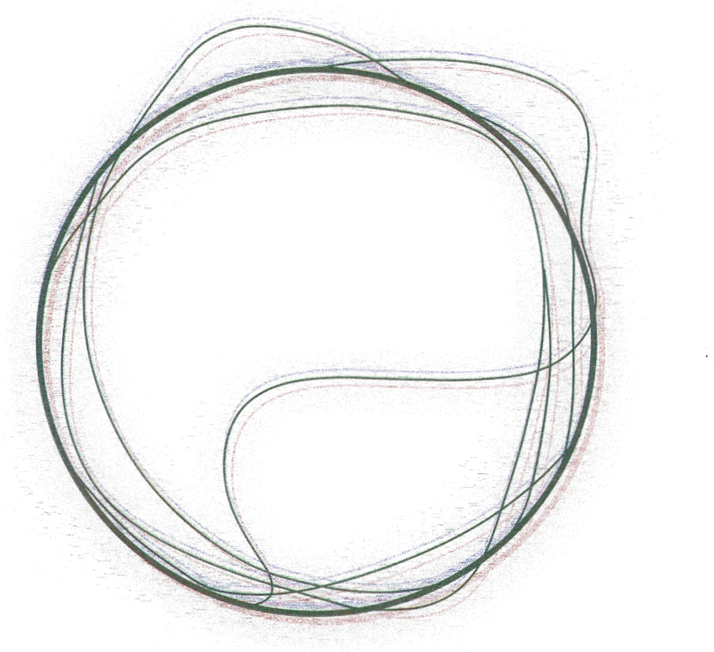


Figure 11: Disrupted nitrogen cycle

3
Analysis

Figure 12: Soil types

Figure 13: Flood risk

Figure 14: Natura 2000 areas

Soil

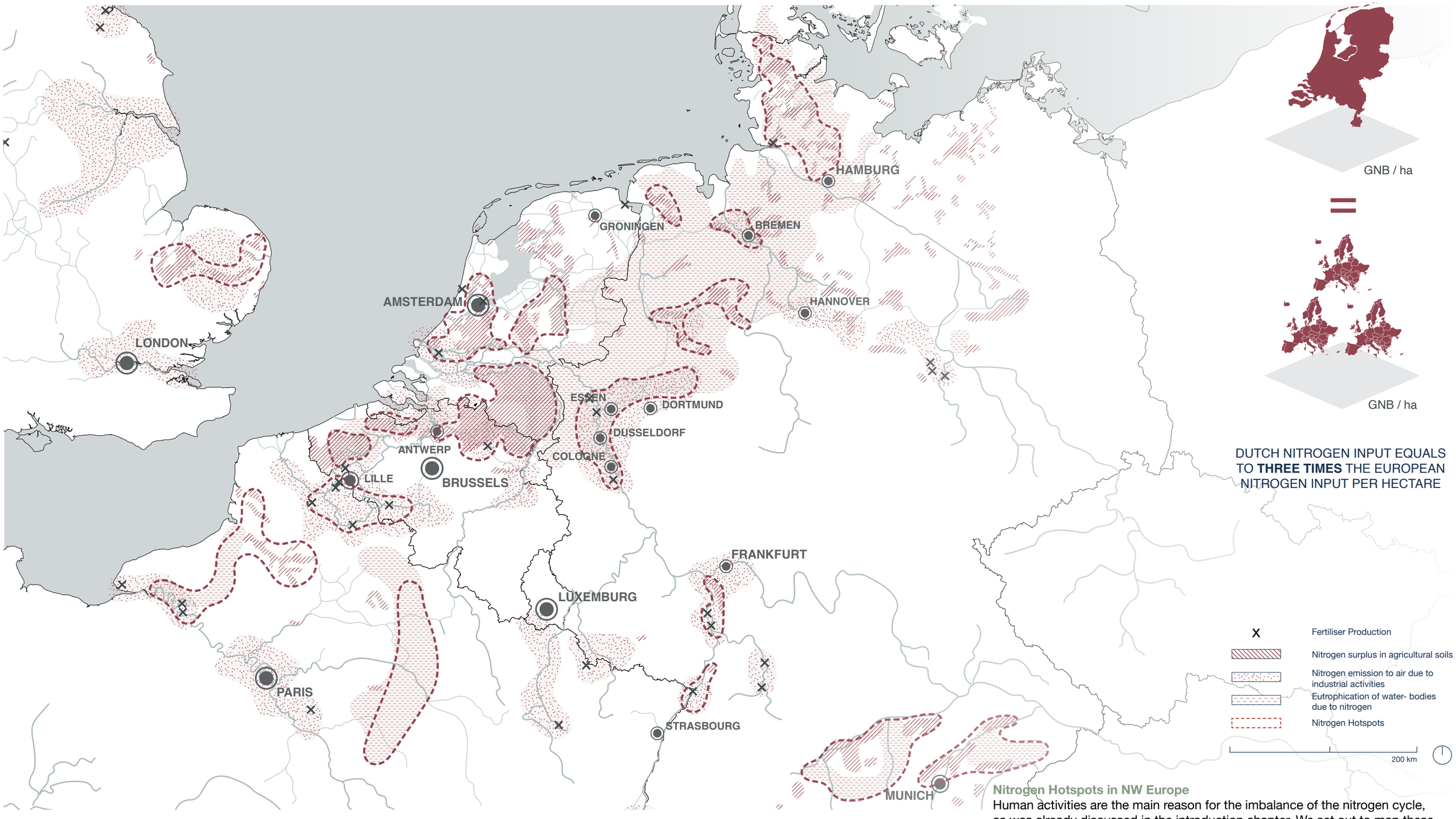
The Ministerie van Infrastructuur en Waterstaat (Ministry of Infrastructure and Water Management) released a document in 2022 about water and soil, how they should be an integral part of every project that is being planned or realised in the Netherlands, as they are the base of life in the country. To get familiar with the given conditions, we looked at multiple maps and articles, starting with soil. The four dominant soil types are clay, peat, sand and loess, all with their unique qualities that have to be considered during the project. To give an example, when grass is grown on peat for cattle grazing, the water is drained from the land so the peat is compressed, which leads to soil subsidence in the country, as well as emitting nutrients like ammonia to water and nature (Making peatland use more sustainable, n.d.).

Flood

26% of the Netherlands are situated under sea level (NAP). To survive, the Dutch had to constantly and precisely regulate their water-system throughout the centuries, using innovative technologies and multiple defence lines. However, from time to time floods devastated the land, both from the sea and the rivers (Hooimeijer et al., 2005). With the sea levels rising and the glaciers melting in the Alps, the flood probabilities have also become more threatening, leading to innovative plans from urban designers to save or sink parts of the country (for example the project Plan B: NL2200 by LOLA landscape architects).

Natura 2000

According to the document of Aandeel beschermde natuurgebieden in Nederland, 2022., the protected nature areas in the country amount to 20% of the land area. Almost half (9%) of these are legally protected Natura 2000 areas. For inland waters this percentage is 26%. As a result of the nitrogen crisis, natural areas are under significant threat from biodiversity loss, soil degradation and acidification (Aan de Burg, 2022). There are already existing policy documents trying to protect these areas from nitrogen-related emissions like the ‘National Rural Area Program’ parliamentary letter (2022), which suggests a buffer around these protected areas to mitigate the harmful effect of ammonia and other compounds.



What are the **causes** and **effects** of the disrupted nitrogen cycle, and where is the nitrogen surplus located?

Figure 15: Nitrogen hotspots in NW Europe

Figure 16: Dutch nitrogen input compared to European nitrogen input

Nitrogen Hotspots in NW Europe

Human activities are the main reason for the imbalance of the nitrogen cycle, as was already discussed in the introduction chapter. We set out to map these anthropogenic emissions with the overall goal to find hotspots of nitrogen surplus in North-West Europe.

Three basemaps related to nitrogen were used for this process. One described the concentrations of nitrogen and phosphorus in European agricultural soils (EEA, 2020), the second heatmap estimated nitrogen emission (NOx, N2O, NH3) to air due to industrial activities (EEA, 2023), while the third located the exceedance of atmospheric nitrogen deposition above critical loads for eutrophication in Europe in 2021 (EEA, 2022). These layers were then overlaid, resulting in clusters showing critical nitrogen-hotspots, mostly in the Netherlands, Belgium, and the Northern provinces of Germany.

Nitrogen deposition in The Netherlands

Directing our focus to the Netherlands, the map on the right shows the highest amounts of nitrogen deposition in the country (RIVM, 2021). It is important to make a difference between places of emission and places of deposition. Ammonia (NH3) usually settles near its source, while nitrous oxides (NOx, N2O) can travel further through wind or water due to their more insoluble nature (Aan de Burg, 2022). This is problematic for natural areas, when they are in a close proximity to agricultural lands. The plants that are more nitrogen-dependent can overpopulate, leaving no space for species with less need for nutrient-rich soils. In the long run, it leads to soil acidification and biodiversity loss, threatening the integrity of existing ecosystems.
In the Netherlands the agricultural sector is responsible for 45% of the nitrogen deposition (Aan de Burg, 2022), so we decided to look at dairy farming as our focus topic. Out of the aforementioned 45 percent, one-third comes from the use of (mineral) fertilisers, while the other two thirds can be traced back to animal manure, 62% of which is related to cattle farming (Eurostat, 2017). This equation is illustrated by the diagram below (figure 17).

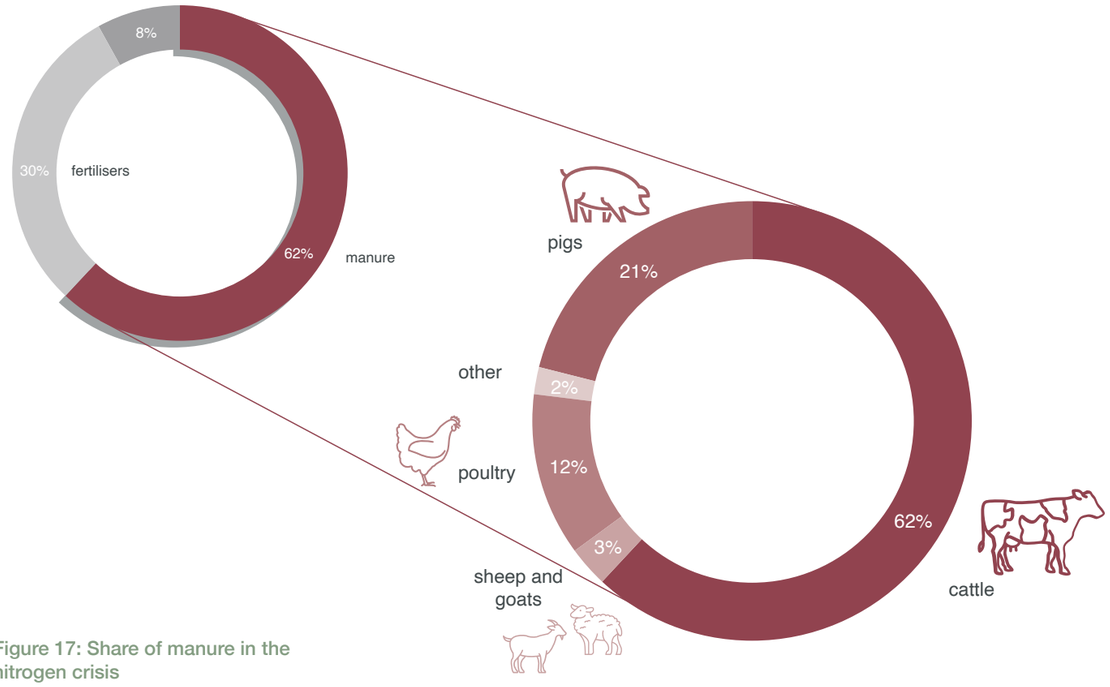


Figure 17: Share of manure in the nitrogen crisis

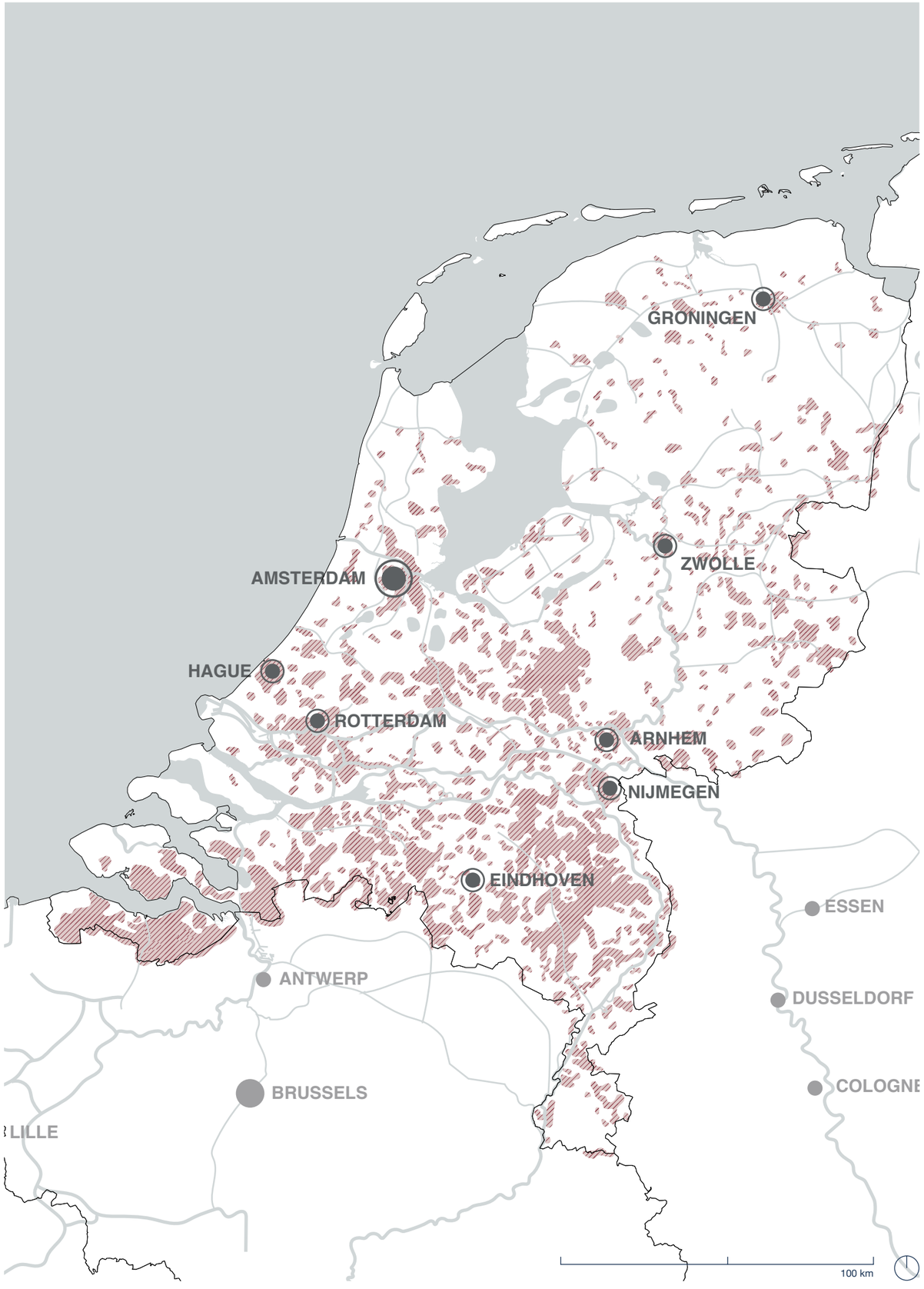
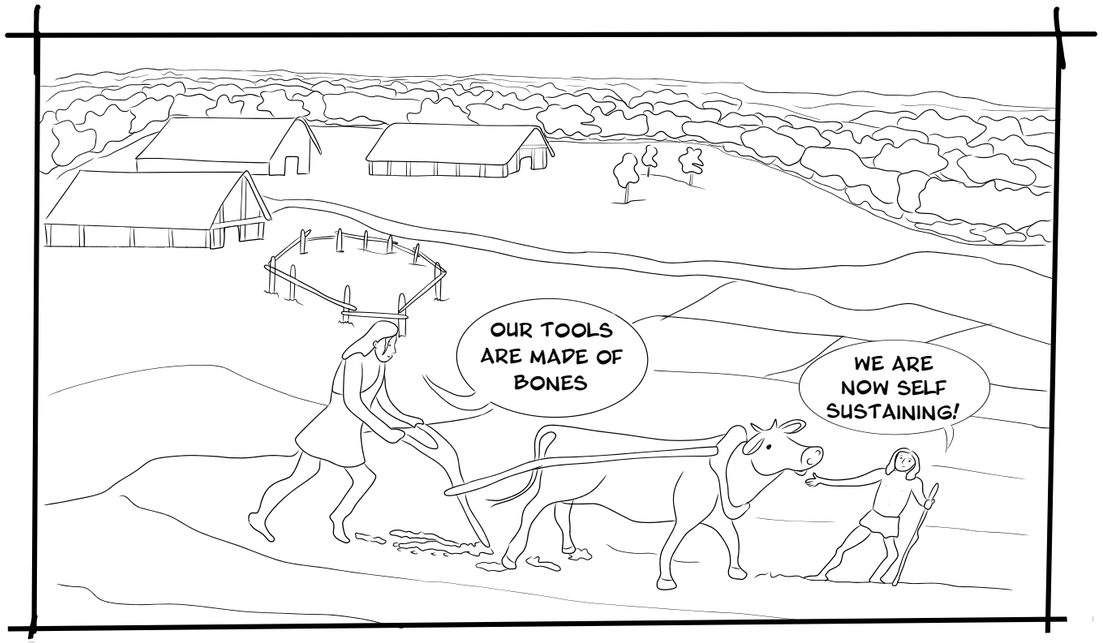
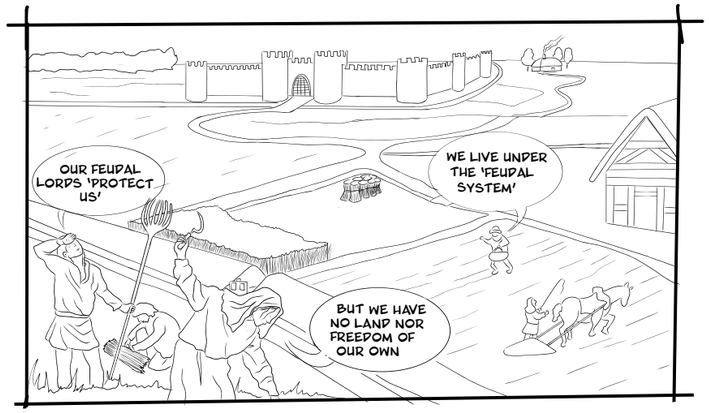


Figure 18: Nitrogen deposition in the Netherlands





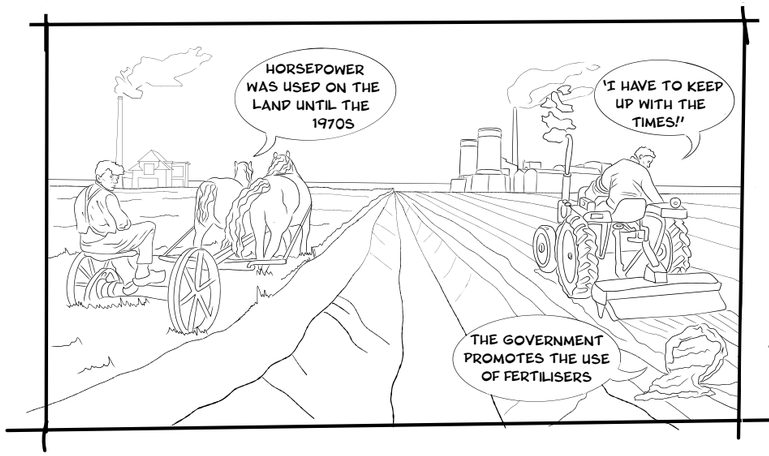
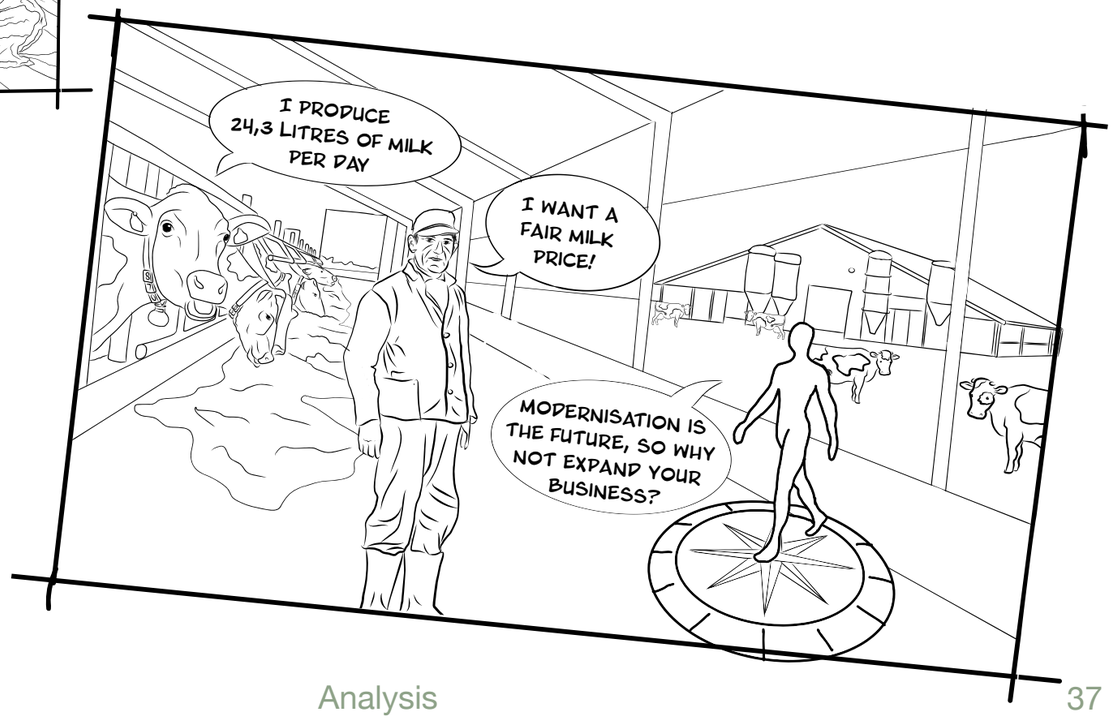


Figure 19: Farming through history



The farmer has always played an important role in our society. The practice appeared around 10.000 BCE, during the Great Neolithic Revolution. Due to the new technology and knowledge of farming, people started building permanent settlements (Gijn & Louwe, 2005). Compared to the rest of Europe, the Neolithic Revolution started later in the Netherlands. The first settlers arrived around 5300 BCE from Scandinavia. These people were known as the “Bandkeramiekers” or so called Linear Band Ware people. Their tools were often made from animal bones, and used to maintain the land (Gijn & Louwe, 2005). After the Neolithic Revolution came to an end, a new era started with the rise of cities and emperors, and the lifestyle of these mainly self-sustaining early farmers changed, as they started to produce in greater amounts and with new tools.

During the Middle Ages, most farmers of Europe lived under the feudal system, meaning that they were usually serfs who worked on the land of rich feudal lords. In return for labour on the land, these lords would provide security, food and shelter. However, this also meant that these serfs had no freedom of their own. It was only after a number of outbreaks of the plague that the peasants were given a greater say and more freedom to work the land (DBNL & Van Der Kieft, 1974).

Around 1500-1650, the Dutch landscape changed drastically and increasingly resembled the classic image of meadows and cows, as it is today. Thanks to the new technique of reclamation, the swampy marshlands could be drained for arable farming and pastures. Because of the polders system, more and more farmers were able to own pieces of land. With the growing demand from the ever-expanding cities, some farmers began to specialise in cattle and horse breeding (Kromhout, 2023).

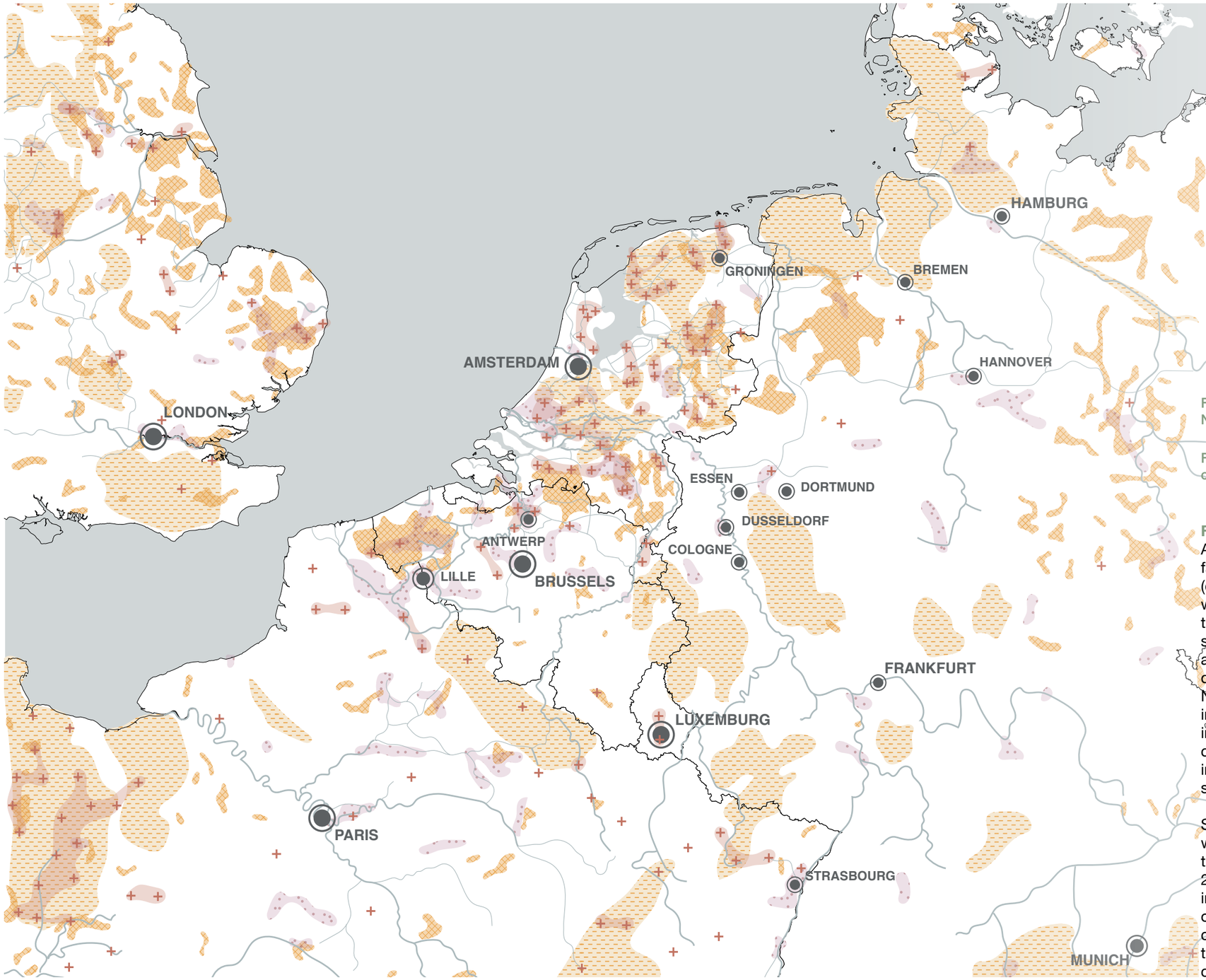
A completely new era started around 1850 with the Industrial Revolution. New technologies such as the steam engine and the steamboat enabled Dutch farmers to export products like cheese, meat and livestock to the rest of Europe. This open agricultural economy had a downside: thanks to the steamboat, American farmers could compete with European farmers for grain, and Dutch dairy farmers also suffered an economic setback due to the introduction of margarine (Kromhout, 2023). As a result of this European agricultural crisis and ‘New World’ marketing, more people moved to the United States. Most of the emigrants came from the western part of the Netherlands. Between 1870 and World War I, more than 138,000 Dutch emigrated, which was 0.7% of the total population (Visser, 2019). To help farmers, the Dutch government set up ‘agricultural committees’. They went from village to village to provide education on the use of fertilisers and increasing crop production (Kromhout, 2023).

In the 20th century, there were several agricultural crises. In general, Dutch farmers often depended on income from exports, where the government tried to help with implementing regulations, investments and subsidies. These governmental interventions sometimes lead to protests. When Flevoland was completed around the 1960s, Dutch agriculture began to grow again on a large scale (Kromhout, 2023). Farms became more modern thanks to the Industrial Revolution and new technologies such as fertilisers and tractors. The Land Consolidation Act also contributed to the expansion and intensification of farms (Ministry of the Interior and Kingdom Relations, 2006). By 1965, there were as many tractors as horses on farms. At the same time, the number of employed farmers decreased due to modernisation, as well as the number of farms. On the contrary, the number of hectares per farm has increased (Bieleman, 2008).

In 2000, many farmers were encouraged to further expand their farmland and production. Rabobank, in particular, has granted many loans for farm expansion over the past 20 years (Joosten, 2022). The amount of milk produced per cow has risen significantly due to concentrated feed, better milking machines and a new breed of cow, the American Holstein (Bieleman, 2008). In 1910, for example, a cow produced 6.8 litres of milk per day; today it produces more than 24.3 litres per day (CBS, 2023). Because of high investment costs and production and competition from abroad, farmers earn less and less per litre of milk. This led, among other things, to a large protest for fairer milk prices in 2008 (van Es, 2010).

The comic shows that farmers are used to moving with and adapting to the climate. As our society continues to grow and climate change demands more action, we should not only ask ourselves, as the socialists did in the 19th century, “What is the farmer’s place in society?”(Kromhout, 2023), but also what does society mean to the farmer?

Figure 20: Agricultural landscape



Where is the **industry** associated with cow farming located, and what effect does it have on the Dutch and global **economy**?

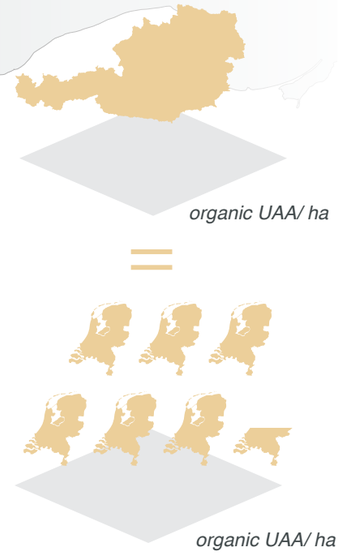


Figure 21: Farming industry hotspots in NW Europe

Figure 22: Share of organic farmland comparison

AUSTRIA'S SHARE OF UTILISED AGRICULTURAL AREA IS 6.5 TIMES THE ONE OF THE NETHERLANDS

Farming industry hotspots in NW Europe

After highlighting the nitrogen hotspots and looking at the historical process of farming, the next step was to investigate where the industry associated with (dairy) farming is located in North-Western Europe. For that, four basic layers were used. One was the pastureland from the Corine Land Cover (CLC, 2018), the second was the animal farms (EEA, 2023 and OpenStreetMap, 2023), the slaughterhouses (EEA, 2023 and OpenStreetMap, 2023) as well as the treatment and processing industry (EEA, 2023 and Zuivel NL, 2022). The conclusion drawn from this map is that farming industry hotspots are located mostly in the Netherlands, the North-Western provinces of Germany, the Normandy province in France as well as the southern and central United Kingdom. It is especially interesting to note that the "hotspots" in the Netherlands and Northern Germany could constitute one unified bigger cluster, also possessing the densest industry associated with farming (treatment and processing industries and slaughterhouses).

Specifically, the Netherlands – as commonly known – is a leading character within the global dairy industry (Zuivel NL, 2022). The Netherlands was within the 5 biggest leading exporters of milk and cheese worldwide in 2022 (Statista, 2023a+c). However, it is logical that the Netherlands was also in the top 3 leading importers of dairy products in 2021 (Statista, 2023b), since approximately 70% of dairy products manufactured in the Netherlands are then exported to other countries (Zuivel NL, 2022). It is also important to note that FrieslandCampina, the largest Dutch dairy company is also in the top 10 of the largest dairy companies globally with a turnover of 11.5 billion euro (Zuivel, 2022).

Nevertheless, for such a country so intensely fixated on agriculture and specifically dairy farming, it is disappointing to see the low percentage of organic farmland compared to that of other countries with competitive markets. For example, it is very interesting to note that Austria's percentage of organic farmland from the utilised agricultural area (UAA) is 6.5 times the one of the Netherlands, as shown in figure 21 below (Statistics Netherlands, 2022). For context, Austria is the pioneer in organic farming in the EU, while the Netherlands is unfortunately located just 6 spots from the bottom of the list showcasing the share of utilised agricultural area (UAA) occupied by organic farming in the EU member states (Statistics Netherlands, 2022). member states (Statistics Netherlands, 2022).

Dairy farming in The Netherlands

The map on the right (figure 23) shows again a more zoomed-in and precise version of the European map, focusing now on the Dutch scale. One of our first observations was that the pastureland, which is roughly one fourth of the surface of the Netherlands (Zuivel, 2022), is mostly focused on the Northern provinces of the country such as Friesland and Overijssel, while the associated industry interspersed across the whole country, with the exception of the heavy industry such as the slaughterhouses which is located closer to major cities such as Rotterdam, the Hague and Eindhoven. Specifically, there are 54 dairy plants in the Netherlands, belonging to 26 companies in total, with the leading one being FrieslandCampina with 19 plants mostly located in the province of Friesland (Zuivel NL, 2022). This map creates an interesting base for it to be overlayed with the nitrogen and the other basemap layers.

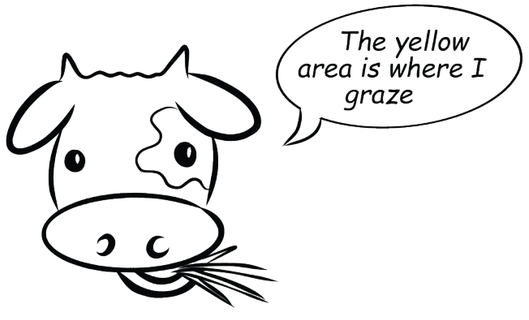
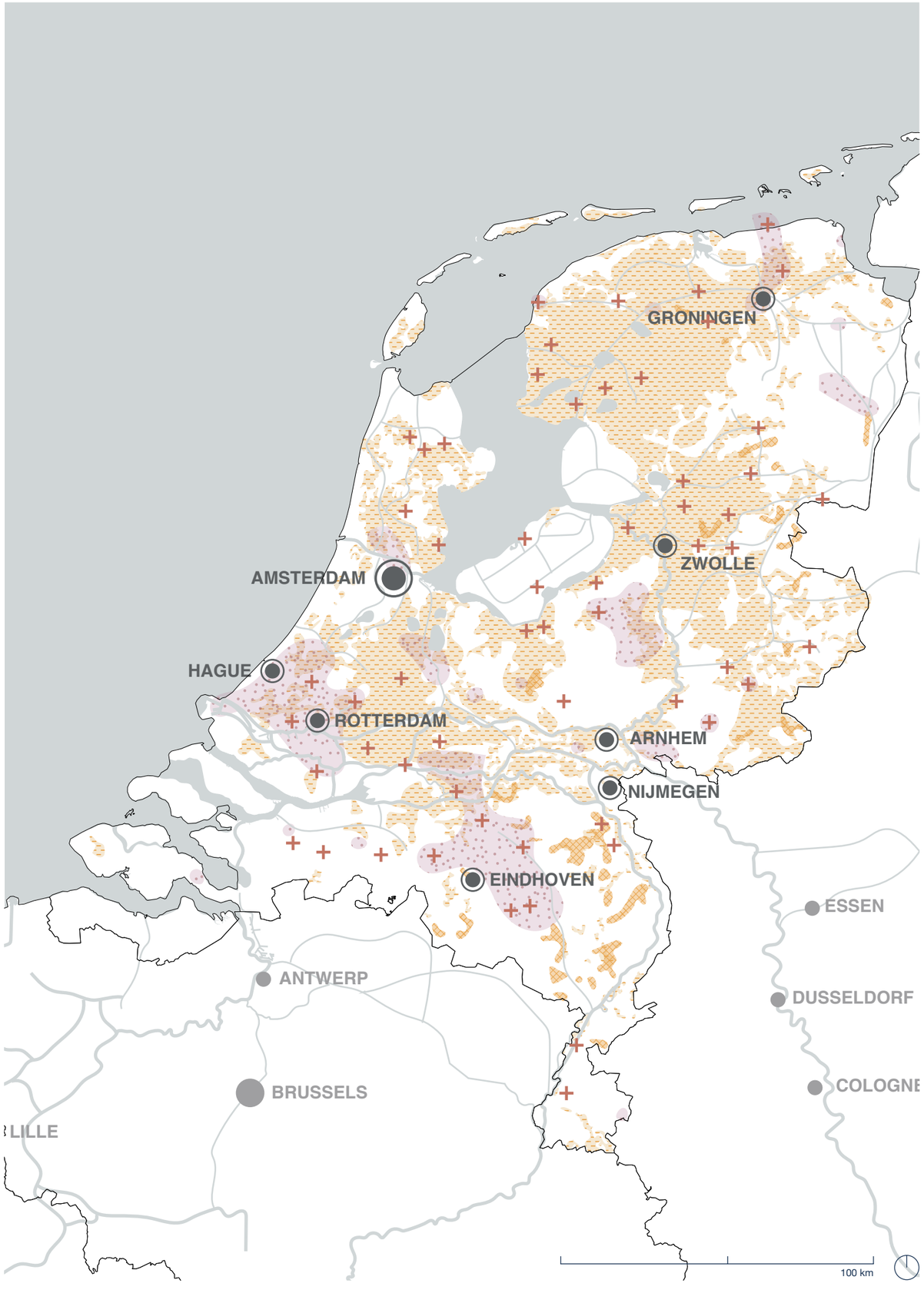


Figure 23: Dairy farming industry in the Netherlands



Organic farmland and labourforce by province

As of 2022, the dairy industry provided 46.000 full-time jobs (Zuivel NL, 2022). However, in the last years and, especially after the nitrogen crisis of 2019, the dairy industry is only getting smaller and smaller with 3% of the farms shutting down each year (Zuivel NL, 2022). It is interesting for us to study the percentages of people working in dairy farming within the agricultural sector per province, compared to the size of the agricultural sector itself. Friesland, Drenthe and Overijssel along with Zeeland have the largest agricultural sectors, and it is also interesting to point out that the percentages of people occupied in dairy farming in these provinces except for Zeeland are also high. Friesland has the highest share, approximately 45%, while also Utrecht and Overijssel have significant percentages of 38% and 34% respectively.

This diagram also shows the share of agricultural land occupied by organic farming. In general, the percentages are low (below 5%) except for Flevoland which stands out with 12% of organic farmland compared to the total agricultural area. Even though these numbers are still not high, it is encouraging to observe that the number of organic farms has been steadily increasing in the last years, marking a positive transition (Statista, 2022b).

This shift is also observed in the increase of consumption of milk substitutes, yet the amount of dairy products still being consumed has remained stable, and even slightly increased (Statista, 2022a). 47% of the Dutch people asked in a survey in 2019 stated that they would not consciously not eat dairy products, which still highlights the need for a societal shift towards more alternative products (Statista, 2020).

Import-export

Agro and Food contributes almost 60 million euros to the Dutch economy, from which roughly 13% is the share of the dairy industry (Zuivel NL, 2022). It is also interesting to see in which countries the Netherlands exports meat and dairy products to and from where it imports the same products. In both cases Germany is the main export and import partner, followed by Belgium and France as well as other – mostly European – countries (The Observatory of Economic Complexity, n.d.). Consequently, when transitioning dairy farming in the Netherlands we should consider the spatial and financial implications of trade relationships between countries being imbalanced for some time.

Import

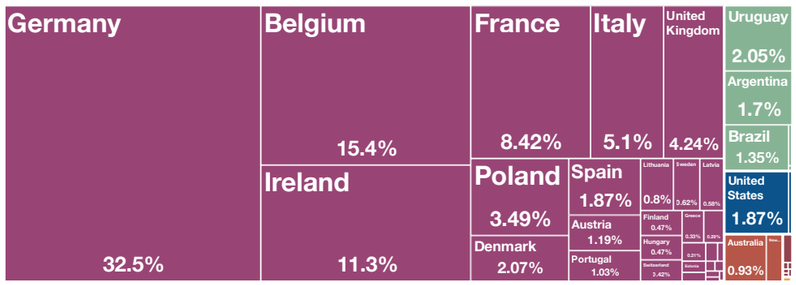


Figure 24: Dutch import of dairy products

Export

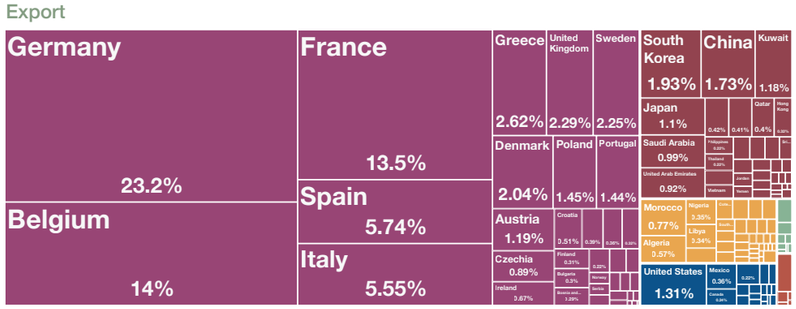


Figure 25: Dutch export of dairy products

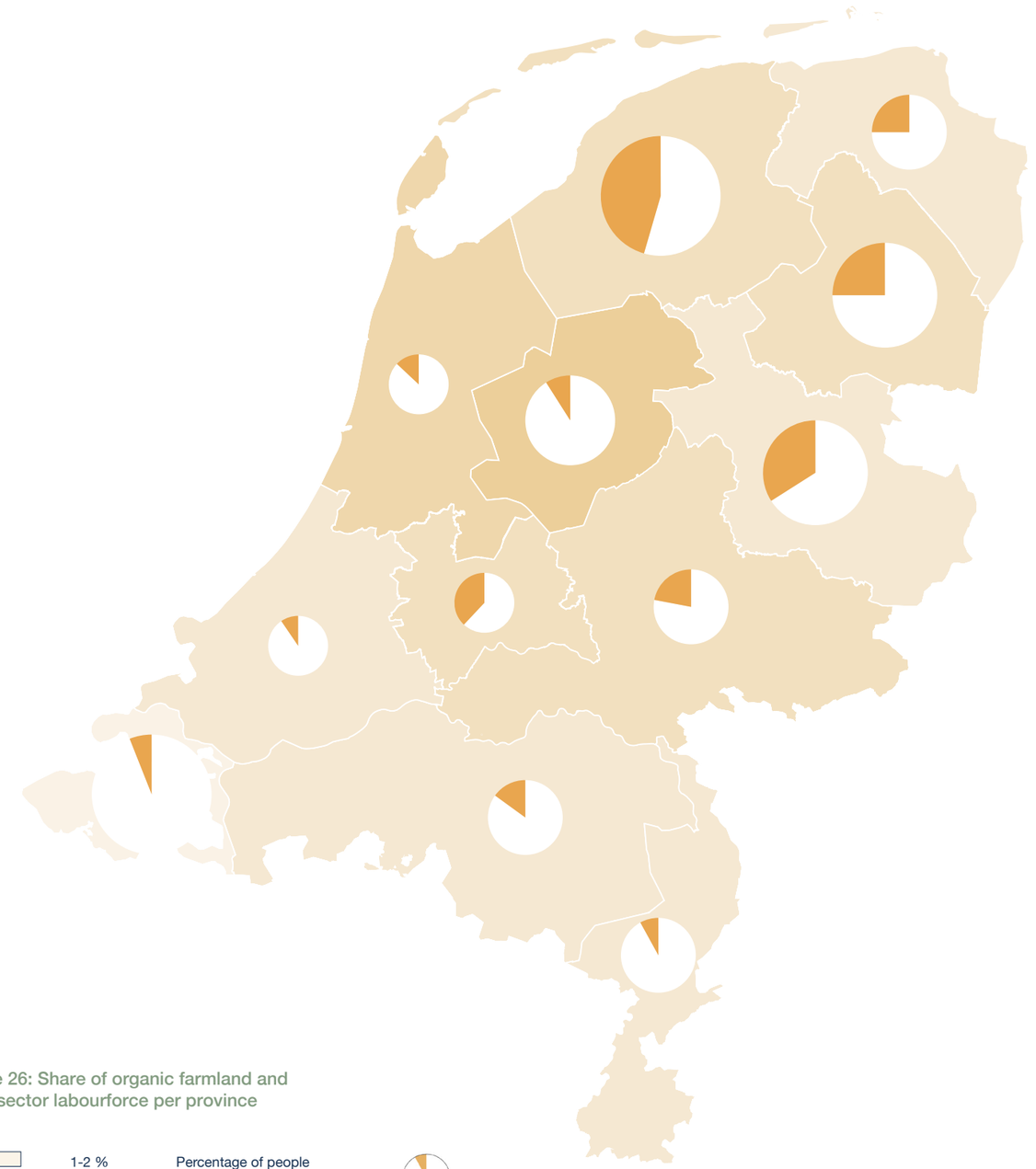
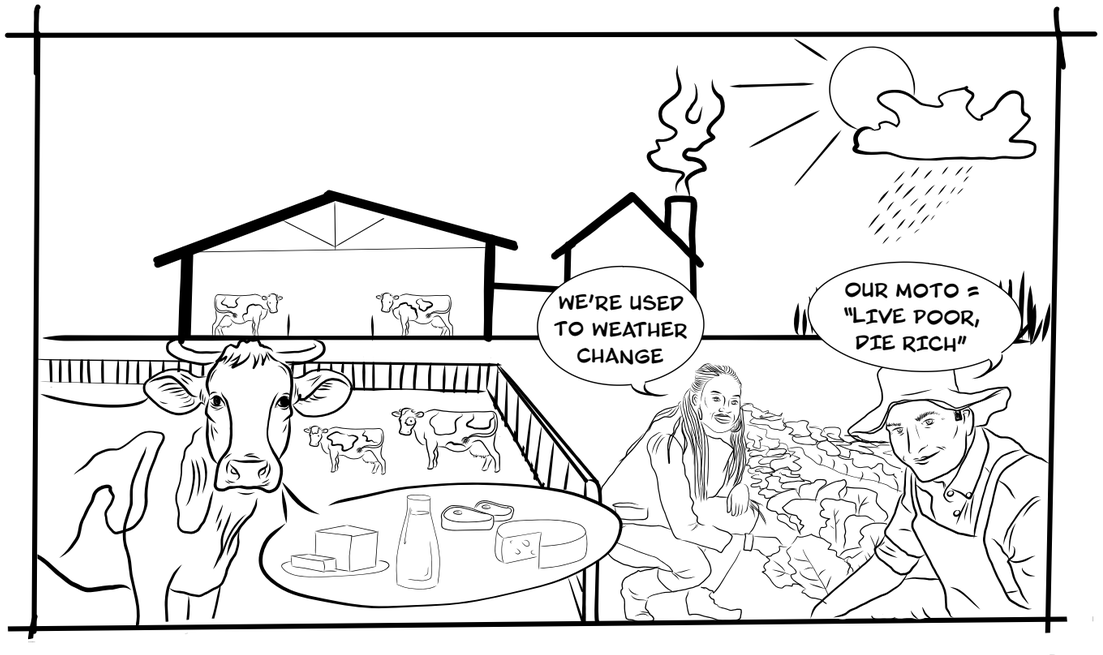
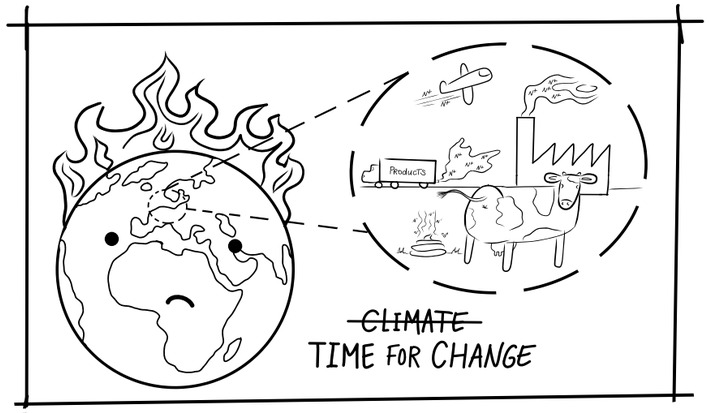


Figure 26: Share of organic farmland and dairy sector labourforce per province





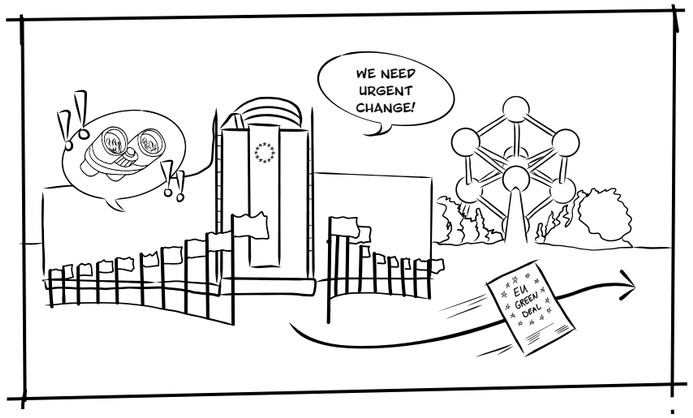
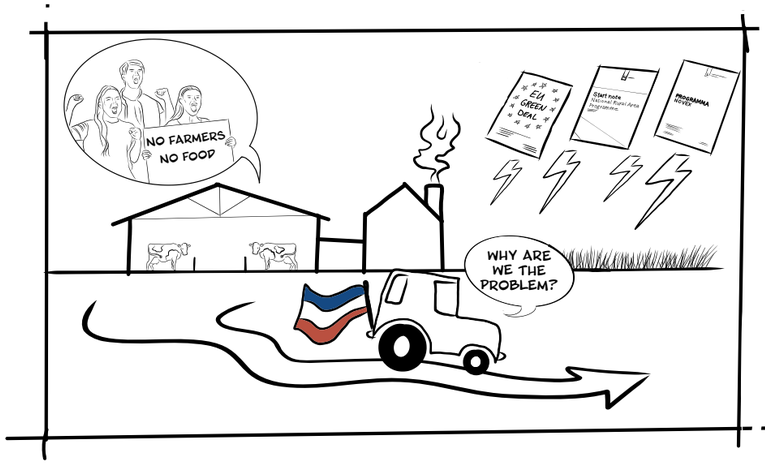


Figure 27: Why are the farmers angry?



What are the **consequences** of existing policies concerning nitrogen and agriculture activity, and how are they received by the directly affected groups?

Socio-geopolitics

Analysis

Socio-geopolitics

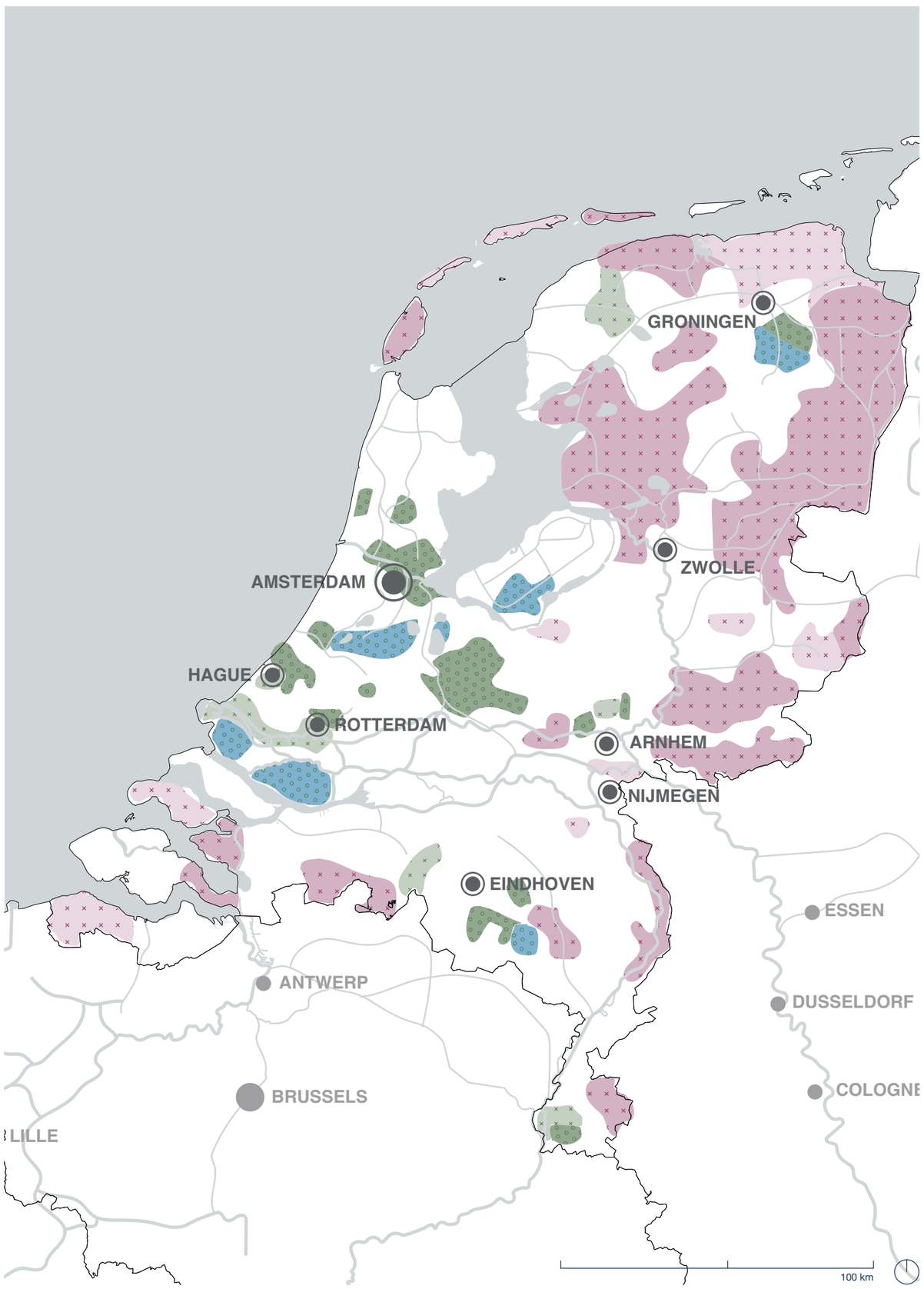
Figure 28 shows the conclusion of the socio-geopolitical layer of the 2023 local elections and the income differences per municipality, with the goal to show which regions are more open to change, and which are more conservative.

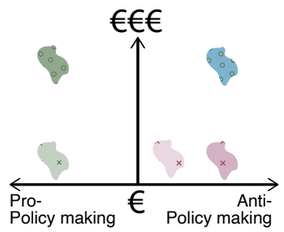
In the 2022 local elections, the largest political parties per province were: BBB (Boerenburger Beweging), VVD (Volkspartij voor Vrijheid en Democratie), CDA (Christen Democraten Appèl), GroenLinks, PVV (Partij voor de Vrijheid) and SGP (Staatkundig Gereformeerde Partij) (de Joode & Mouissie, 2023). The political party that was the largest party in most municipalities is the BBB. The BBB stands for the rights of the agricultural sector and the quality of life in the countryside. As a result of the new nitrogen reduction plans and policies of the government, the agricultural sector will have to fundamentally change to become a more sustainable sector. A consequence might be that even more people working in the sector are in danger of losing their jobs. Farmers in particular feel pressured by this new policy (Oudman, 2023).

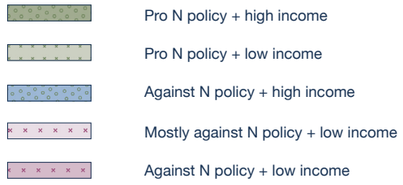
By looking at the political parties and their position on sustainability, it can be concluded which regions in the Netherlands are either opponents or proponents of sustainability policy. The parties that are more opposed to sustainability are the BBB, the PVV and the SGP (BBB, 2024; PVV, 2024 SGP, 2024), and the parties that are more likely to be supporters are the VVD, the CDA and GroenLinks (CDA 2024; GroenLinks 2024; VVD,2024). This combined with population density and income wealth per municipality paints a good picture of the current societal atmosphere. In the larger cities there are more people with higher income, while in the countryside the majority has a low income (Centraal Bureau voor de Statistiek, 2023). This makes these areas less resilient to economic change.

Unsurprisingly, in the west of the Netherlands, as well as at the Friesland, Groningen and Drenthe regions, the BBB was the most popular party per municipality, as this is a region of the Netherlands with a lower population density and where the agricultural sector is mainly positioned (Centraal Bureau voor de Statistiek, 2023). The opposite applies to the more diverse Randstad area. People living there are more likely to support sustainable policies, have a high income and are less likely to support the BBB. For further steps in the design it is important to take into account that not all regions are eager to change. Therefore, stakeholders with different interests should be involved throughout the process.

Figure 28: Socio-geopolitical situation in the Netherlands



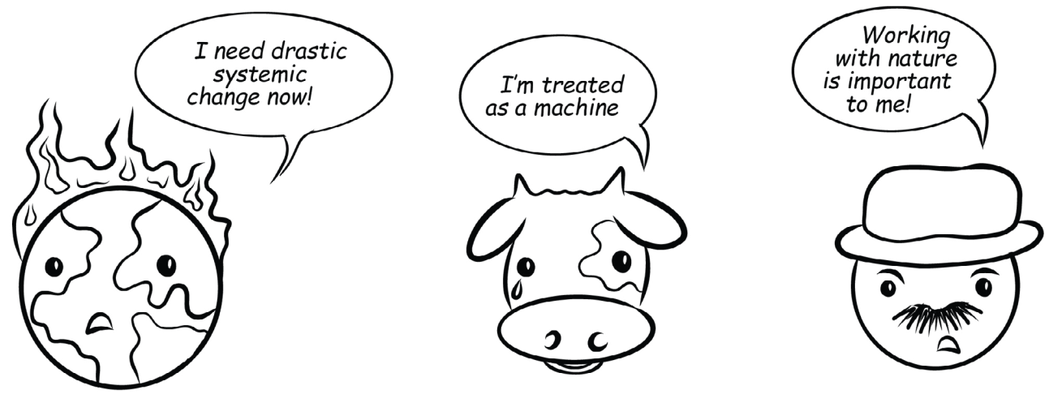




The current dairy farming system

To further familiarise ourselves with dairy farming, we conducted an extensive background research on each aspect of the supply-chain. The main sector of dairy farming is at the centre of the flow-chart on the right, showing related flows and industries, which is then also translated into a system section shown at figure 30. During various steps of this process, ammonia and nitrous-oxides are released into nature affecting habitats, water and soil, or are exported to-, and imported from other countries. Apart from nitrogen compounds being emitted, dairy farming also needs other resources like water and energy, while sufficient rail- or road connections are crucial for transporting the products. The supply-chains are long and suboptimal, leading to even more harmful nitrous-oxide molecules.

To talk about the social aspects of the industry, many farmers are disadvantaged by the cheap export of dairy products from other countries, as they cannot sell their own goods at a competitive price. To tackle the environmental, economical and social issues generated by this system, we need to rethink its working mechanisms in an integral way that encourages transformative change (Van Bruggen et al., 2019). This requires an in-depth analysis of the current stakeholders regarding the nitrogen crisis and dairy farming.



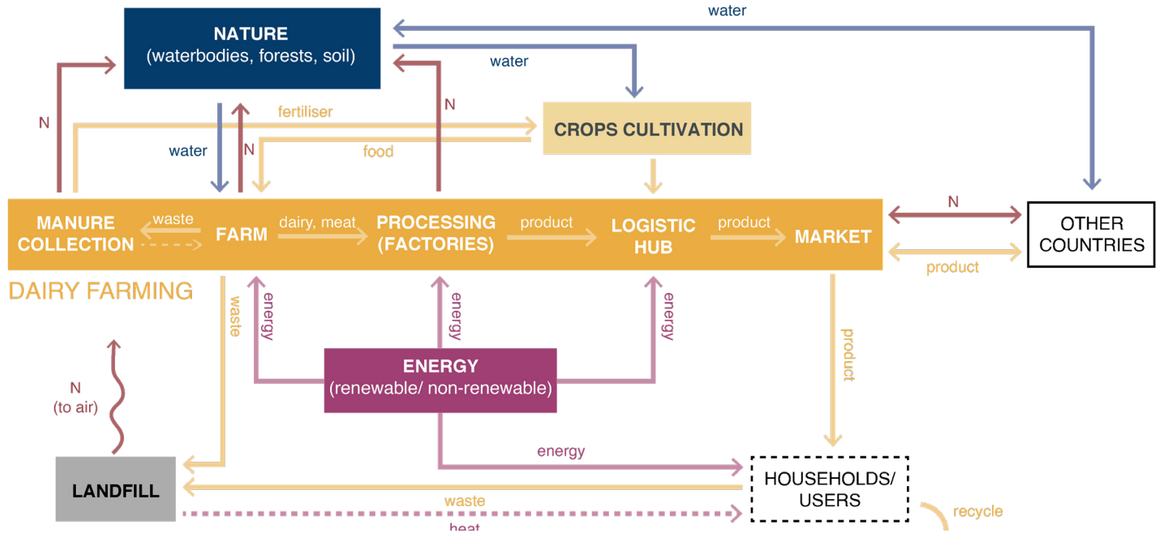


Figure 29: Status quo system flows

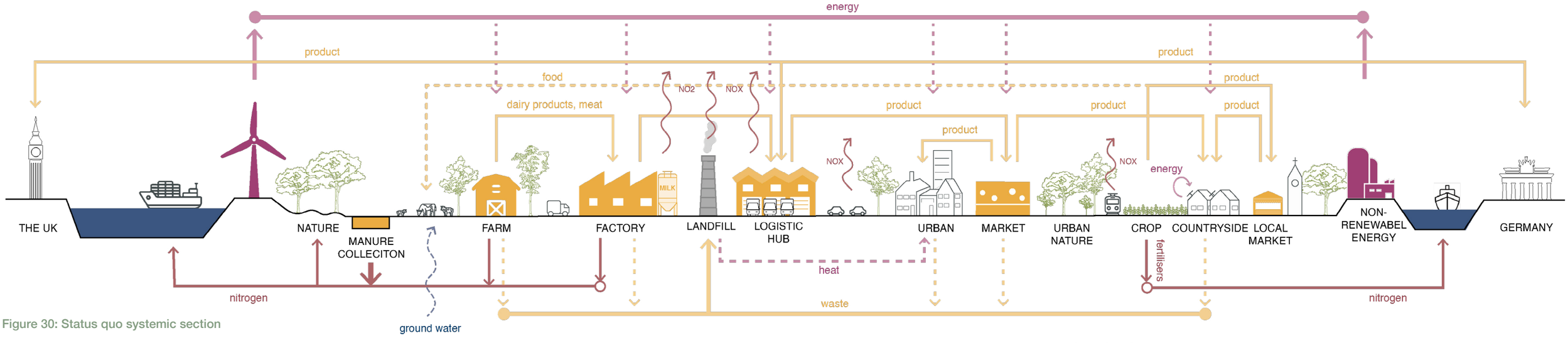


Figure 30: Status quo systemic section

Summary of stakeholders

0 - Government Agencies

1. EUROPEAN UNION
2. NATIONAL GOVERNMENT (1ST AND 2ND HOUSE)
3. PROVINCIAL GOVERNMENTS
4. MUNICIPAL GOVERNMENTS
5. ZBOs (AUTONOMOUS ADMINISTRATIVE AUTHORITIES)

1 - Primary Sector (Dairy Darming)

1. CATTLE FARMING
2. ARABLE FARMING
3. BIO-CATTLE FARMING
4. BIO-ARABLE FARMING
5. ANIMAL (POWER) FOOD PRODUCER INDUSTRY
6. (GRASS) SEED & PESTICIDE PRODUCERS
7. FERTILIZERS MANUFACTURERS INDUSTRY

2 - Secondary Sector (Dairy Processing)

1. SLAUGTHER HOUSES INDUSTRY
2. TREATMENT AND PROCESSING INDUSTRIES (DAIRY)
3. TREATMENT AND PROCESSING INDUSTRIES (ALTERNATIVE PRODUCTS)
4. HEAVY MACHINERY INDUSTRY
5. FARM CONSTRUCTION INDUSTRY

3 - Tertiary Sector (Distribution and Retail)

1. SUPERMARKETS
2. CONSUMERS

4 - Quaternary Sector (Research and Development)

1. RESEARCH ORGANISATIONS
2. MEDIA

2 - Quinary Sector (Finance)

1. SUPERMARKETS

6 - Senary Sector (Research and Development)

1. THE PLANET
2. COWS
3. NATURE CONSERVATION ORGANISATIONS
4. CLIMATE ACTIVIST GROUPS

Figure 31: Analytical summary of stakeholders

The stakeholder analysis was based on the system drawings shown on the previous page. This includes the actors of the primary, secondary and tertiary sectors. To further understand these, the 2023 Agricultural Agreement was used as a base document. During this meeting, several ministries, organisations from the agricultural sector, supermarket-chain parties and nature organisations met to discuss the transition of agriculture in 2040. The most relevant stakeholders from arable and dairy farming were used in our analysis (Ministry of Agriculture, Nature and Food Quality, 2023). Research platforms such as universities and the media were also included. For example, Facebook is an important platform for farmers to share information about protests and their frustrations. Banks are also important in terms of investment for farm expansion. The industries highlighted include the food industry, but also the machinery industry that supplies raw materials to farms, for example manufacturers of fertiliser, grass seed, concentrates and pesticides.

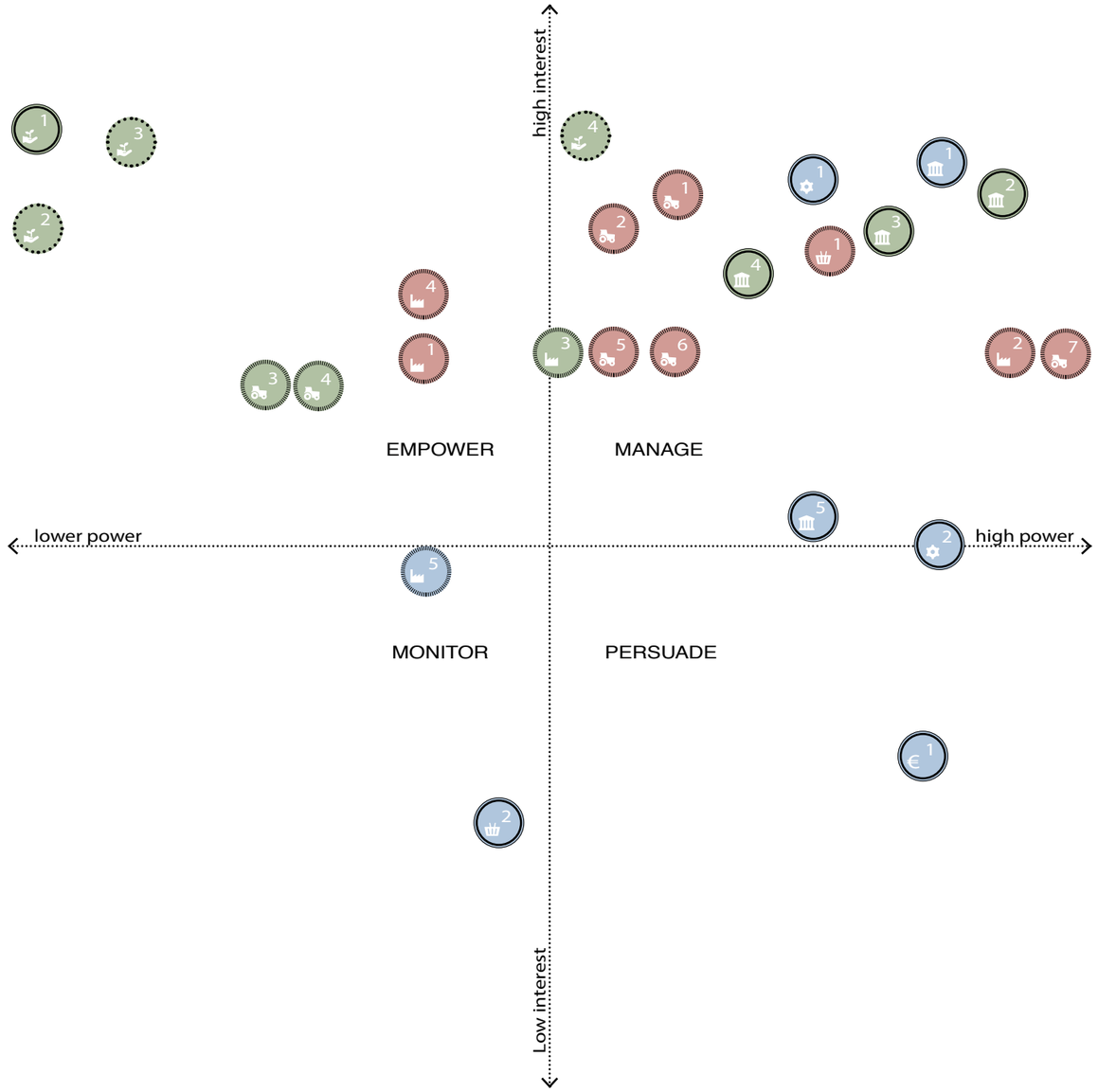
Throughout the design process, more and more stakeholders have been added, from the European scale to small organisations in the region of Drenthe, Friesland and Groningen. Not all stakeholders have the same power or interest in the consequences of the nitrogen problem. These differences will be visualised in the next step.

Power-interest matrix of the status quo

The key stakeholders by sector have been applied to the power-interest matrix from the summary of the stakeholder analysis presented earlier. To better understand the position of some stakeholders, a number of lobbies are explained in more detail. These are the currently ongoing milk lobby, supermarket lobby and fertiliser lobby.

The treatment and processing industry is a multi-million dollar industry and has a large stake in both milk production and the consumption of dairy products. In addition, many farmers work for milk manufacturers such as Campina and therefore have a lot of indirect power over milk production (BNN VARA, 2023). Consumers, on the other hand, are mainly dependent on supply and demand, which means they have less influence. In 2023, it was decided that milk alternatives such as oat milk would be subject to a “soda tax”. Milk is excluded because it is part of the five-layer diet. Not only does this make buying alternatives unattractive, but producers such as Appelsientje are also starting to add milk powder to their apple juice in order to get around the soda tax (Van de Keuken, 2024).

Despite the fact that supermarkets claim to be neutral in the nitrogen crisis, it is usually not true in practice. For example, supermarkets have a lot of influence over buying and selling prices, so they continue to buy milk from competing countries such as Germany, Hungary and Romania in order to keep their milk price as low as possible, even though the Netherlands produces more than enough milk for its own consumption. (De Waard, 2022; research agency Zembla, 2020). Organic farmers emit up to 50% less nitrogen-related compounds, partly due to not using artificial fertilisers, pesticides or feed concentrates. Researchers and climate organisations such as Milieudefensie are demanding fertilisers to be phased out (Investico investigative journalists, 2023). This is exactly what the big fertiliser, pesticide and feed industries do not want, fearing losing their multimillion-dollar industry. According to fertiliser manufacturer Yara Sluiskil, the global food industry is now too dependent on the use of fertilisers. As a result, they play a critical role in global food security (Koster & Opheikens, 2022). Therefore, in our research, the fertiliser industry and the dairy treatment and processing industry are the stakeholders with the most influence and interest. This comes in contrast with the silent stakeholders like the planet and the cows, who have a lot of interest but the least amount of power.



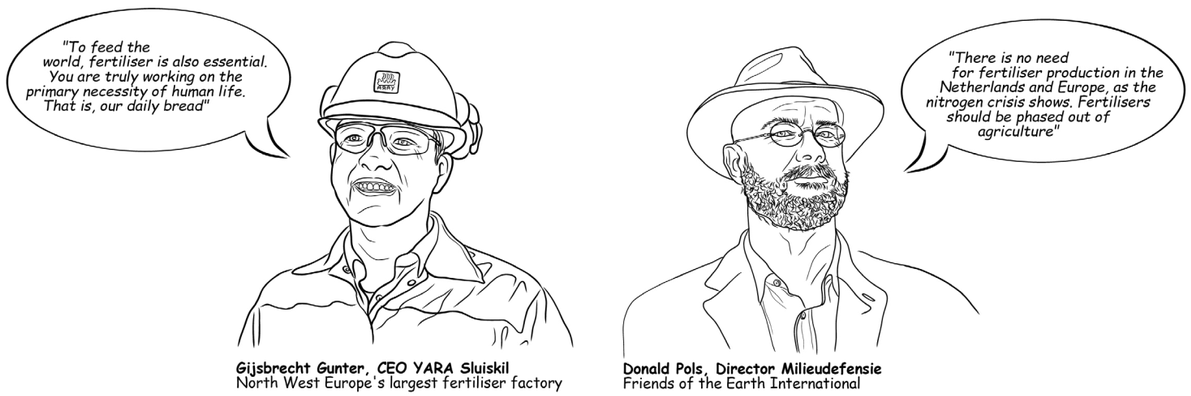


Figure 32: Status quo stakeholder power-interest matrix

0_GOVERNMENT AGENCIES
- EUROPEAN UNION
- NATIONAL GOVERNMENT (1ST AND 2ND HOUSE)
- PROVINCIAL GOVERNMENTS
- MUNICIPAL GOVERNMENTS
- ZBOs (AUTONOMOUS ADMINISTRATIVE AUTHORITIES)

1_PRIMARY SECTOR (DAIRY FARMING)
- CATTLE FARMING
- ARABLE FARMING
- BIO-CATTLE FARMING
- BIO-ARABLE FARMING
- ANIMAL (POWER) FOOD PRODUCER INDUSTRY
- (GRASS) SEED & PESTICIDE PRODUCERS
- FERTILIZERS MANUFACTURERS INDUSTRY

2_SECONDARY SECTOR (DAIRY PROCESSING)
- SLAUGTHER HOUSES INDUSTRY
- TREATMENT AND PROCESSING INDUSTRIES (DAIRY)
- TREATMENT AND PROCESSING INDUSTRIES (ALTERNATIVE PRODUCTS)
- HEAVY MACHINERY INDUSTRY
- FARM CONSTRUCTION INDUSTRY

3_TERTIARY SECTOR (DISTRIBUTION AND RETAIL)
- SUPERMARKETS
- CONSUMERS

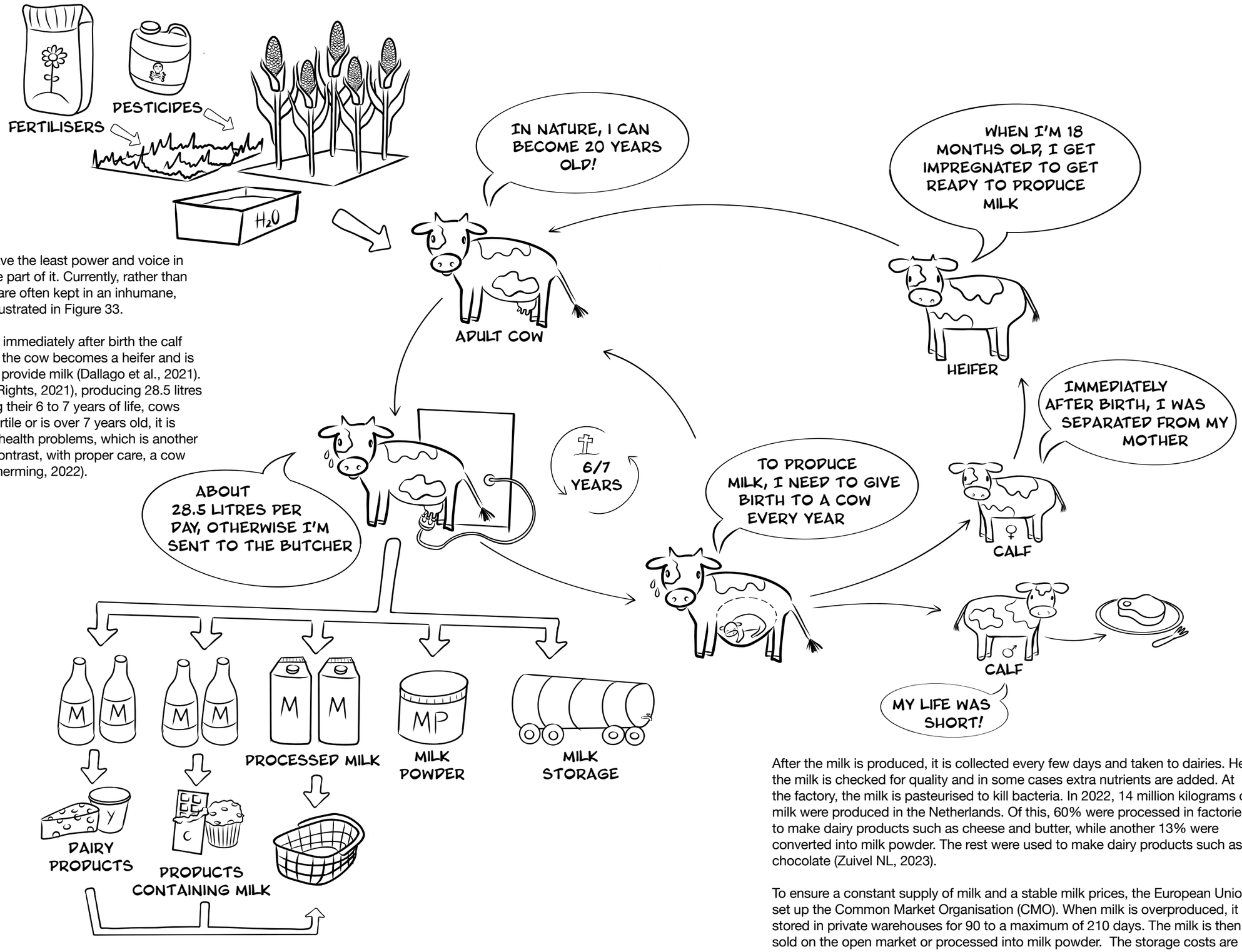
4_QUATERNARY SECTOR (RESEARCH AND DEVELOPMENT)
- RESEARCH ORGANISATIONS
- MEDIA

5_ QUINARY SECTOR (FINANCE)
- SUPERMARKETS

6_ SENARY SECTOR (RESEARCH AND DEVELOPMENT)
- THE PLANET
- COWS
- NATURE CONSERVATION ORGANISATIONS
- CLIMATE ACTIVIST GROUPS

LEGEND
CIVIL SOCIETY · PRIVATE SECTOR · PUBLIC SECTOR · PROPO-NENTS · OPPO-NENTS · FENCE SITTERS

The life of a dairy cow



As shown in the stakeholder matrix, the cows have the least power and voice in the system, even though they are an inescapable part of it. Currently, rather than being treated as living, breathing animals, cows are often kept in an inhumane, machine-like manner. The life of a dairy cow is illustrated in Figure 33.

The average lifespan of a dairy cow is short, and immediately after birth the calf is separated from her mother. Within 18 months, the cow becomes a heifer and is then inseminated with her first calf, to be able to provide milk (Dallago et al., 2021). The cow is then milked 2-3 times a day (Animal Rights, 2021), producing 28.5 litres per day on average (Animal Rights, 2024). During their 6 to 7 years of life, cows give birth to 4 calves. When a cow becomes infertile or is over 7 years old, it is sent to a slaughterhouse. Half of the cows have health problems, which is another reason to be sent away (Wakker Dier, 2024). In contrast, with proper care, a cow can live well over 20 years naturally (Dierenbescherming, 2022).

Figure 33: The life of the cow

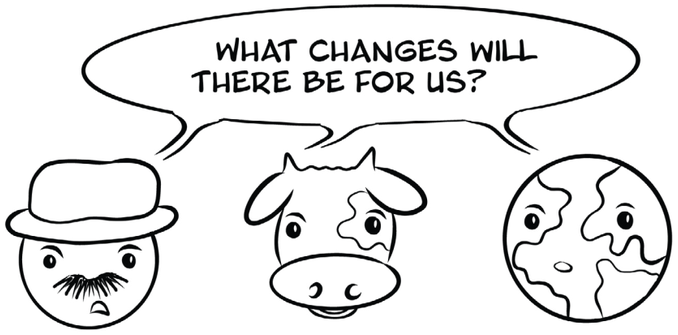
After the milk is produced, it is collected every few days and taken to dairies. Here the milk is checked for quality and in some cases extra nutrients are added. At the factory, the milk is pasteurised to kill bacteria. In 2022, 14 million kilograms of milk were produced in the Netherlands. Of this, 60% were processed in factories to make dairy products such as cheese and butter, while another 13% were converted into milk powder. The rest were used to make dairy products such as chocolate (Zuivel NL, 2023).

To ensure a constant supply of milk and a stable milk prices, the European Union set up the Common Market Organisation (CMO). When milk is overproduced, it is stored in private warehouses for 90 to a maximum of 210 days. The milk is then sold on the open market or processed into milk powder. The storage costs are paid by the CMO. (European Commission, 2024)

In conclusion, having looked at the dairy system using the systemic sections, stakeholder analysis and understanding the position of the dairy cow, it is important that in the next design steps we take into account both the interests of the powerful stakeholders and give voice to the silent ones.

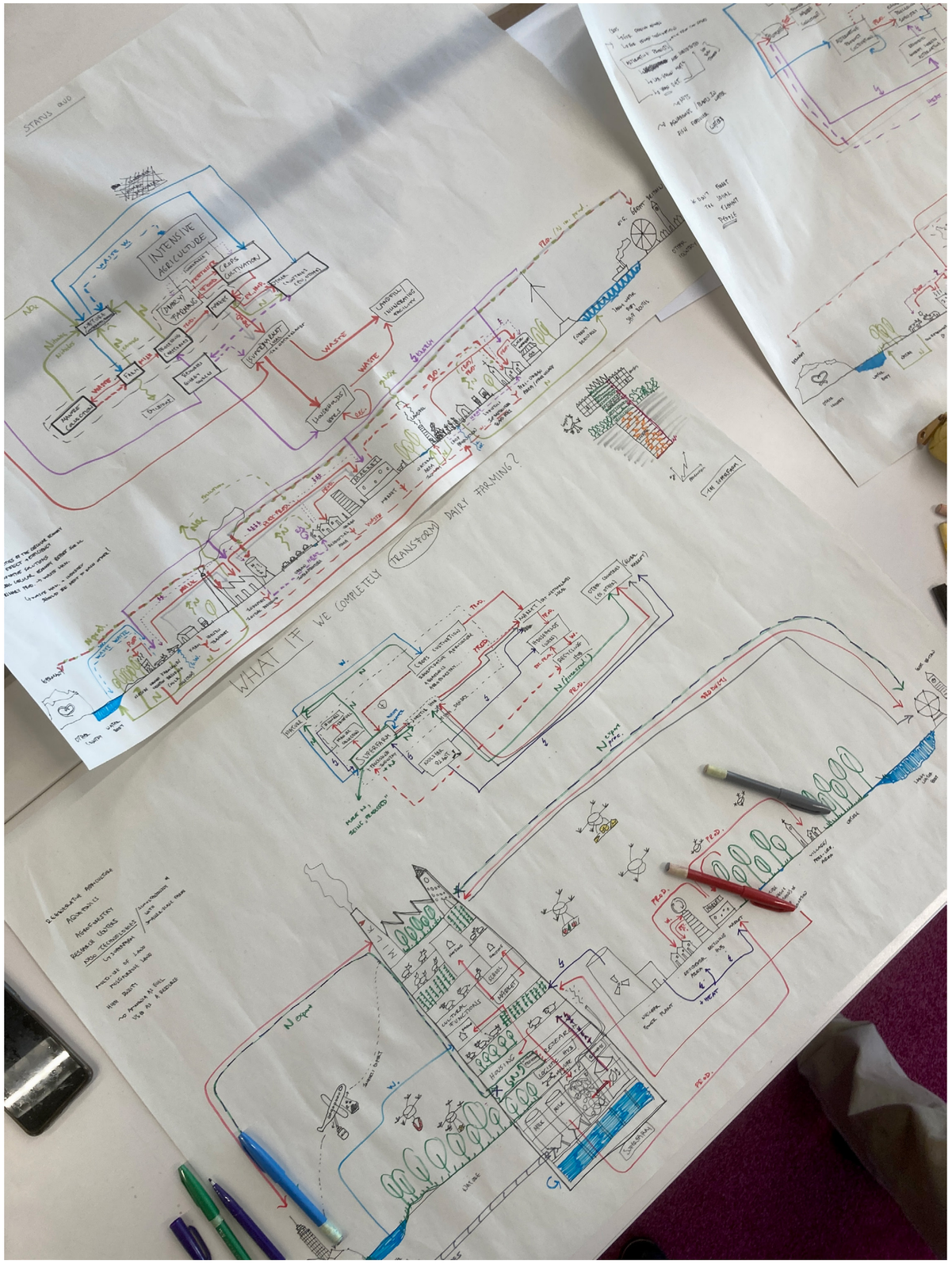
Quitting?

Figure 34: Experimentation process



As the next step of our analysis, we created two extreme scenarios based on the suggestion of the parliamentary letter. We previously concluded that quitting and transforming dairy farming encompasses relocation, so from now on we will discuss the previous two in detail. In order to determine the characteristic elements of both quit and transform, we took them to the extreme, depicting ‘black and white worlds’. This helped us to pinpoint important concepts, possibilities and limitations of each.

Realistically, neither quit nor transform is a sufficient strategy on its own, our goal is to find a healthy combination, a gradient of the two, that leads to the future transition of the dairy industry.



Transforming?

Quitiing

The quit scenario is based on a behaviour shift in society, namely that humans will be able to change their dietary habits by only consuming plant-based dairy products in the future. It plays into the idea of local, decentralised production, short supply-chains and nature-based solutions.

Compared to the previous system drawings of the status quo, alternative products cultivation and processing are in the centre of the flow-diagram, replacing classical dairy farming, cultivating only plant-based products. Therefore, the dairy cows are able to 'retire', gaining back their freedom in nature, leaving behind the cruel lifestyle of their predecessors. Nitrogen-related emissions are reduced, the manure of the cows are used for biomass energy production which can also provide electricity and heat for nearby settlements. Crops are cultivated in balance with nature in permaculture-like ecosystems. Waste and greywater are reused, establishing local recycling hubs.

Limitations of this scenario lie in the fact that it relies almost completely on societal change. Eating and producing animal-based dairy products is a 'national heritage' of the Netherlands. After a survey was conducted on the willingness of Dutch people to switch to alternatives, it turned out that almost half (46%) of the population would not change their consumption habits (Centraal Bureau voor de Statistiek, 2022). As the stakeholders of pro-dairy industry are economically and socially powerful actors, it would take complex participation and engagement events and sufficient compensation to convince them.

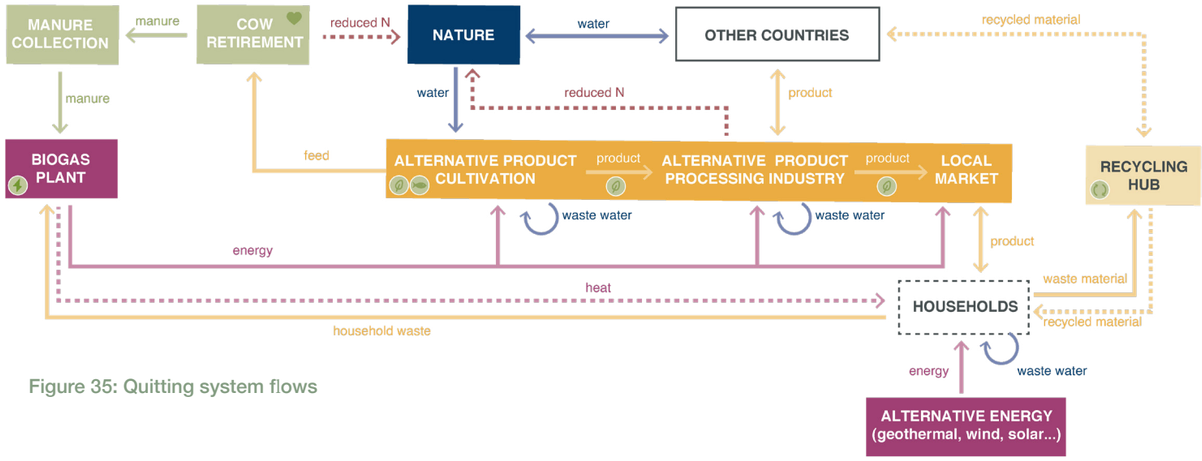


Figure 35: Quitting system flows

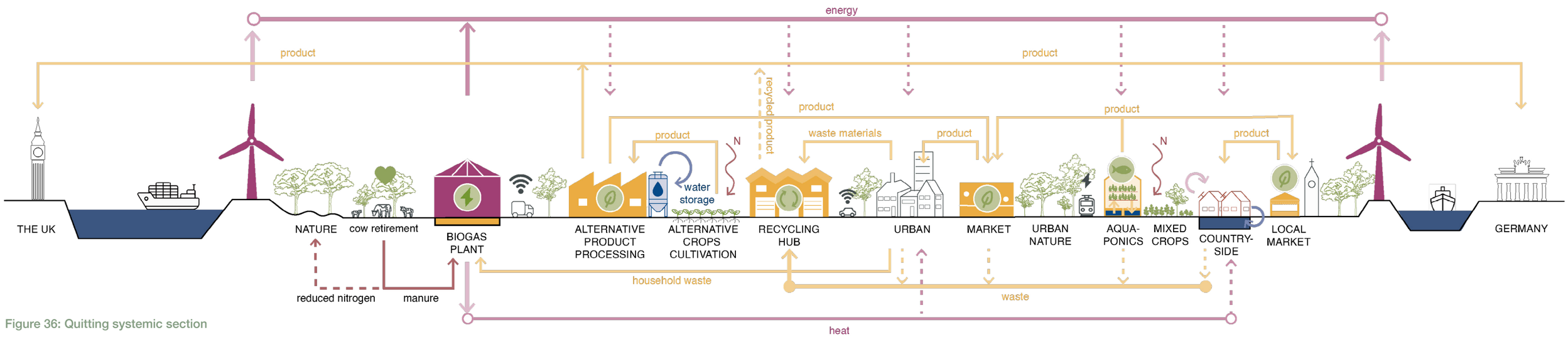


Figure 36: Quitting systemic section

Stakeholder projections - quitting

The system section shows that traditional dairy farming has been replaced and meat-based products are substituted with alternatives. For both organic dairy farmers and traditional dairy farmers, this means that they can no longer continue their work so they also become opponents of the strategy. Retiring the cows means that the slaughterhouse industry loses a big part of their supply and therefore their practices. In this scenario, the arable farming industry gets a bigger and more important market share in food supply, making them proponents of the idea. In conclusion, the alternative processing industry gains much more power in this scenario, while the dairy processing industry loses its importance.

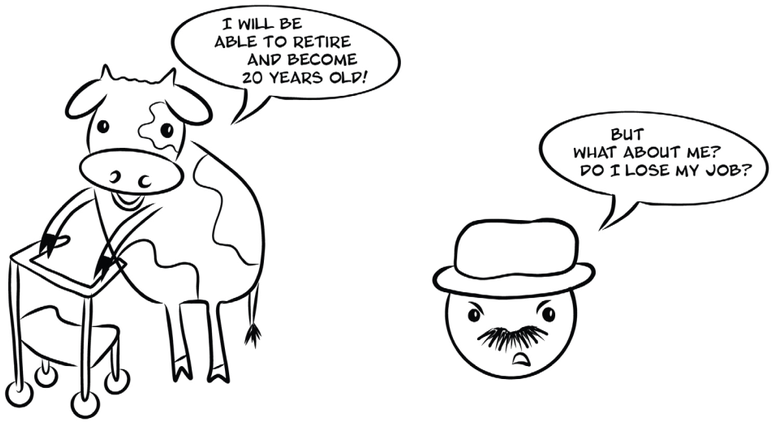
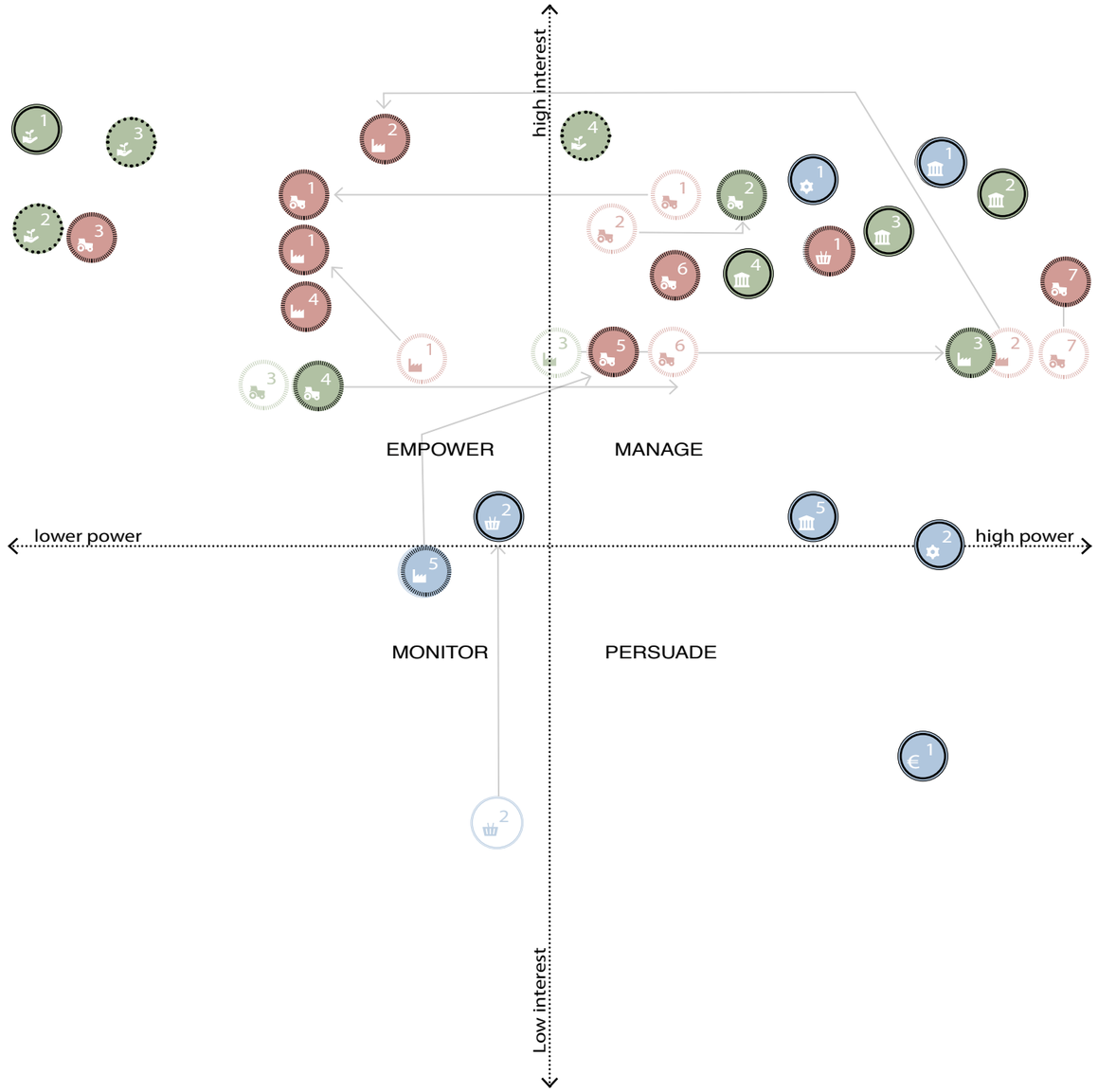


Figure 37: Stakeholder projections for quitting



0_GOVERNMENT AGENCIES

1. EUROPEAN UNION
2. NATIONAL GOVERNMENT (1ST AND 2ND HOUSE)
3. PROVINCIAL GOVERNMENTS
4. MUNICIPAL GOVERNMENTS
5. ZBOs (AUTONOMOUS ADMINISTRATIVE AUTHORITIES)

1_PRIMARY SECTOR (DAIRY FARMING)

1. CATTLE FARMING
2. ARABLE FARMING
3. BIO-CATTLE FARMING
4. BIO-ARABLE FARMING
5. ANIMAL (POWER) FOOD PRODUCER INDUSTRY
6. (GRASS) SEED & PESTICIDE PRODUCERS
7. FERTILIZERS MANUFACTURERS INDUSTRY

2_SECONDARY SECTOR (DAIRY PROCESSING)

1. SLAUGTHER HOUSES INDUSTRY
2. TREATMENT AND PROCESSING INDUSTRIES (DAIRY)
3. TREATMENT AND PROCESSING INDUSTRIES (ALTERNATIVE PRODUCTS)
4. HEAVY MACHINERY INDUSTRY
3. FARM CONSTRUCTION INDUSTRY

3_TERTIARY SECTOR (DISTRIBUTION AND RETAIL)

1. SUPERMARKETS
2. CONSUMERS

4_QUATERNARY SECTOR (RESEARCH AND DEVELOPMENT)

1. RESEARCH ORGANISATIONS
2. MEDIA

5_ QUINARY SECTOR (FINANCE)

1. SUPERMARKETS

6_ SENARY SECTOR (RESEARCH AND DEVELOPMENT)

1. THE PLANET
2. COWS
3. NATURE CONSERVATION ORGANISATIONS
4. CLIMATE ACTIVIST GROUPS

LEGEND

CIVIL SOCIETY · PRIVATE SECTOR · PUBLIC SECTOR · PROPO-NENTS · OPPO-NENTS · FENCE SITTERS

Transforming

The scenario of transforming relies on a technological shift, where innovation plays a key role in how we deal with nitrogen-related emissions in the future. The premise of the idea is that society is not willing to change, so dairy farming needs to be transformed in a way that there is still production, but the emissions are reduced and more space is freed for nature.

We constructed the utopia of the superfarms, a self-sustaining, concentrated unit of animal-based dairy industry, using nitrogen-energy (a new type of energy invented), and supercows with enhanced efficiency of milk production. Housing, schools and other social institutions are incorporated, as well as markets, vertical farming, a logistic hub and a biomass plant for internal energy use to recycle manure. It exports dairy products and nitrogen-energy globally through new types of infrastructure like transport-drones. This way the area of the previous pasturelands can be given back to nature, creating a vast network of ecosystems and habitats, restoring the balance of the nitrogen cycle.

As a thought-experiment, it is possible to depict the future in this technocratic way, while in real life the feasibility of the concept is low. It requires unwavering faith in science, a strong belief that in the next decades we will be able to discover innovations mentioned in the previous paragraph. This way of thinking can lead to false hopes, resulting in not taking action in time to solve the very real issues of nitrogen-surplus, waiting for a saviour technology.

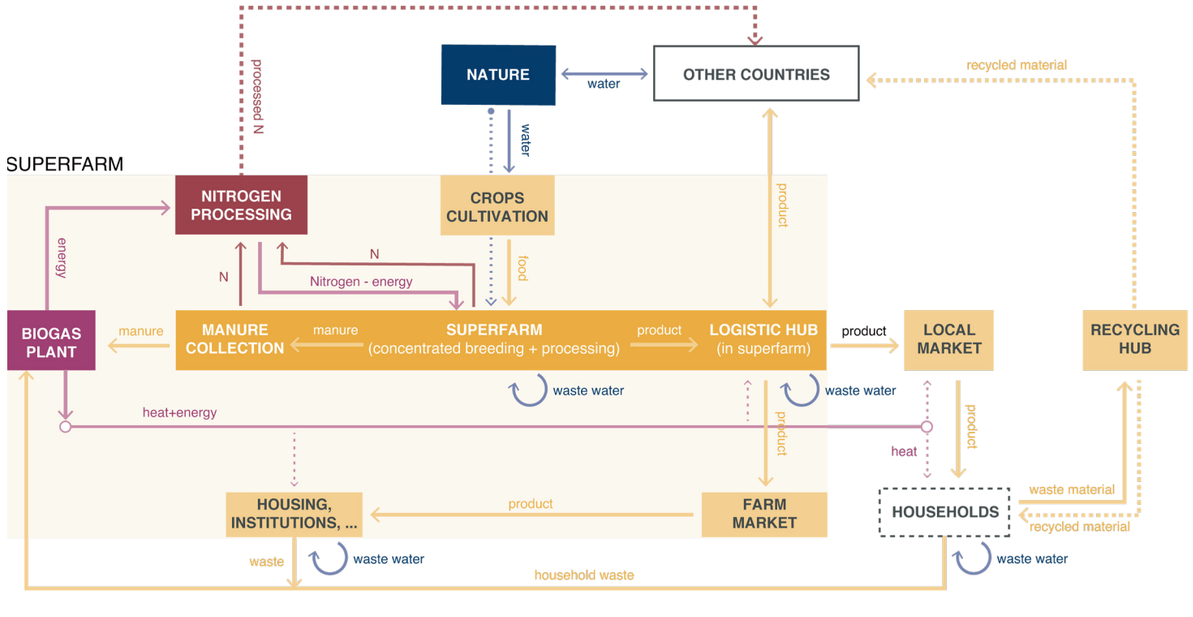


Figure 38: Transforming system flows

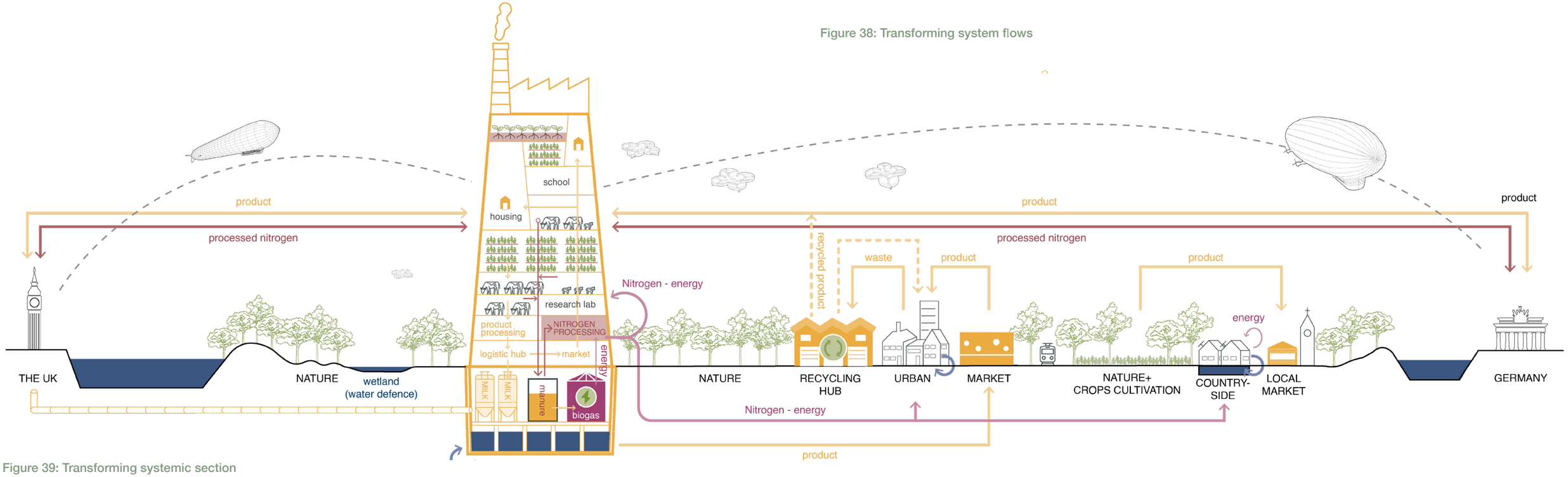
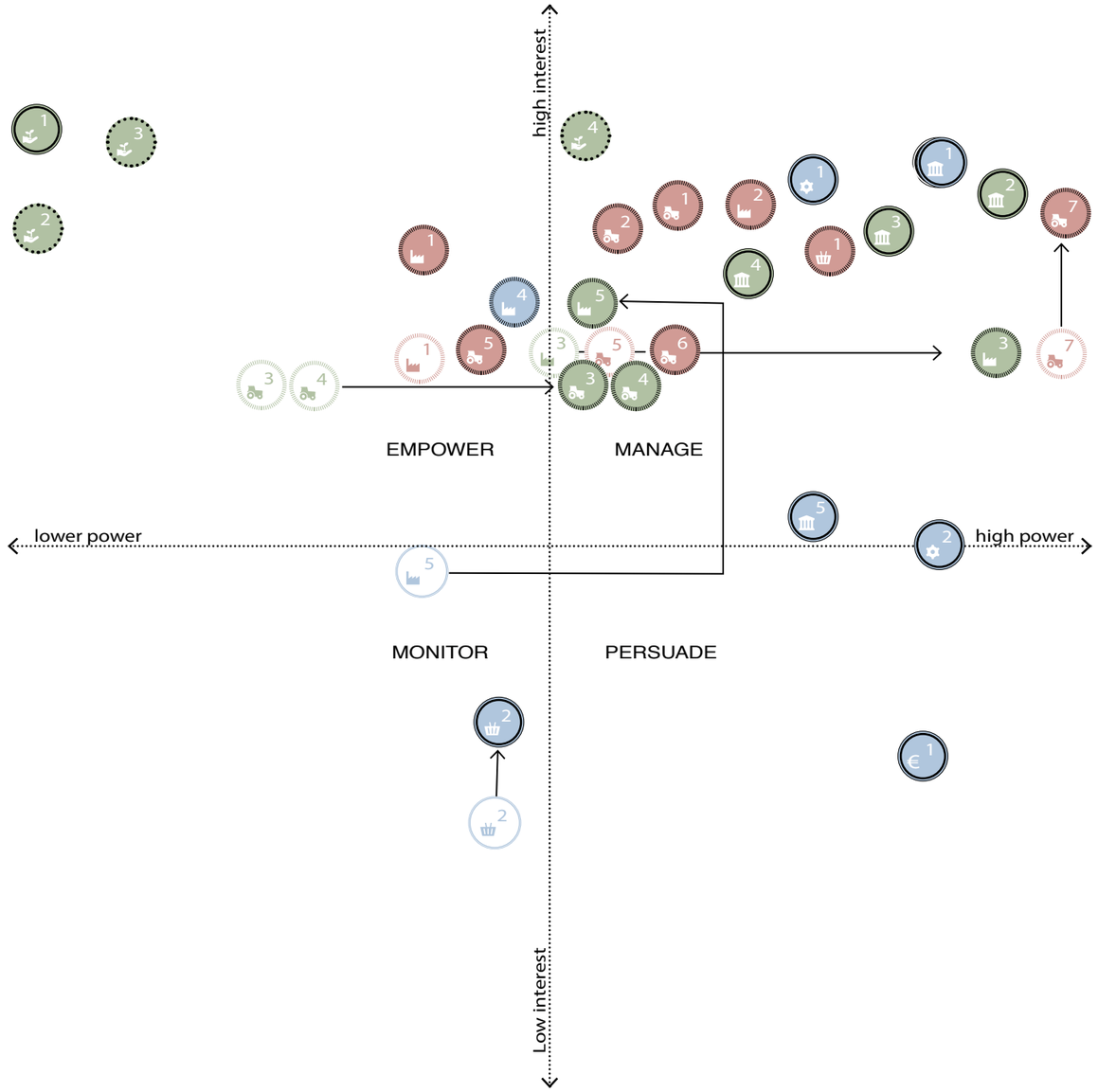
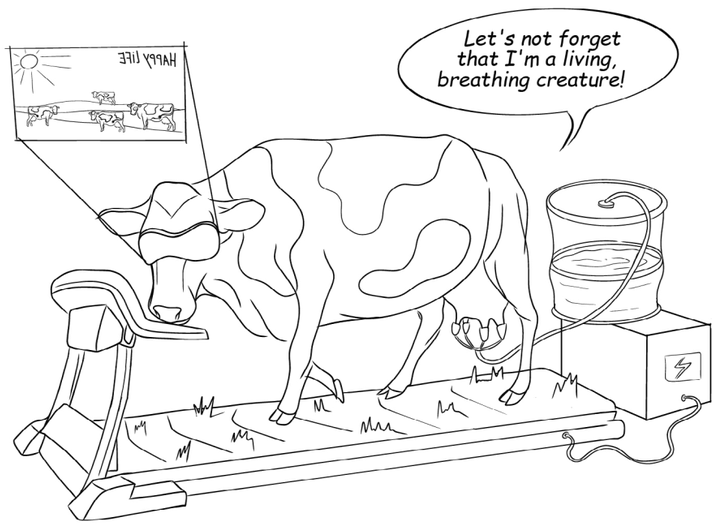


Figure 39: Transforming systemic section

Stakeholder projections - Transforming

In this scenario consumers are not interested in changing their diet fully, therefore the demand for milk based products remains. In order to adequately supply this, a lot of trust and power goes to the heavy machinery industry and the farm construction industry. Being fence sitters in the status quo, changing their industry towards the superfarm means high investment costs, on the other hand they gain a lot of power and influence in the food supply. In addition, both the biological arable and cattle farms earn more powerful positions, as all farms will be transformed into biological farms. This also means that the pesticide, fertiliser and animal food producers lose most of their market, making them even stronger opponents than they already were in the status quo. The slaughterhouse industry loses a smaller piece of their market, but stay opponents in this scenario. As the dairy industry gets compacted, remaining space is freed for nature, which makes the planet also a more important, 'heard' actor in this case.





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2. TREATMENT AND PROCESSING INDUSTRIES (DAIRY)
3. TREATMENT AND PROCESSING INDUSTRIES (ALTERNATIVE PRODUCTS)
4. HEAVY MACHINERY INDUSTRY
3. FARM CONSTRUCTION INDUSTRY

3_TERTIARY SECTOR (DISTRIBUTION AND RETAIL)

1. SUPERMARKETS
2. CONSUMERS

4_QUATERNARY SECTOR (RESEARCH AND DEVELOPMENT)

1. RESEARCH ORGANISATIONS
2. MEDIA

5_ QUINARY SECTOR (FINANCE)

1. SUPERMARKETS

6_ SENARY SECTOR (RESEARCH AND DEVELOPMENT)

1. THE PLANET
2. COWS
3. NATURE CONSERVATION ORGANISATIONS
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LEGEND

CIVIL SOCIETY · PRIVATE SECTOR · PUBLIC SECTOR · PROPO-NENTS · OPPO-NENTS · FENCE SITTERS

Figure 40: Stakeholder projections for transforming

4
Frameworks

Theoretical framework

The two main concepts of Transitional Landscapes and Socially Just Transition, together with the concept of Planetary Boundaries constitute our theoretical framework which functions as the base of our conceptual framework.

Transitional Landscape

Transitional Landscapes is a term that lately has gained importance within the scientific community (Russo et al., 2023). The ongoing transformation of peripheral landscapes requires the “redesign” and “rethinking” of spaces – inhabited or not – and of flows between them, which naturally affects decisions made in urban and territorial planning (Russo et al., 2023). Transitional landscapes are often considered as the in-between spaces between the urban and nature, often fragmented and with a repetitive character (Kamvasinou, 2006). The current change in their potential is creating opportunities for innovation and dialogue, with a necessary inter-scalar and multidisciplinary approach (Colafranceschi, 2023). A collection of essays about this topic, titled “Transitional Landscapes”, was published in 2023, including contributions by architects and urban planners reflecting upon the shift these marginal territories are undergoing and its consequences on the built environment, society, and economy. Another publication by the European Environment Agency (EEA) titled Landscapes in Transition (2017) also stresses the importance of studying the land cover change, and especially the conversion of agricultural land to “manufactured” land such as urban areas and infrastructure. The need for policy-making in order to support sustainable land management (EEA, 2017) is urgent, the development of rural land in a multifunctional territory in particular is crucial for improving the life quality of European citizens. The concept of transitional and transitioning landscapes is especially interesting for our project since with the implementation of our strategies the landscape of the Netherlands, and generally North-Western Europe, will have to undergo a fundamental transition. Therefore, it is important to consider the spatial implications of such a change.

Socially Just Transition

Just Transition is a commonly used term, very closely tied to sustainable development (Sabato & Fronteddu, 2020). The aim of Just Transition is to ensure that the process of implementing measures to combat climate change is fair to all and “no one is left behind” (European Commission, n.d.). During the sustainability transition it is vital to support the regions, industries and people that will be most affected by these transformations, by incorporating elements of social justice in order to guarantee economic stability and tackle social inequalities that could arise (Just Transitions: How to Manage Social Impacts?, 2022). The Just Transition Mechanism is a tool introduced by the European Commission in order to provide funding for territories that will need the most support, with the condition that they have formed a territorial just transition plan up to 2030 (European Commission, n.d.). This is also a very important concept within our work, since fundamentally transitioning to a more holistically sustainable model of dairy farming will have an immense socio-economic impact. Consequently, it is necessary to make sure that this change happens as smoothly as possible, and alternatives are offered to people currently working in the traditional dairy sector.

Planetary Boundaries

The Planetary Boundaries framework aims to define the safe operating space for human development, with respect to the Earth’s biophysical flows (Rockström et al., 2009). Nine interlinked Earth system processes were chosen, each with their respective critical values that should not be transgressed in order to keep the planet in a stable, ‘Holocene era’. By 2009 already three of the boundaries were crossed, namely climate change, the rate of biodiversity loss and, most relevant to our project, human interference with the nitrogen cycle. Compared to pre-industrial data, where no nitrogen was removed from the atmosphere artificially, anthropogenic actions now fixate more than natural processes do, transgressing the boundary immensely (Richardson, 2023). Nowadays six of the nine values are over the suggested critical loads. To return to safe operating space on Earth again, we need to look at human impact in a systemic manner. Therefore, within our study we aim to restore the balance of the nitrogen cycle, envisioning a radical transition in how we farm, live and work.

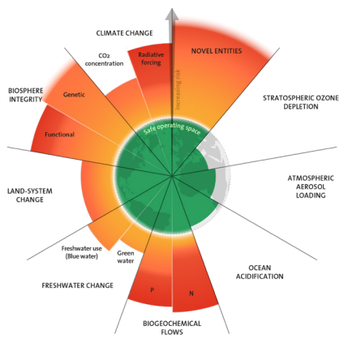


Figure 41: Planetary boundaries

Figure 42a,b,c: Instances of agricultural life

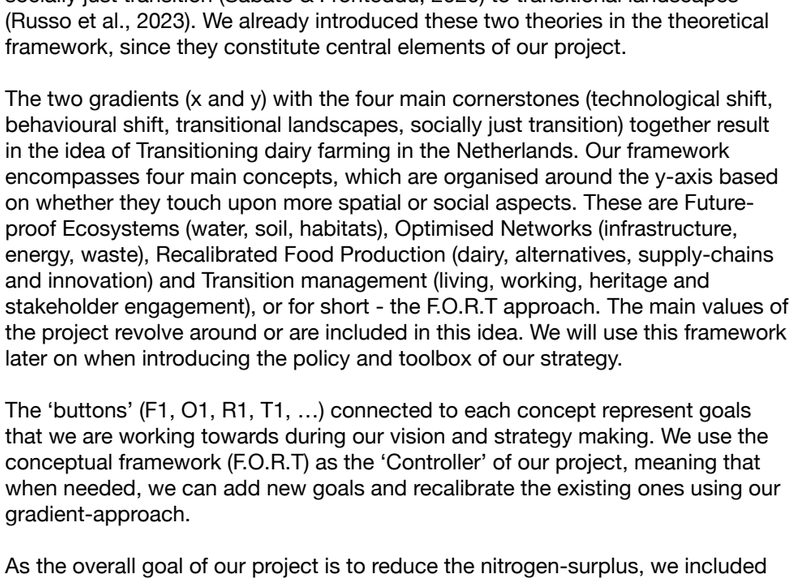
Conceptual framework

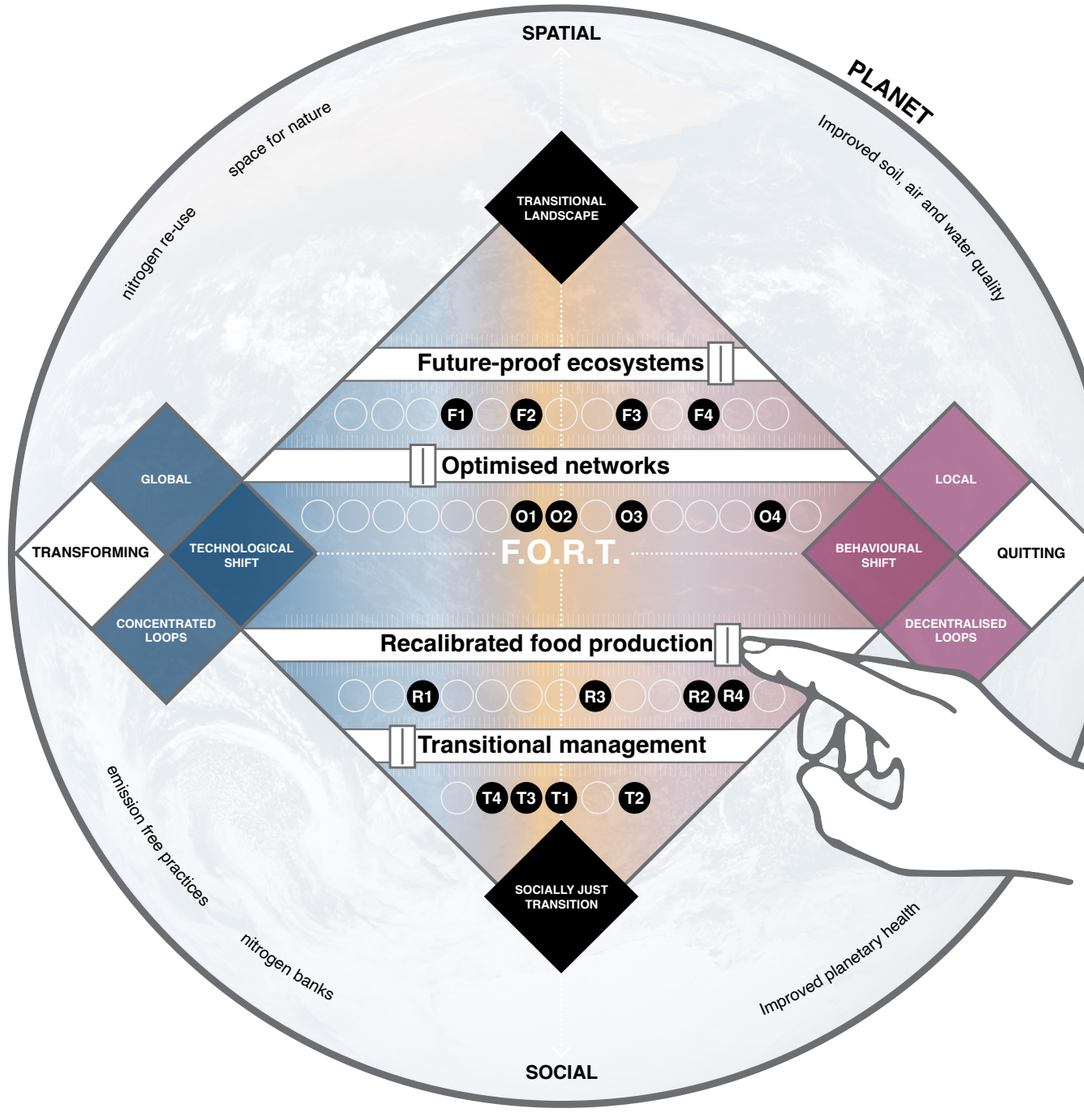
Our conceptual framework consists of two main axes: the axis of strategies (x) and the axis of social to spatial (y). In the horizontal direction on the left side is the strategy of Transformation, with its most important conceptual elements: global, concentrated loops and technological shift. The strategy of Quitting is on the right, encompassing local, decentralised loops and the behavioural shift. Together the technological and the behavioural shift create a gradient, from technocratic to anthropogenic, from extreme dairy production to only plant-based products. On the other hand, the vertical axis shows the sequence from socially just transition (Sabato & Fronteddu, 2020) to transitional landscapes (Russo et al., 2023). We already introduced these two theories in the theoretical framework, since they constitute central elements of our project.

The two gradients (x and y) with the four main cornerstones (technological shift, behavioural shift, transitional landscapes, socially just transition) together result in the idea of Transitioning dairy farming in the Netherlands. Our framework encompasses four main concepts, which are organised around the y-axis based on whether they touch upon more spatial or social aspects. These are Future-proof Ecosystems (water, soil, habitats), Optimised Networks (infrastructure, energy, waste), Recalibrated Food Production (dairy, alternatives, supply-chains and innovation) and Transition management (living, working, heritage and stakeholder engagement), or for short - the F.O.R.T approach. The main values of the project revolve around or are included in this idea. We will use this framework later on when introducing the policy and toolbox of our strategy.

The ‘buttons’ (F1, O1, R1, T1, …) connected to each concept represent goals that we are working towards during our vision and strategy making. We use the conceptual framework (F.O.R.T) as the ‘Controller’ of our project, meaning that when needed, we can add new goals and recalibrate the existing ones using our gradient-approach.

As the overall goal of our project is to reduce the nitrogen-surplus, we included a circle around the previously explained parts of the framework, representing the planetary boundaries (Rockström, 2009), a concept already introduced with the theory. The text written around into the curve highlights goals and benefits connected to nitrogen and biodiversity, as well as positive effects on human and planetary health.





F O R T

Future-proof ecosystems
- F1 Flood resilience
- F2 Connected habitats
- F3 Permaculture
- F4 Vital soils

Optimised networks
- O1 Lelyline as a catalyst
- O2 Smart infrastructure systems
- O3 Renewable energy sources
- O4 Circular waste management

Recalibrated food production
- R1 Concentrated dairy production
- R2 Alternative products
- R3 Direct supply chain
- R4 Food innovation

Transition management
- T1 Innovative housing
- T2 New forms of employment
- T3 New heritage and cultural shift
- T4 Co-creation

Figure 43a,b: Conceptual framework

5
Vision

“By 2100, cow farming in the Netherlands will have ***completely transitioned*** to a new economically viable, environmentally sustainable and socially just model, by combining processes of **quitting** and **transforming**”

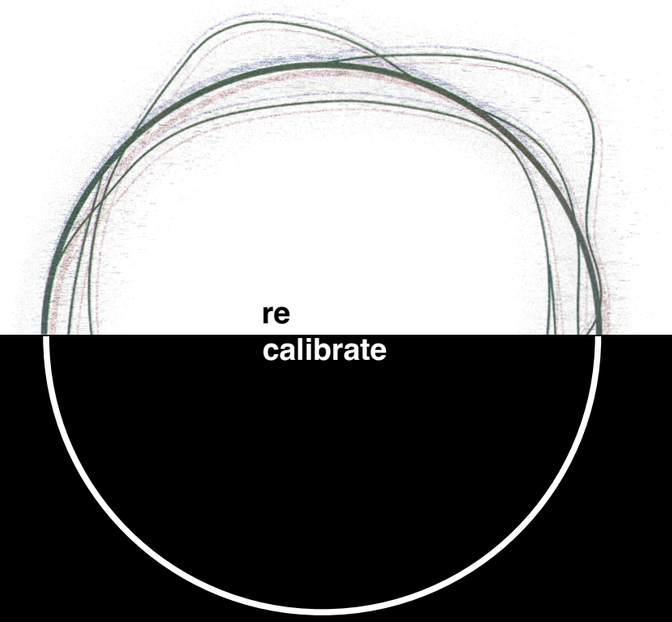


Figure 44: Recalibrated nitrogen cycle

Process

As one of our research sub-questions states, a general goal was to find the “hotspots” where most problems are coming together and, according to their different character, they would require different solutions. In order to find these problematic spots and form our vision for the Netherlands, we followed a very specific process.

Firstly, we set criteria of what would constitute a place in need for transition, and we overlaid the necessary layers of the analysis we had previously conducted. The goal was to locate spatially where two or more elements were coming together. The layers used were the nitrogen deposition, farming industry and flood risk, also taking into account the varying soil types. Six categories of areas were created (figure 46):

- One combining all elements (nitrogen deposition, farming industry, flood risk)
- One combining nitrogen deposition and farming industry
- One with just farming industry
- One with just nitrogen deposition
- One combining farming industry and flood risk
- One combining nitrogen and flood risk

Figure 45: Overlaying of the analysis

The first result of this process was very detailed, therefore we found it necessary to cluster our findings, making them a bit more generalised so they would be easier to draw conclusions from. Then we made certain assumptions and determined areas where to mostly quit and where to mostly transform dairy farming, therefore putting the quit-transform gradient from our conceptual framework for the first time into effect. Specifically, in the areas where nitrogen deposition overlaps with the farming industry and/or are under the threat of flood risk – which by default are deemed as more “urgent” areas – we implement strategies closer to the quitting side of the gradient. At the same time, the areas with just farming or farming combined with flood risk are more to the other side of the spectrum, meaning they need to be transformed.

After completing the first classification, we also overlaid the Natura 2000 areas and made the gradient more precise. It was necessary to include this layer, since protecting the habitats within and surrounding the Natura 2000 zones was the main aim of the ‘National Rural Area Program’ Parliamentary Letter (2022), which constituted the normative backbone of our project. Furthermore, it also aligns with our goal of environmental sustainability and biodiversity preservation. This addition in turn meant that some clustered areas previously more on the “transforming” side would have to move along the gradient line towards “quitting”.

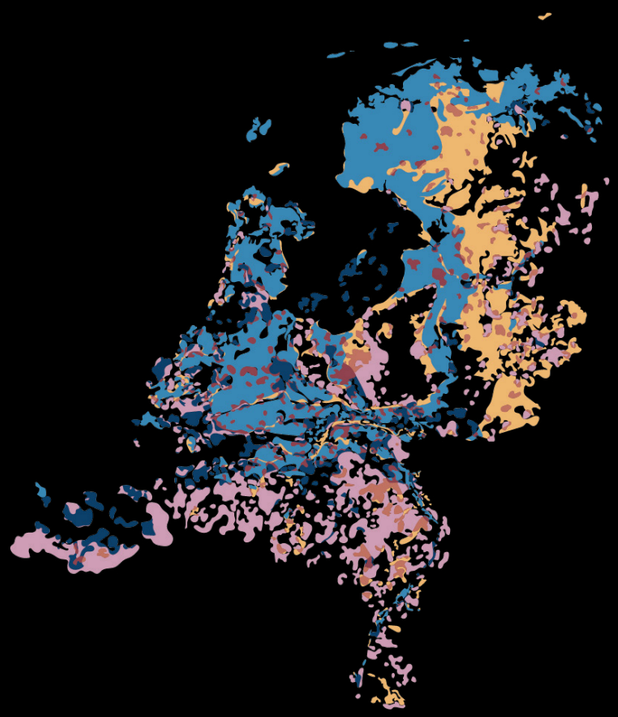


Figure 46: Combinations of nitrogen, farming and flood risk

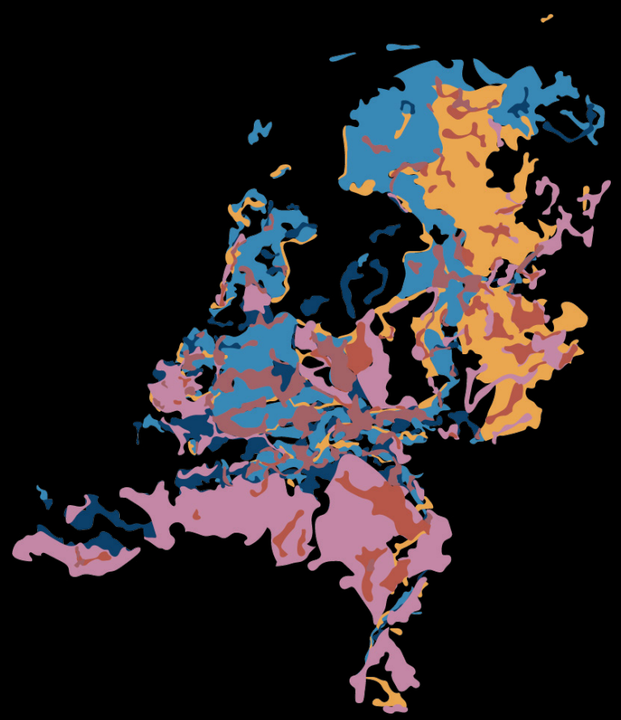


Figure 47: Initial clustering

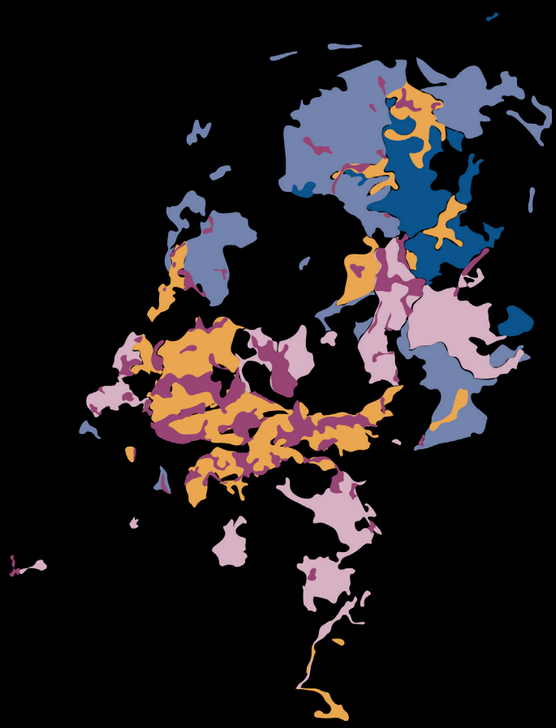
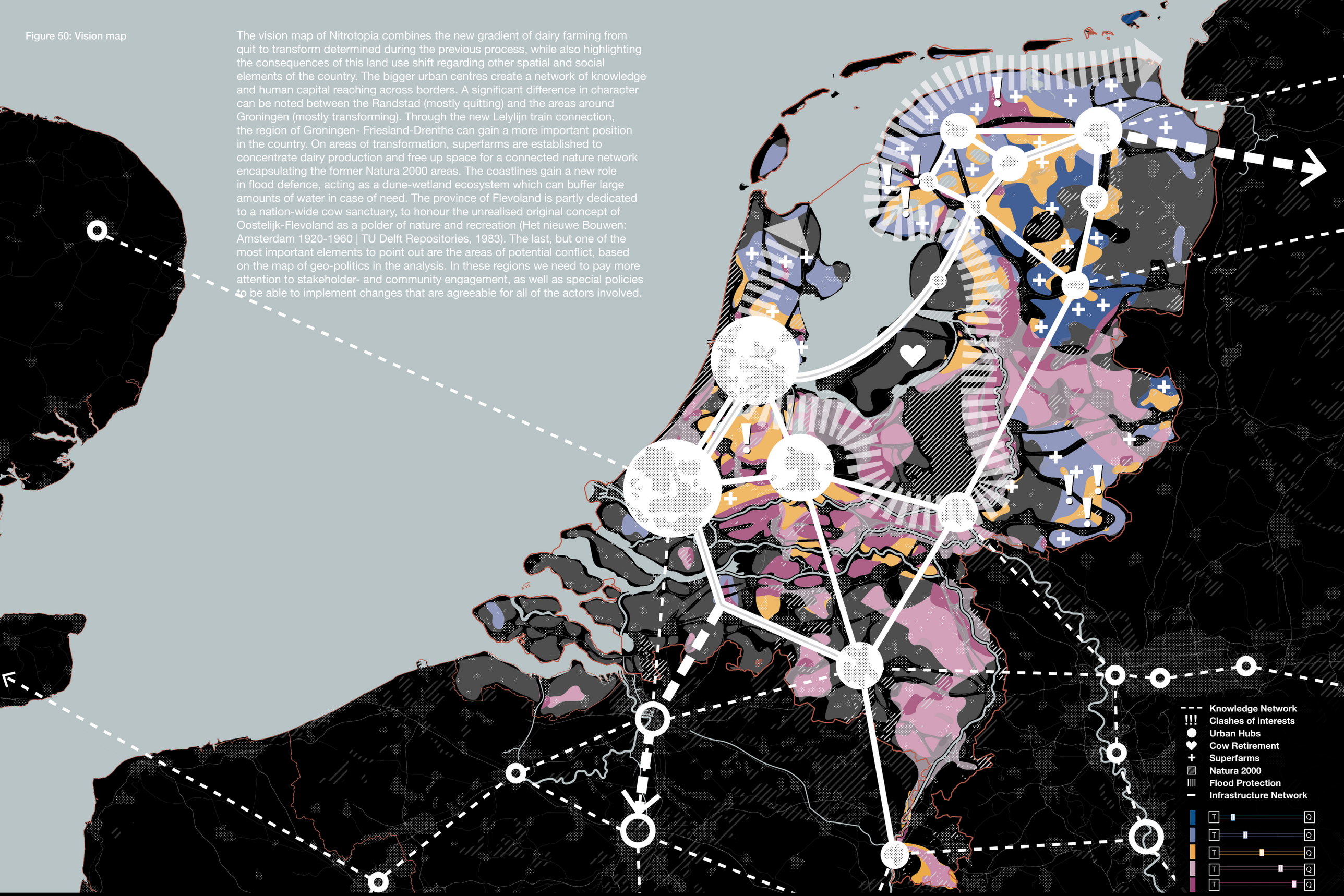


Figure 48: First application of the quit-transform gradient

Figure 49: Fine-tuning clusters with Natura 2000

Figure 50: Vision map

The vision map of Nitrotopia combines the new gradient of dairy farming from quit to transform determined during the previous process, while also highlighting the consequences of this land use shift regarding other spatial and social elements of the country. The bigger urban centres create a network of knowledge and human capital reaching across borders. A significant difference in character can be noted between the Randstad (mostly quitting) and the areas around Groningen (mostly transforming). Through the new Lelylijn train connection, the region of Groningen- Friesland-Drenthe can gain a more important position in the country. On areas of transformation, superfarms are established to concentrate dairy production and free up space for a connected nature network encapsulating the former Natura 2000 areas. The coastlines gain a new role in flood defence, acting as a dune-wetland ecosystem which can buffer large amounts of water in case of need. The province of Flevoland is partly dedicated to a nation-wide cow sanctuary, to honour the unrealised original concept of Oostelijk-Flevoland as a polder of nature and recreation (Het nieuwe Bouwen: Amsterdam 1920-1960 | TU Delft Repositories, 1983). The last, but one of the most important elements to point out are the areas of potential conflict, based on the map of geo-politics in the analysis. In these regions we need to pay more attention to stakeholder- and community engagement, as well as special policies to be able to implement changes that are agreeable for all of the actors involved.



Stakeholder analysis projections of transition

To be able to depict the stakeholder shift after the envisioned transition, the power and interests from both the quitting and transforming scenarios were taken into consideration. This matrix can also be seen as a target for where we want to situate the stakeholders with their power and interests in the future. The strongest opponents of our vision are the fertiliser industry, the milk treatment and processing industry, traditional cattle farmers and the seed and pesticide industry. Consumers are affected more, as they will have to change their behaviour towards the consumption of alternative dairy products. Both organic farmers and the alternative food industry are becoming more powerful. In addition, traditional arable farmers turn into proponents, gaining more power. Finally, the agricultural construction industry and the heavy machinery industry have more interest and power, as a major technological change is needed. The previously silent stakeholder of the cows and the planet are now gaining more power, and are considered in the transition.

In conclusion, it is important that the interests of the opponents are taken into account throughout the phasing of our design.

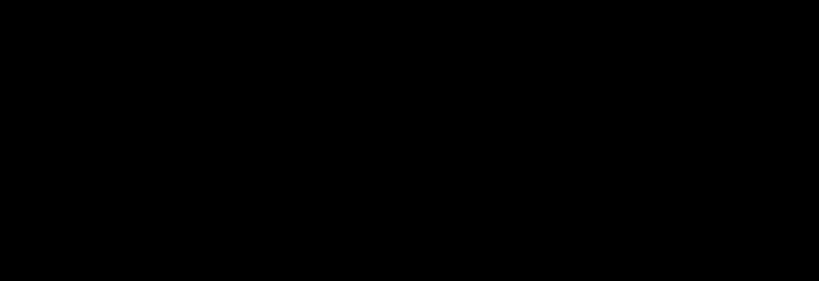
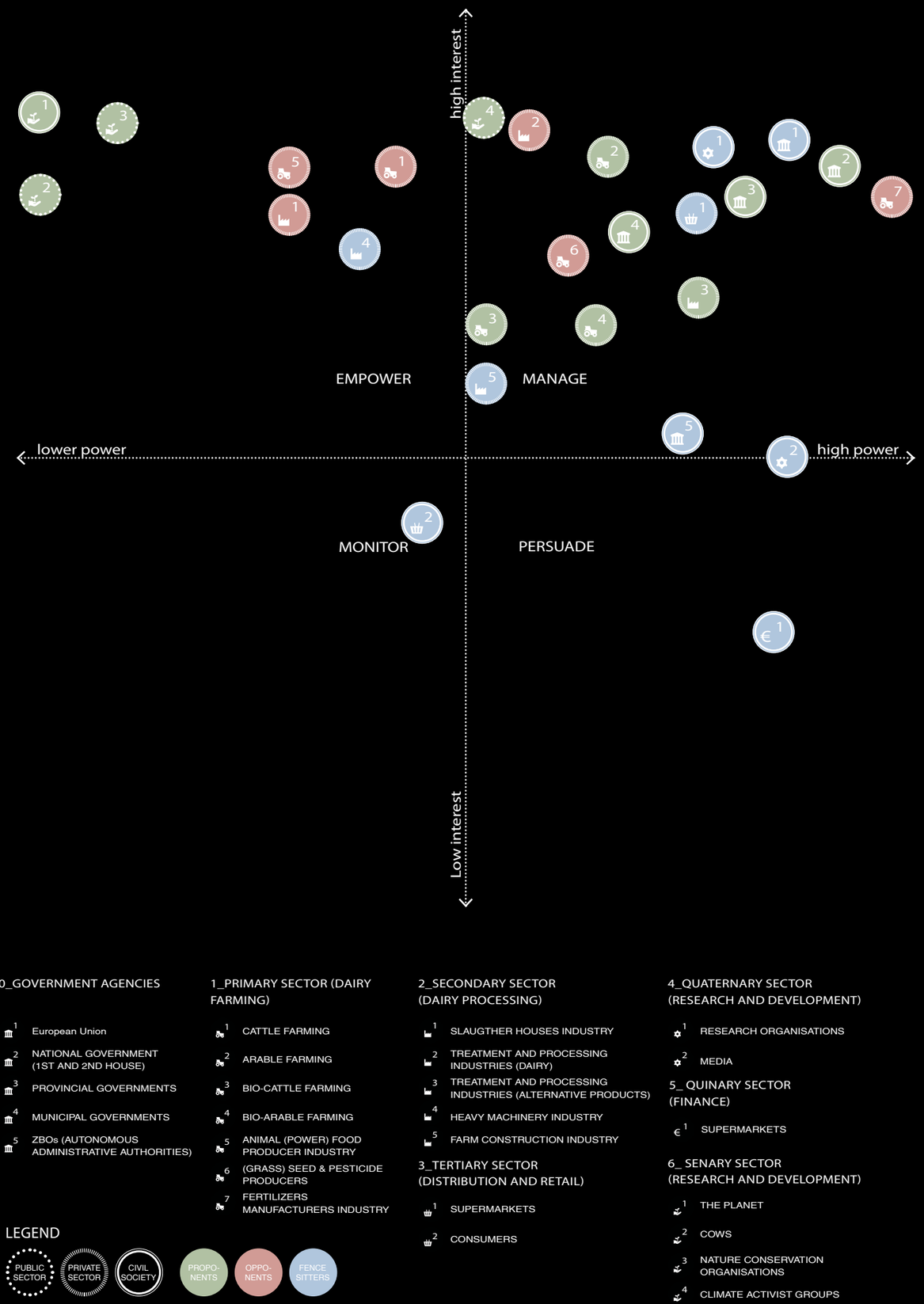


Figure 51: Stakeholder projection for transition



X-Curve

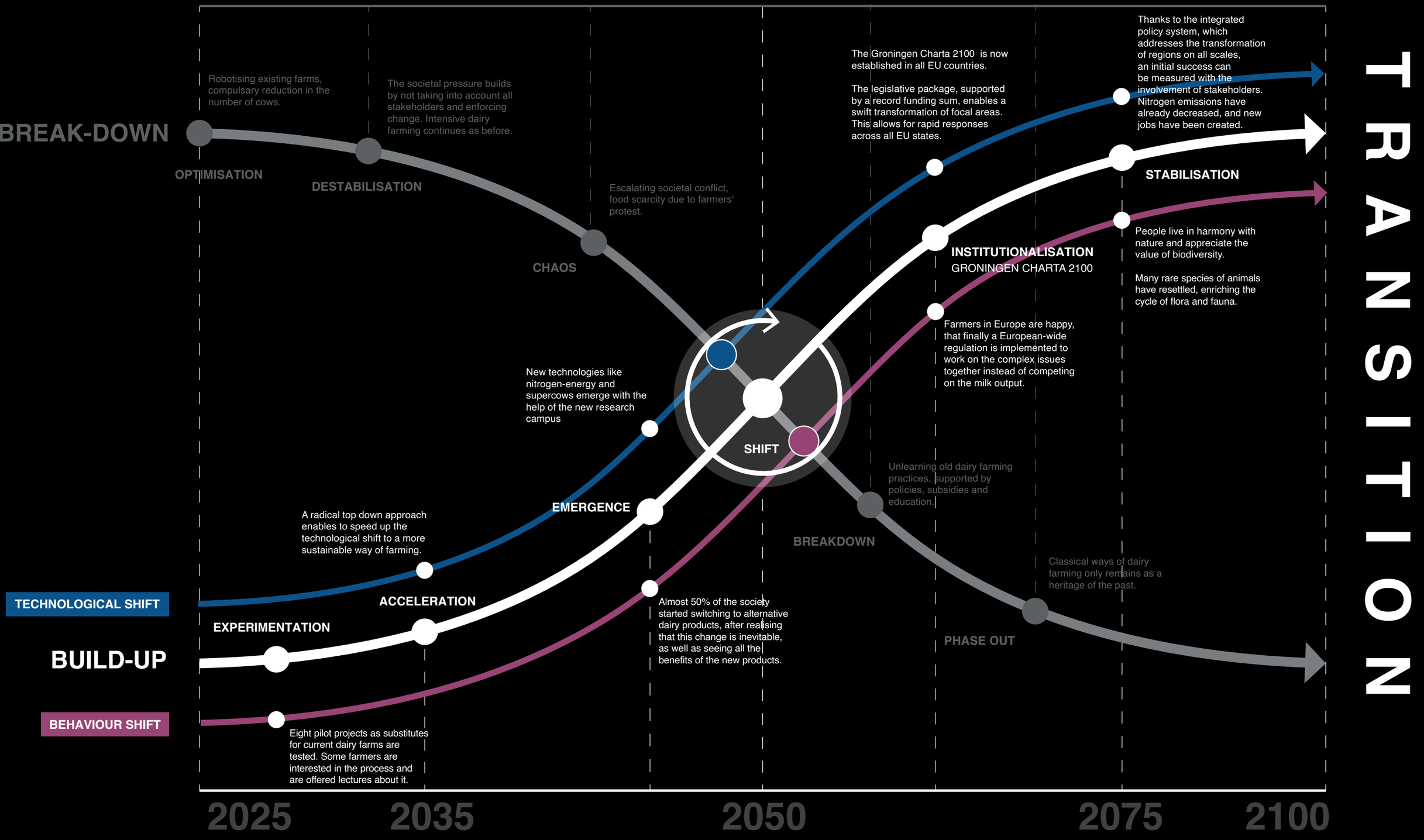


Figure 52: X-curve

6
Strategy

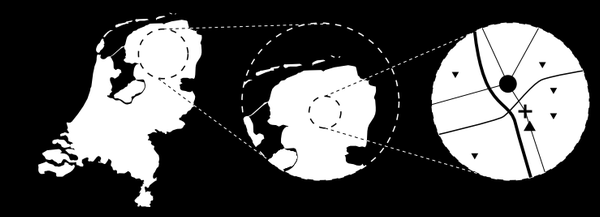
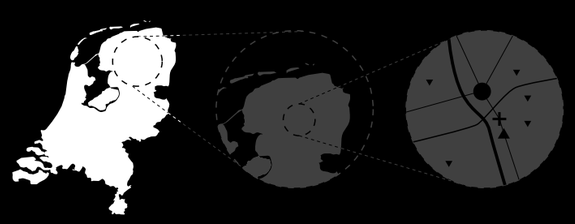


Figure 53: Multi-scalar approach



L - Netherlands

Strategy

Policy conclusion

To establish a strong strategic backbone, we have outlined this normative agenda based on our “Controller”, the conceptual framework mentioned earlier. We mainly worked with the “Schéma de développement du territoire”, a territorial development strategy of the Wallonia region in Belgium to transfer the structure and the institutional integration of the concept in our policy framework.

NOVEX Area GCBA: Greater Cow Bay Area
According to the Ministry of the Interior and Kingdom Relations Housing and Planning (2022), the Novex program represents a national spatial planning strategy built on two main pillars. Firstly, the Direction per province serves as an initial framework, outlining overarching goals. Secondly, the area-based direction prioritises various national tasks, fostering close collaboration between national and regional governments. Across the Netherlands, there are a total of 16 such areas established to enhance provincial cooperation. For instance, the Arnhem-Nijmegen-Foodvalley focuses on urban and peri-urban areas between Arnhem and Nijmegen, shaping a comprehensive urbanisation strategy for the region..

To tackle the issues of the nitrogen surplus in The Netherlands, we suggest the “GCBA: Greater Cow Bay Area”, a new NOVEX area which builds an interprovincial bridge between the provinces of Friesland, Groningen and Drenthe. Within this framework, more specific development goals can be achieved within two main strategies and an established task force.

What: F.O.R.T.
The F.O.R.T. approach aims to revolutionise current land use strategies by focusing on four key pillars: Future-proof Ecosystems, Optimised Networks, Recalibrated Food Production, and Transition Management. It offers a holistic and forward-thinking approach to regional design, striving to create peri-urban and urban areas that are not only environmentally sustainable and economically prosperous but also socially inclusive and resilient in the face of global challenges.

How? D.A.R.S.
Introducing the “D.A.R.S. - Dutch Agriculture Renewal Strategy for a recalibration of the Nitrogen Cycle (Q+T)” as the methodological backbone, this strategy embodies a transformative approach to agriculture, emphasising quitting and transformation approaches of existing farms across a spectrum of intensities. Within the F.O.R.T. approach framework, we have designed eight pilot farm initiatives to serve as testing grounds for our innovative development strategy. These pilots are designed to explore, research, and refine our methods as we journey towards agricultural renewal.

Who? GCBA Task Force
The GCBA Task Force, including experts from planning, science, and the economy, plays an important role in implementing the F.O.R.T. and D.A.R.S. strategy. Through comprehensive research and analysis, they identify innovative farming practices and assess technological innovations to advance sustainable cow farming. Engaging key stakeholders, including farmers and industry representatives, the task force gathers insights and feedback through consultations and workshops. A robust communication strategy raises awareness about the benefits of sustainable cow farming, utilising media, public events, and online platforms. Adaptable and flexible, the task force continuously learns from experiences, adjusting strategies to address emerging challenges and opportunities in technology, market conditions, and policy landscapes. Additionally, the task force monitors progress and ensures active participation, steering the entire process to achieve the goals of the strategy.

Groningen charta 2100
The learnings from the new Novex region hold the potential to inform the development of the Groningen Charta 2100. This EU policy serves as a platform for scaling up successful strategies and initiatives to a European level, allowing countries with similar spatial conditions to benefit from these findings. By generating collective knowledge and experiences, the Groningen Charta 2100 facilitates collaborative efforts towards sustainable agriculture and environmental stewardship across Europe.

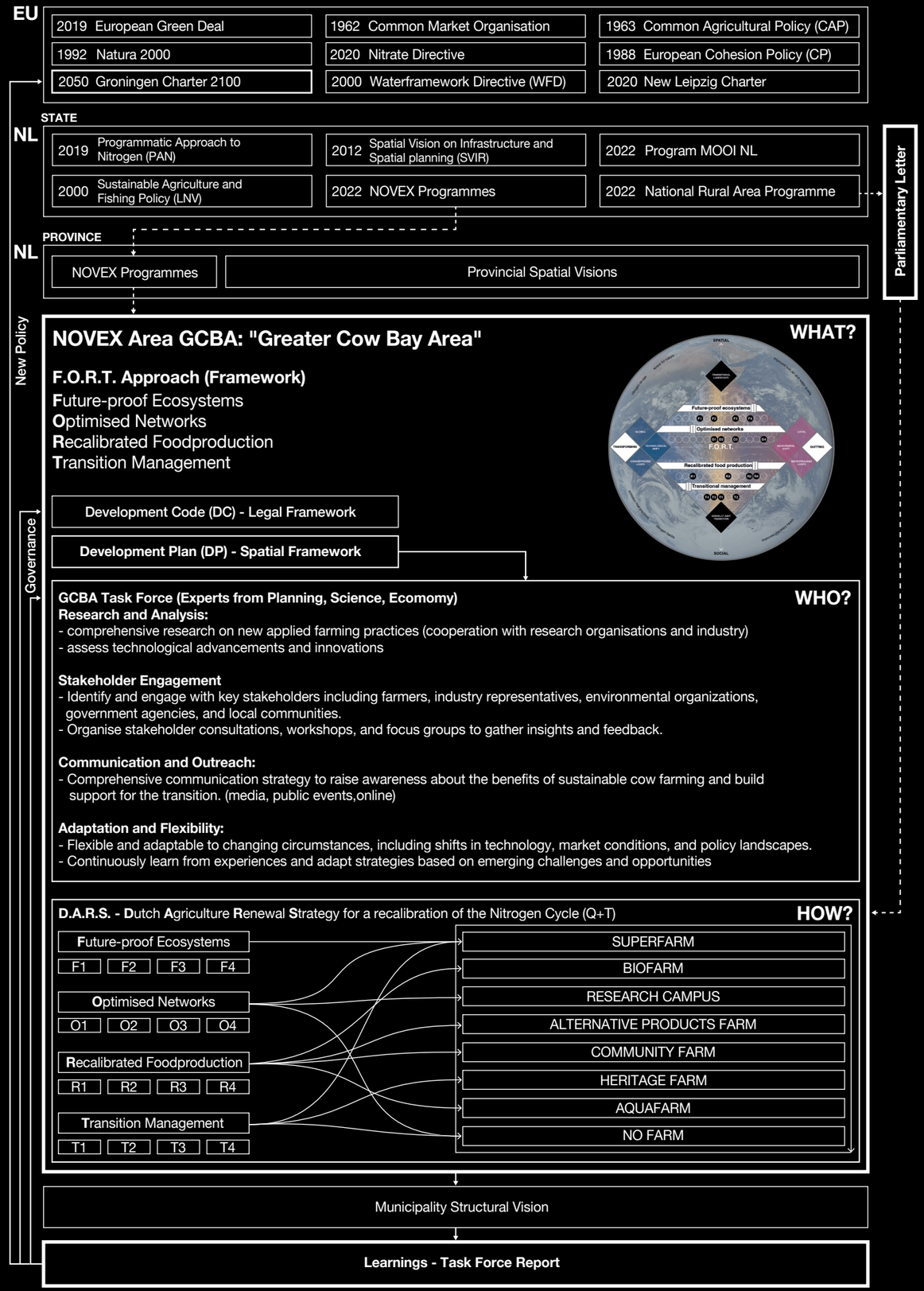
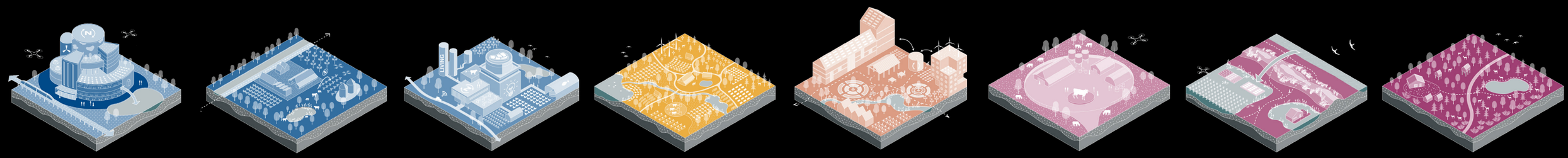


Figure 54: Policy conclusion

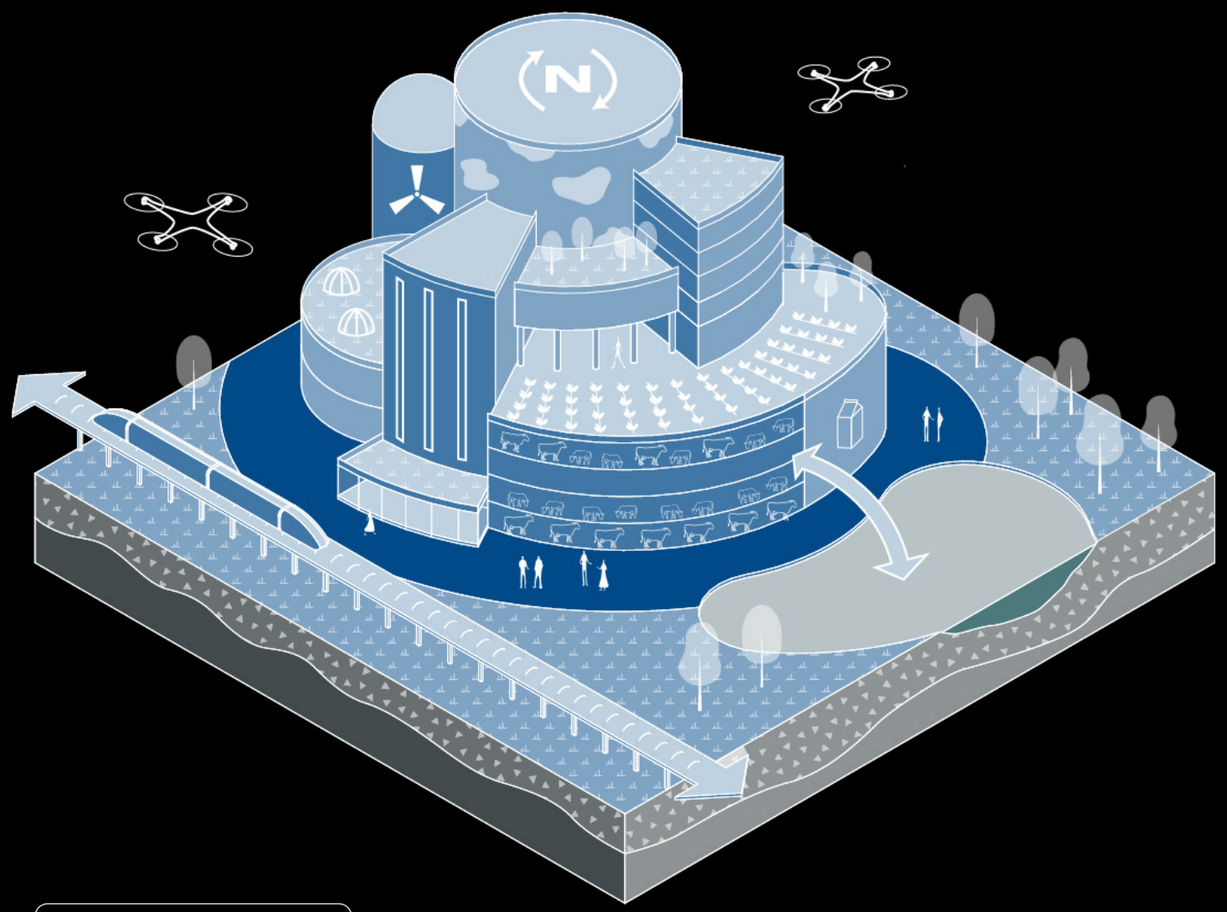
We created a toolbox to represent the previously mentioned eight pilot farm initiatives of the D.A.R.S. strategy as the future typologies of dairy farming. It constitutes of eight axonometric drawings showing their most important characteristics, coloured in a way to correspond our gradient from transforming to quitting. These new typologies can be applied and tested on a Netherlands-scale, acting as the legend for the maps we created on all scales.



SUPERFARM | **BIOFARM** | **RESEARCH CAMPUS** | **ALTERANTIVE PRODUCTS FARM** | **COMMUNITY FARM** | **HERITAGE FARM** | **AQUA FARM** | **NO FARM**

Figure 55: Toolbox

Superfarm
Figure 56



SUPERFARM

A self-sustaining, concentrated (animal-based) dairy production unit with incorporated housing, social institutions, vertical farming and energy production (biomass, nitrogen-energy). It is usually located next to main infrastructure, for example the new Lelylijn. It creates plenty of future work opportunities in farming, research and education among others.

F1 F2 F3 F4
future-proof ecosystems

O1 O2 O3 O4
optimised networks

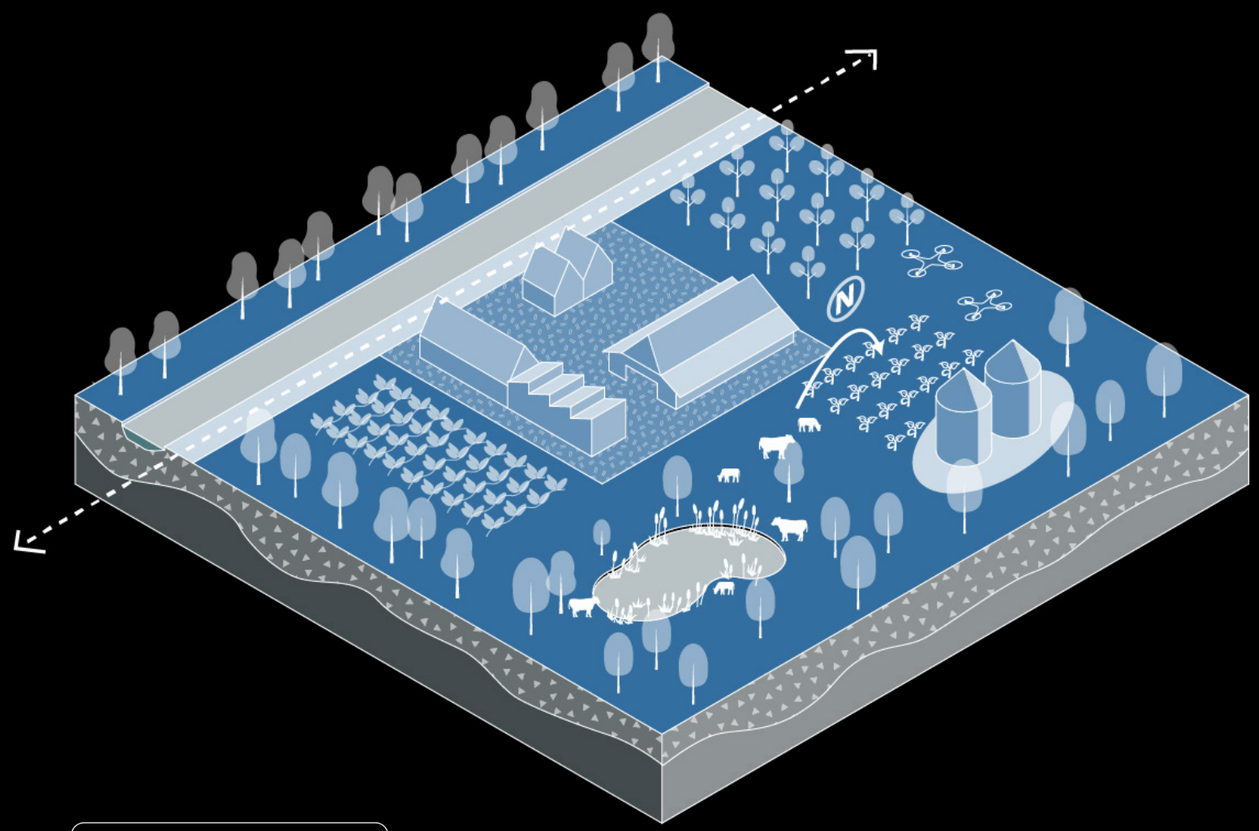
R1 R2 R3 R4
recalibrated food-production

T1 T2 T3 T4
transition management

CLAY SAND PEAT LOESS
soil compatibility

A self-sustaining, concentrated dairy production unit with incorporated housing, social institutions, vertical farming and energy production (biomass, nitrogen-energy). It is usually located next to main infrastructure, for example the new Lelylijn. It creates plenty of future work opportunities in farming, research and education among others.

Biological Farm
Figure 57



BIOLOGICAL FARM

Combines biological farming with permaculture, creating a vital ecosystem of diverse species. Drones are responsible for monitoring and herding cows, as well as harvesting and irrigating crops, while energy is provided by a biomass plant, using manure. Housing is possible in the transformed farm buildings or in newly added units. It is important that this typology is not possible on peat soils!

F1 F2 F3 F4
future-proof ecosystems

O1 O2 O3 O4
optimised networks

R1 R2 R3 R4
recalibrated food-production

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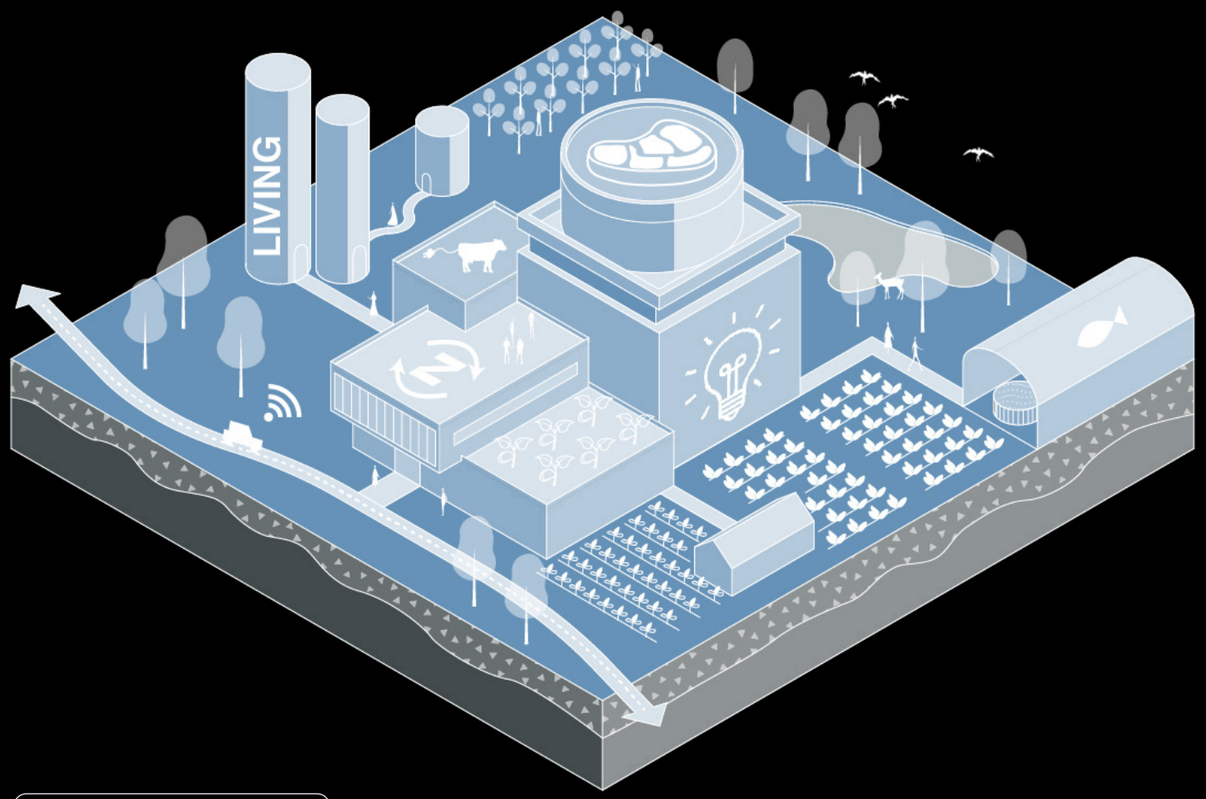
Research campus
Figure 58



RESEARCH CAMPUS

An essential element of the technological shift of the future. Its most important innovations are nitrogen energy, super-cows, experimental crops and lab-grown meat. It has experimental- and student housing units, and it attracts researchers from all over the world. It exports knowledge as part of an international network, while promoting 'lifelong learning' and education locally.

F1 F2 **F3** F4
future-proof ecosystems

O1 **O2** **O3** O4
optimised networks

R1 R2 **R3** R4
recalibrated food-production

T1 **T2** **T3** **T4**
transition management

CLAY | **SAND** | **PEAT** | **LOESS**
soil compatibility

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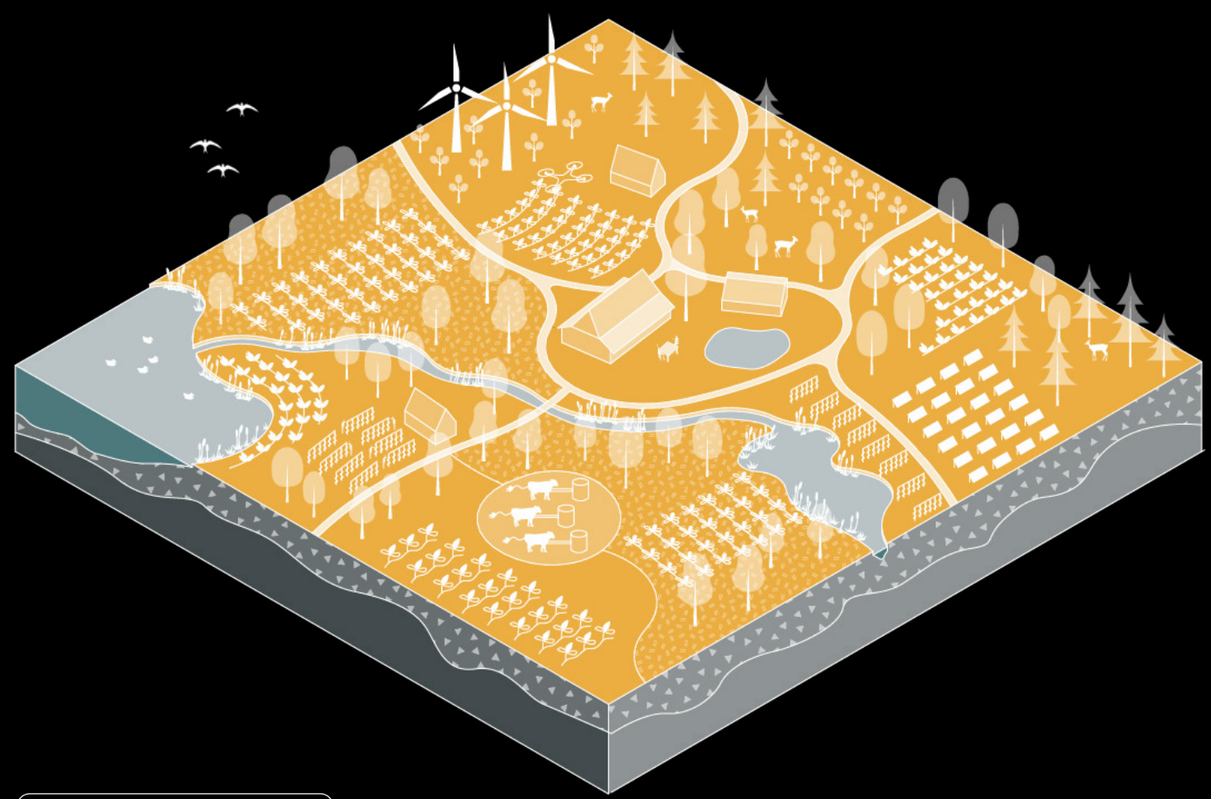
Alternative products farm
Figure 59



ALTERNATIVE PRODUCTS FARM

Promoting behaviour shift, this typology cultivates plants that can be substitutes for animal-based dairy products, using methods like extensive agriculture, agroforestry, mixed crops and wet crops cultivation. It creates experimental products with cellular agriculture and robotic cows. It has renewable energy sources and circular waste management. Housing and work units on location.

F1 F2 **F3** **F4**
future-proof ecosystems

O1 **O2** **O3** **O4**
optimised networks

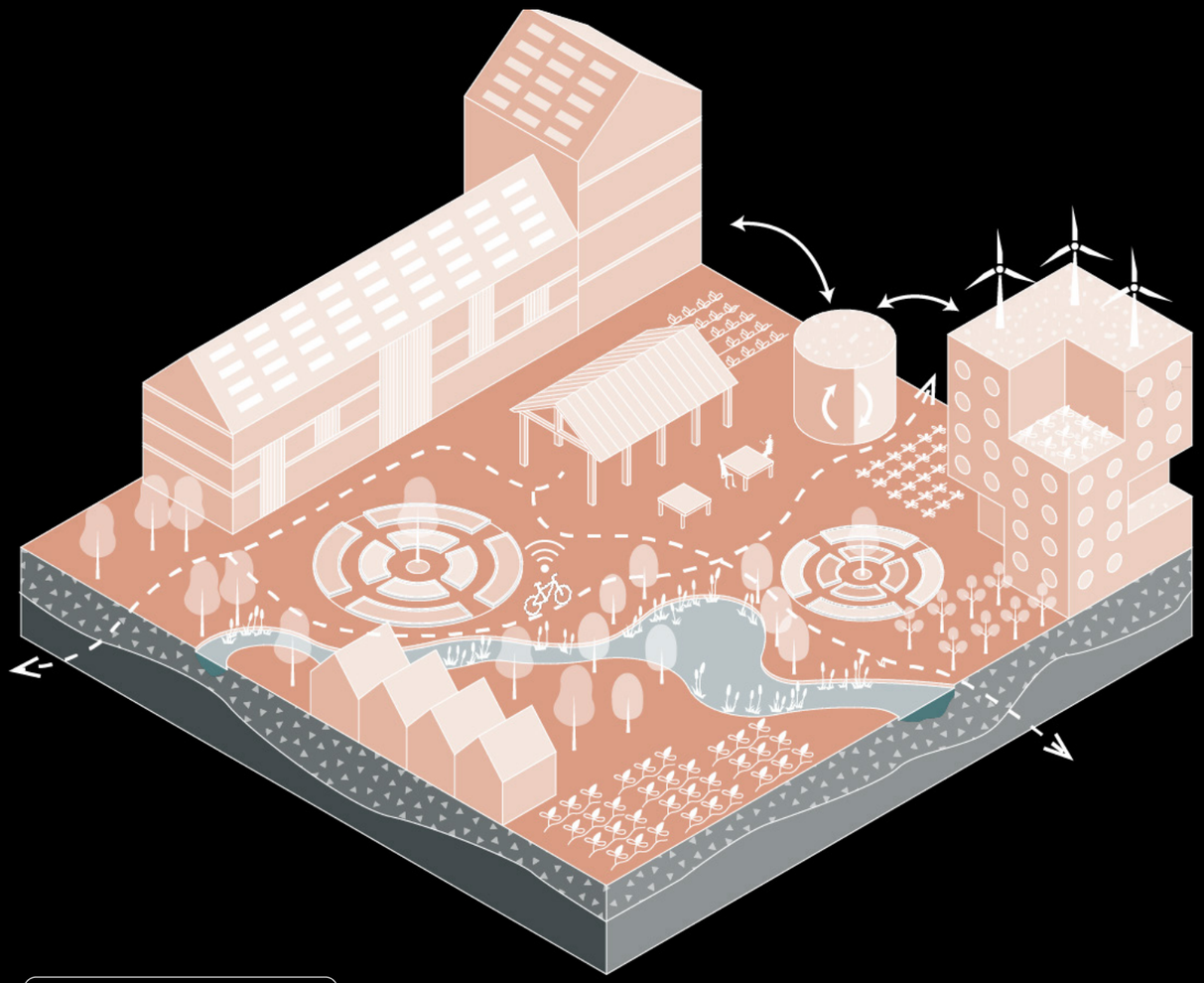
R1 **R2** R3 **R4**
recalibrated food-production

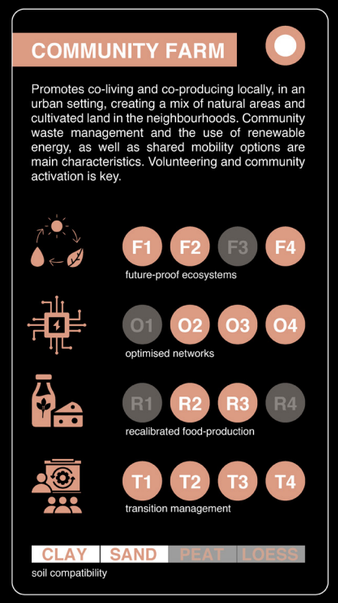
T1 **T2** **T3** T4
transition management

CLAY | **SAND** | **PEAT** | **LOESS**
soil compatibility

Promoting behaviour shift, this typology cultivates plants that can be substitutes for animal-based dairy products, using methods like extensive agriculture, agroforestry, mixed crops and wet crops cultivation. It creates experimental products with cellular agriculture and robotic cows. It has renewable energy sources and circular waste management. Housing and work units on location.

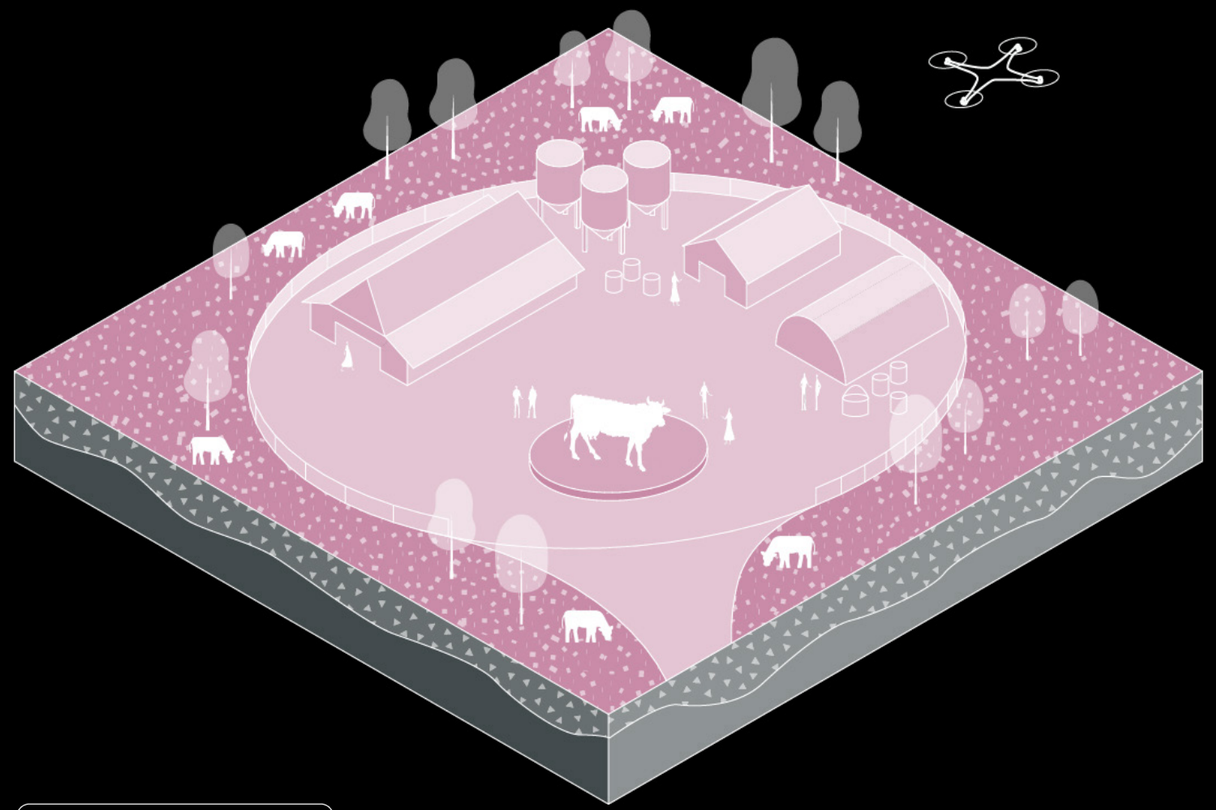
Community farm
Figure 60

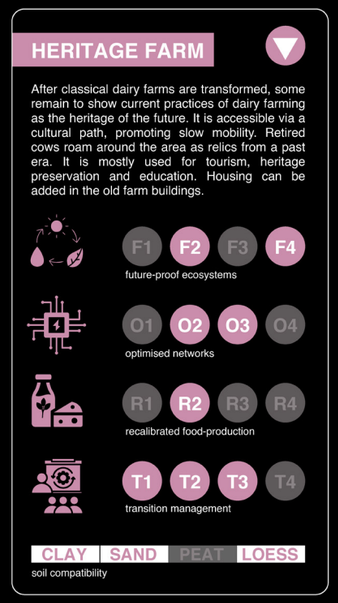




Promotes co-living and co-producing locally, in an urban setting, creating a mix of natural areas and cultivated land in the neighbourhoods. Community waste management and the use of renewable energy, as well as shared mobility options are main characteristics. Volunteering and community activation is key.

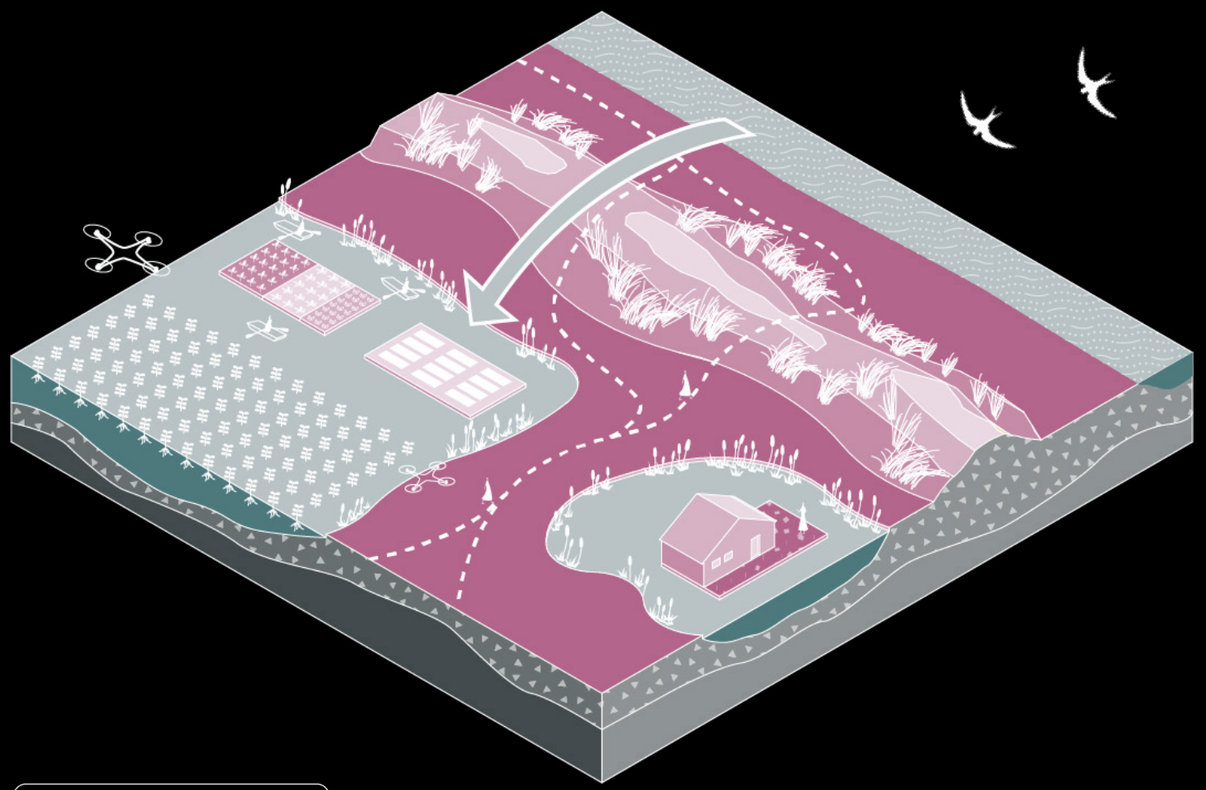
Heritage farm
Figure 61





After classical dairy farms are transformed, some remain to show current practices of dairy farming as the heritage of the future. It is accessible via a cultural path, promoting slow mobility. Retired cows roam around the area as relics from a past era. It is mostly used for tourism, heritage preservation and education. Housing can be added in the old farm buildings.

Aqua farm
Figure 62



AQUA FARM

This typology combines food production with natural habitats and robust water defence and buffering functions, creating a connected coastal ecosystem along the dunes. Salty crops cultivation is tested and perfected here, together with floating farms, solar panel fields and housing. Drones and smart boats help to navigate and travel the area.

F1 F2 F3 F4
future-proof ecosystems

O1 O2 O3 O4
optimised networks

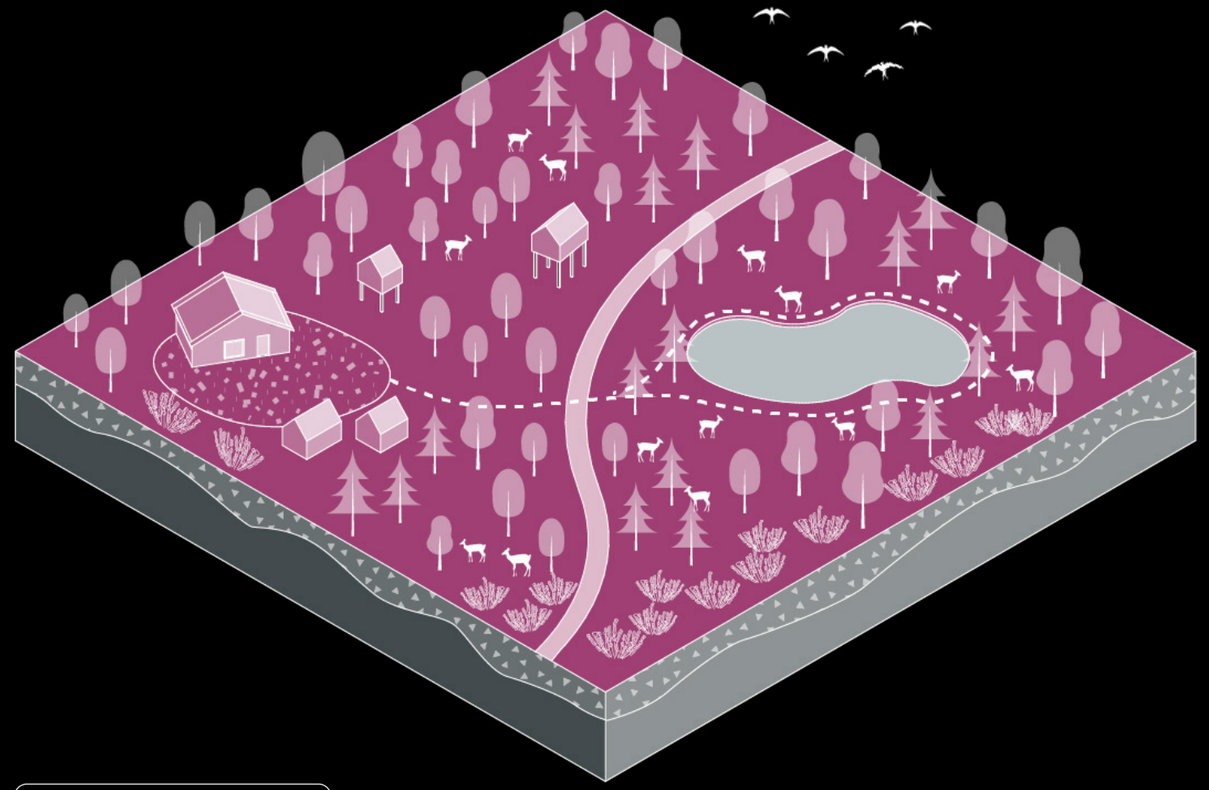
R1 R2 R3 R4
recalibrated food-production

T1 T2 T3 T4
transition management

CLAY SAND PEAT LOESS
soil compatibility

This typology combines food production with natural habitats and robust water defence and buffering functions, creating a connected coastal ecosystem along the dunes. Salty crops cultivation is tested and perfected here, together with floating farms, solar panel fields and housing. Drones and smart boats help to navigate and travel the area.

No farm
Figure 63



NO FARM

A place of respected nature, relaxation and thriving habitats with enhanced biodiversity. Bike- and pedestrian trails lead through these areas, while people can rent out old farms transformed into recreation homes. Offers job opportunities in nature preservation and wildlife monitoring. There is no food-production here to avoid disturbing newly restored ecosystems.

F1 F2 F3 F4
future-proof ecosystems

O1 O2 O3 O4
optimised networks

R1 R2 R3 R4
recalibrated food-production

T1 T2 T3 T4
transition management

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A place of respected nature, relaxation and thriving habitats with enhanced biodiversity. Bike- and pedestrian trails lead through these areas, while people can rent out old farms transformed into recreation homes. Offers job opportunities in nature preservation and wildlife monitoring. There is no food-production here to avoid disturbing newly restored ecosystems.

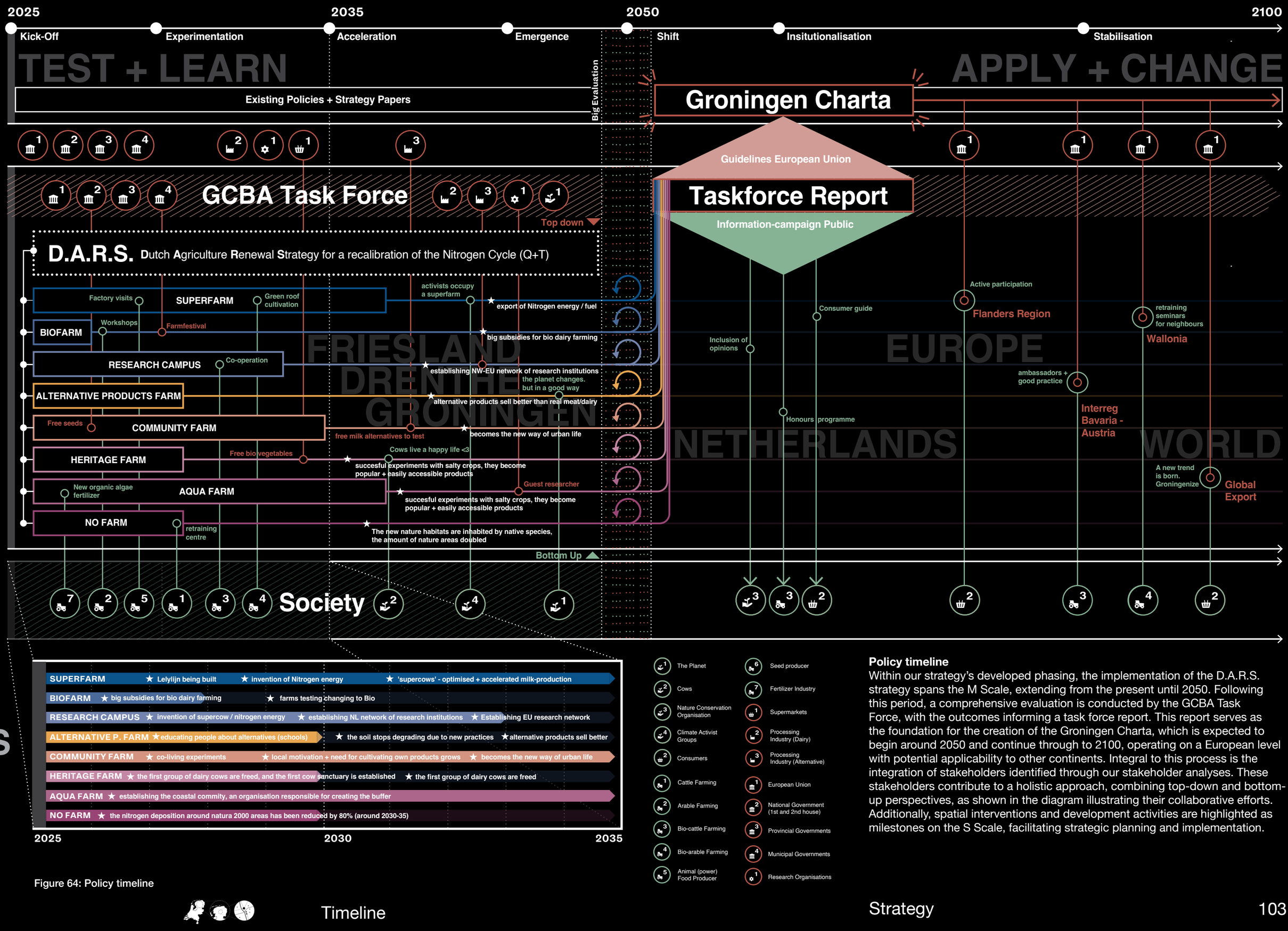
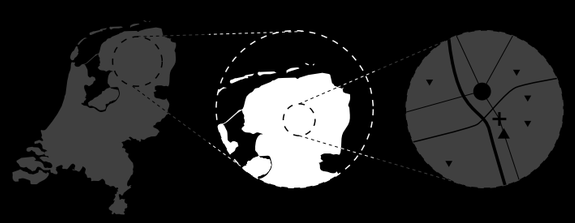


Figure 64: Policy timeline

Policy timeline

Within our strategy's developed phasing, the implementation of the D.A.R.S. strategy spans the M Scale, extending from the present until 2050. Following this period, a comprehensive evaluation is conducted by the GCBA Task Force, with the outcomes informing a task force report. This report serves as the foundation for the creation of the Groningen Charta, which is expected to begin around 2050 and continue through to 2100, operating on a European level with potential applicability to other continents. Integral to this process is the integration of stakeholders identified through our stakeholder analyses. These stakeholders contribute to a holistic approach, combining top-down and bottom-up perspectives, as shown in the diagram illustrating their collaborative efforts. Additionally, spatial interventions and development activities are highlighted as milestones on the S Scale, facilitating strategic planning and implementation.



L - NETHERLANDS **M - REGIONS** S - ZOOM-INS

Figure 65: M-Region selection

Figure 66: Nitrotopia landscape

Looking at our vision map on the scale of the Netherlands, we tried to locate the most heterogeneous areas where most instances of the quit and transform gradient are located adjacent to each other. Considering also the current socio-political circumstances and predicting where the most conflict and opposition from citizens would occur, some areas were brought into focus.

The area we chose to focus on was the region of Friesland, Groningen, and Drenthe. The overall goal was to implement our strategy in a spatial regional context, incorporating the toolbox of new farm typologies, while also connecting them to our policy and stakeholders.

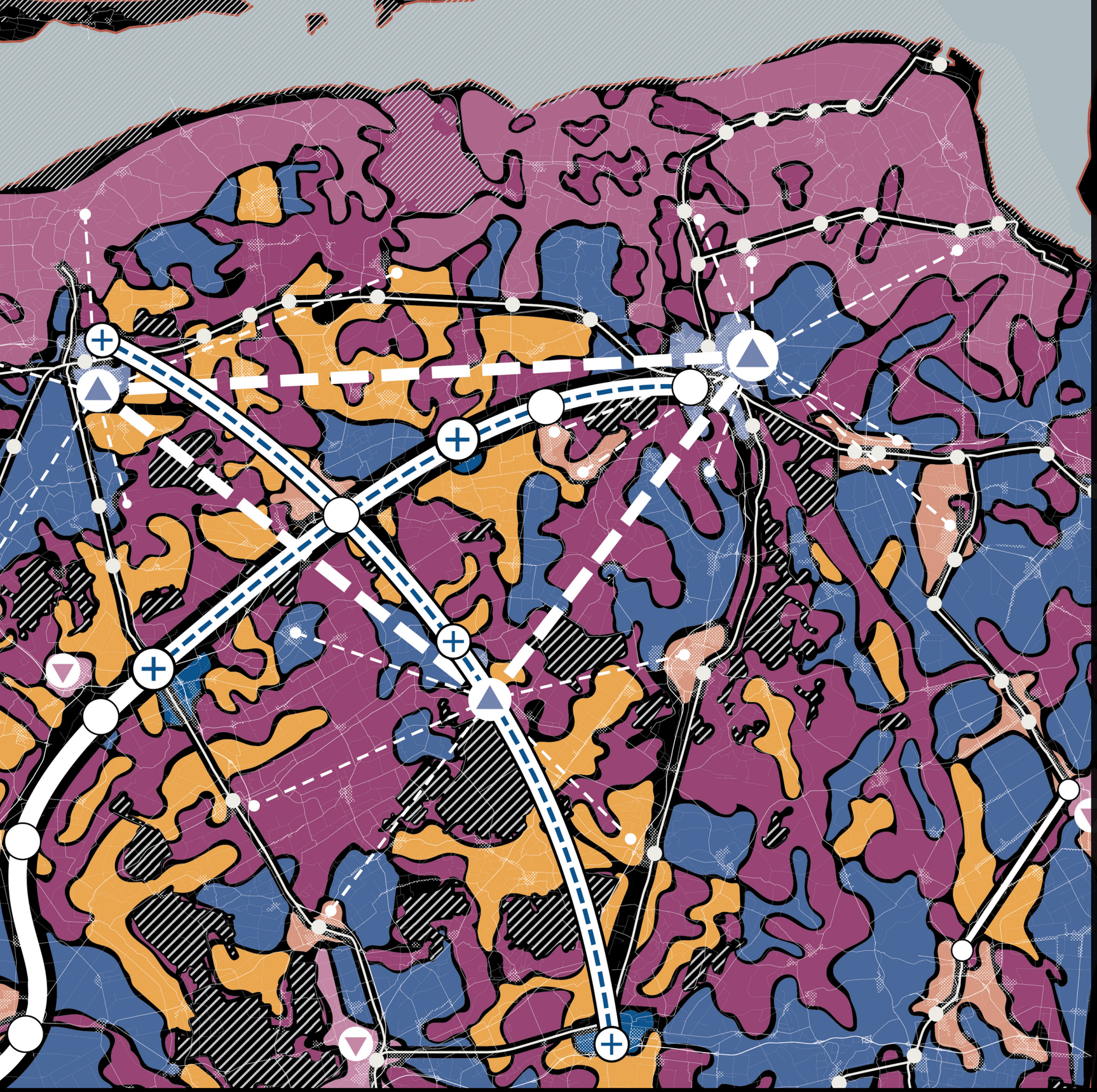
The process followed was similar to that of the vision, meaning that we also overlaid the layers we thought as most important and tried to make spatial conclusions and proposals. One of our main aims was to create a natural network under protection status, which was based on the Natura 2000, the Natural Network of the Netherlands (Natuurnetwerk Nederland, or else NNN), as well as the forested areas that are not part of the existing natural protected network. These were unified and then expanded, adopting the “no-farm” typology. Existing farm structures with interesting configuration patterns were turned into “cultural heritage farms”, with cultural paths running through them and uniting them into a larger network.

Soil type also played a huge part in the spatial allocation of the different farm typologies, since “biological farming” is not possible on peat soil. Furthermore, the groundwater in the area to the North is in imminent danger of becoming saline, therefore rendering the possibility for more traditional agricultural practices there unrealistic. Consequently, this area was typecasted as an “aqua farm”, simultaneously functioning as flood protection.

The newly built Lelylijn terminates in Groningen, creating a very powerful axis running through the region. Already existing milk processing industries are clustered together and “superfarms” are created at their points of convergence. Additionally, spaces where scientific research about sustainable and bio-based practices is conducted are emphasised with the placement of new “research campuses”, specifically in Groningen, Leeuwarden and Oosterwolde. These three points form the “knowledge triangle”. Therefore, two main types of axes were created, the superfarm one and the research one, with the latter gaining more importance since its influence radius is bigger and attracts people from different areas or even regions. The land closer to the superfarms and research campuses is utilised mostly for “alternative products farming” while “community farming” is slowly implemented in the areas with urban character.

Consequently, with the implementation of our strategy, the agricultural landscape of the area will become a “patchwork” of new farming typologies, undergoing a fundamental transition.

Figure 67: M-scale vision



Change in the Farming Labourforce

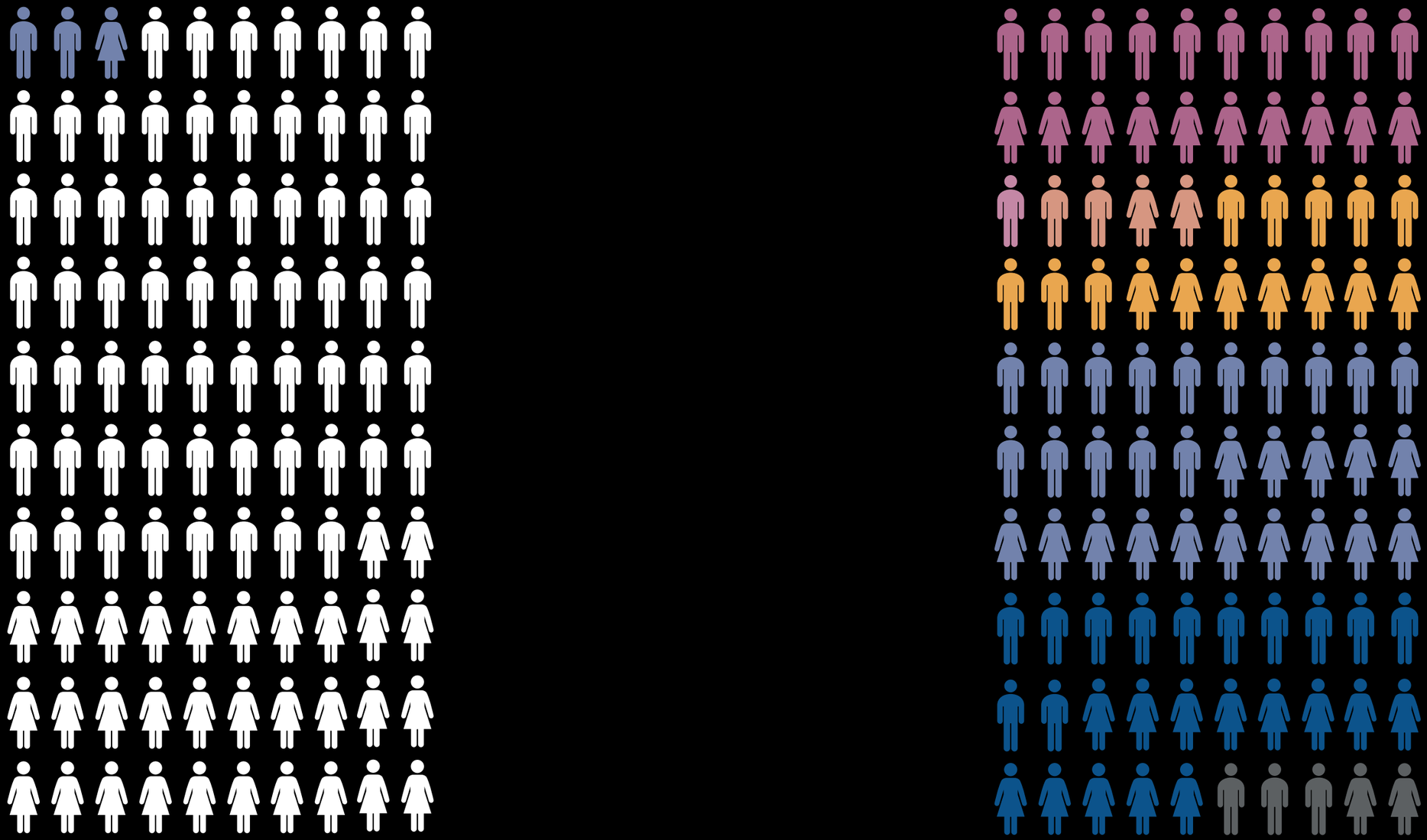
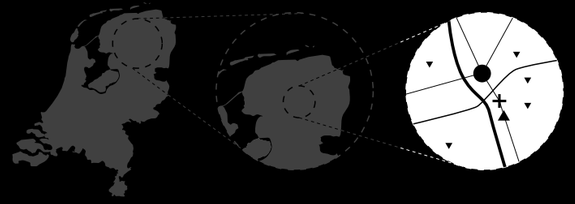


Figure 68: Change in the farming labourforce

Existing Situation
From the people working in the agricultural sector in the general area of the Friesland, Groningen, and Drenthe region, approximately 3% were calculated to be organic in 2020 (using data from CBS StatLine, n.d. and Statista, 2021) According to Centraal Bureau voor de Statistiek (Statistics Netherlands, 2018), in 2017 one third of the people working in farming were women, a percentage that has stayed stable since the beginning of the 21st century, so it is probably safe to say that in the last years it has not fluctuated significantly. These percentages are realistic, yet somehow disheartening. Therefore, with our vision for the M region we aspire to completely reformulate the character of the labourforce.

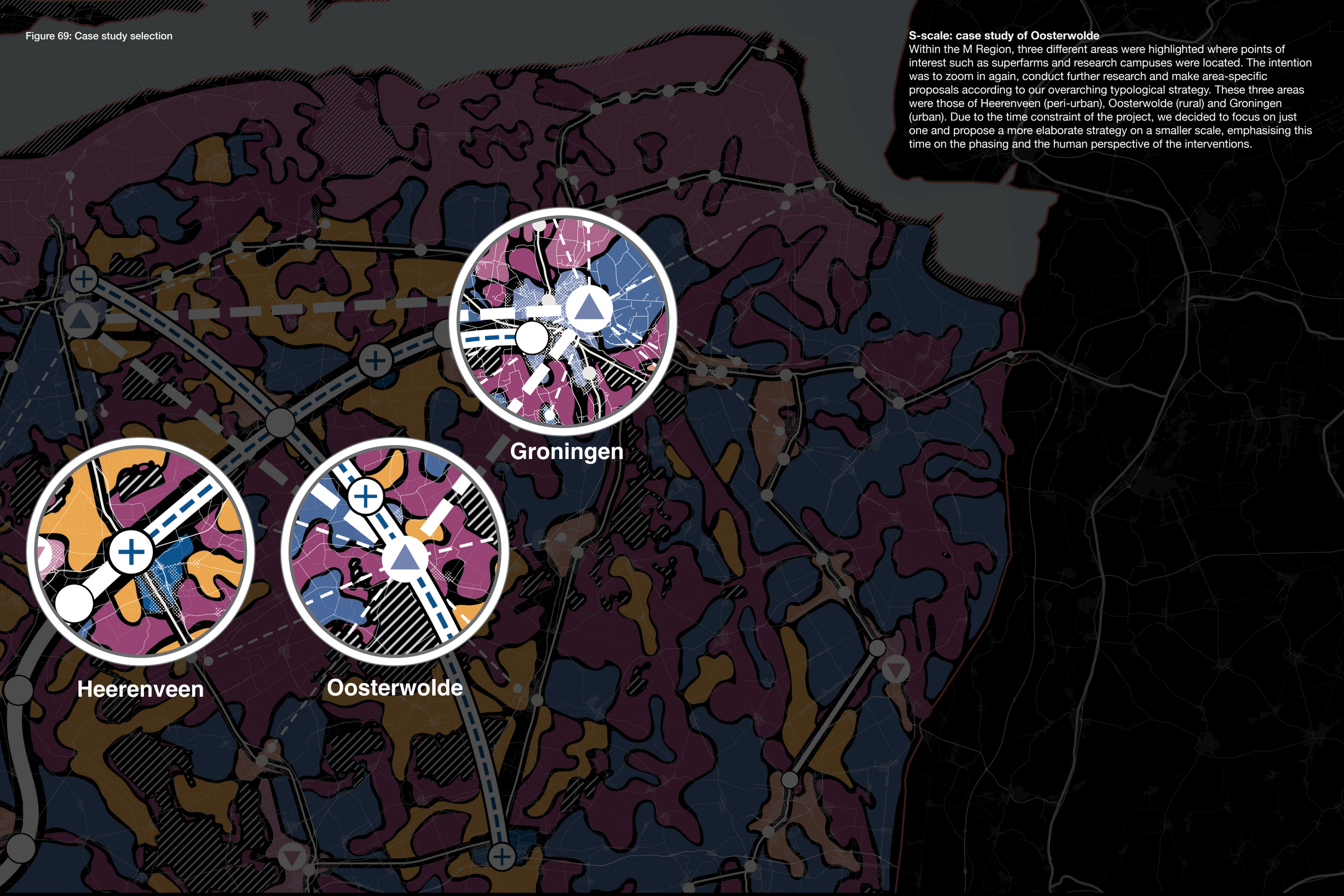
After transitioning
Our vision for 2050 supports an inclusive distribution of labour, with men and women equally as present in the agricultural sector. Taking as base the existing agricultural area (Corine Land Cover 2018) and using our map for the M-Region we roughly calculated and predicted the way the workforce within the agricultural sector will transform in the coming years in this specific area, as highlighted in figure 68 above. It is important to note that almost one third of the people will be working as a bio-farmer, while one fourth of the farmers will be employed at a superfarm instead of completely losing their occupation. Our goal is for the least amount of people (approximately 5%) will have to switch professions to something entirely different.



L - NETHERLANDS M - REGIONS **S - ZOOM-INS**

Figure 69: Case study selection

S-scale: case study of Oosterwolde
Within the M Region, three different areas were highlighted where points of interest such as superfarms and research campuses were located. The intention was to zoom in again, conduct further research and make area-specific proposals according to our overarching typological strategy. These three areas were those of Heerenveen (peri-urban), Oosterwolde (rural) and Groningen (urban). Due to the time constraint of the project, we decided to focus on just one and propose a more elaborate strategy on a smaller scale, emphasising this time on the phasing and the human perspective of the interventions.



2025

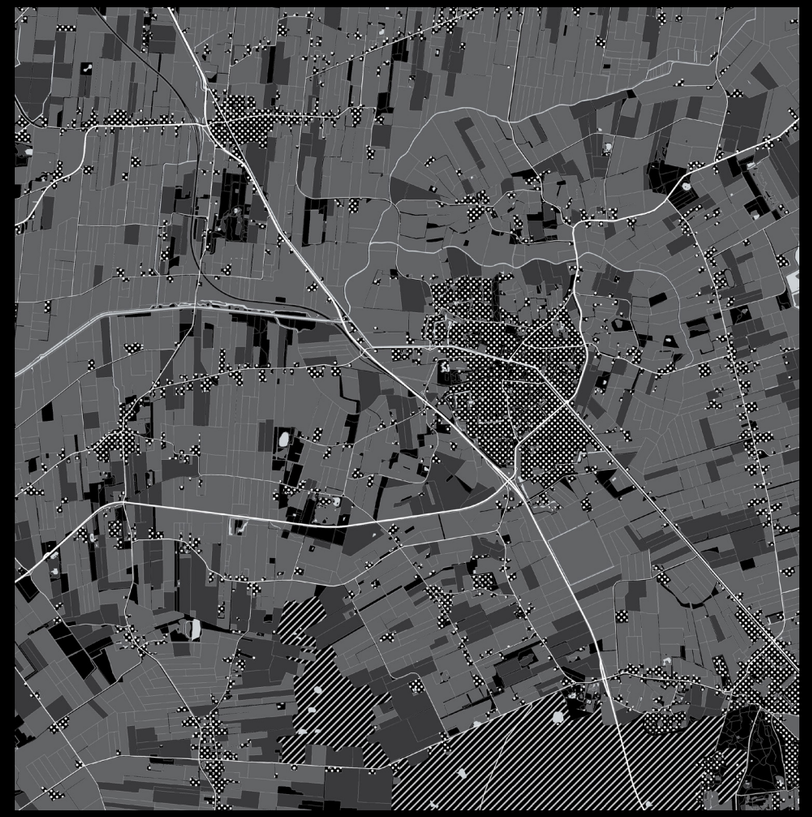


Figure 71: 2025

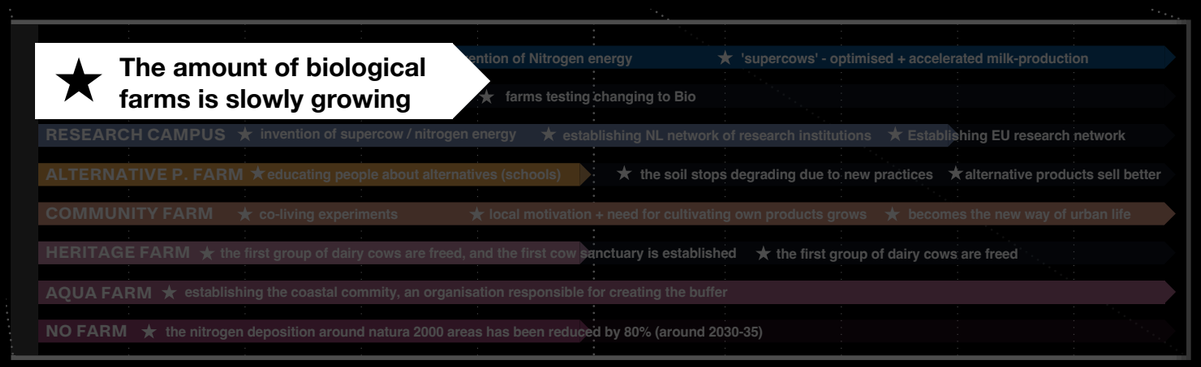


Figure 70: Current landscape

Oosterwolde is a small town of roughly 10.000 people (Statistieken Wijk Oosterwolde, 2024) located in the province of Friesland, close to the border with Drenthe. The landscape surrounding it is largely agricultural, yet an interesting observation is that two Natura 2000 areas are in its immediate proximity. We partly choose this sub-area due to the existing eco-initiatives and a bigger industrial park located at the south side of the city. The existing situation is presented in figure 71, showing the agricultural areas and especially the grasslands where the dairy cows currently graze. A first milestone achieved would be increasing the number of biological farms, with the support of governmental subsidies. The urban fabric and the agricultural landscape have not started fundamentally transitioning yet.

2035

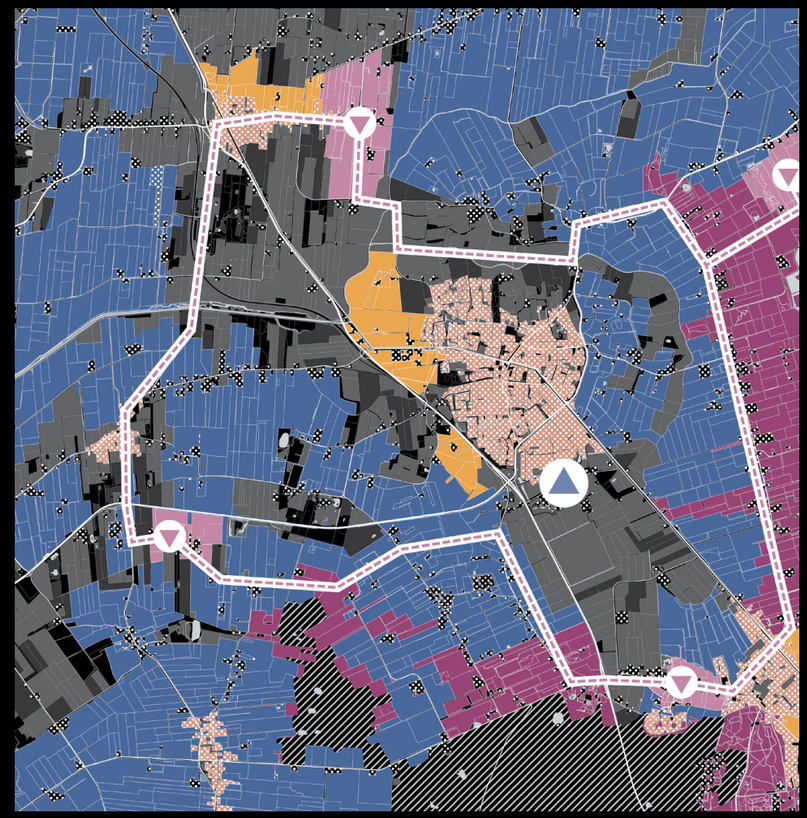


Figure 73: 2035 projections

10 km

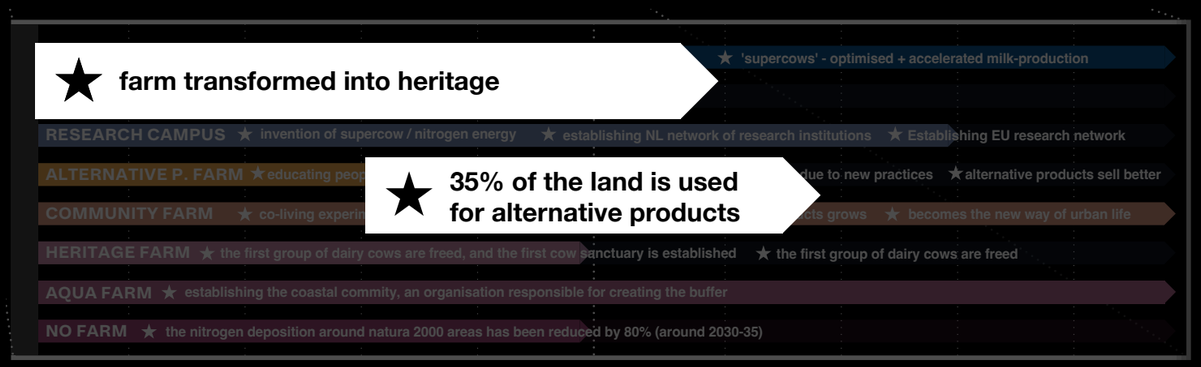


Figure 72: Shifting landscape

In ten years' time, the situation has started shifting. The protected natural network has already started expanding outside of the Natura 2000 areas, while existing farm structures have transformed into heritage locations and the first cultural path has been established. In Oosterwolde's industrial area, located to the south of the city, the first research campus has also been founded, where there is currently a centre conducting research on sustainable solutions and fostering communication between governments, entrepreneurs, and education (Wat We Doen, n.d.). Biological farming has started expanding, and a small amount of farmland has been transitioning towards alternative products, mostly close to the already existing (peri-) urban centres, which have adopted community farming as a practice.

2050

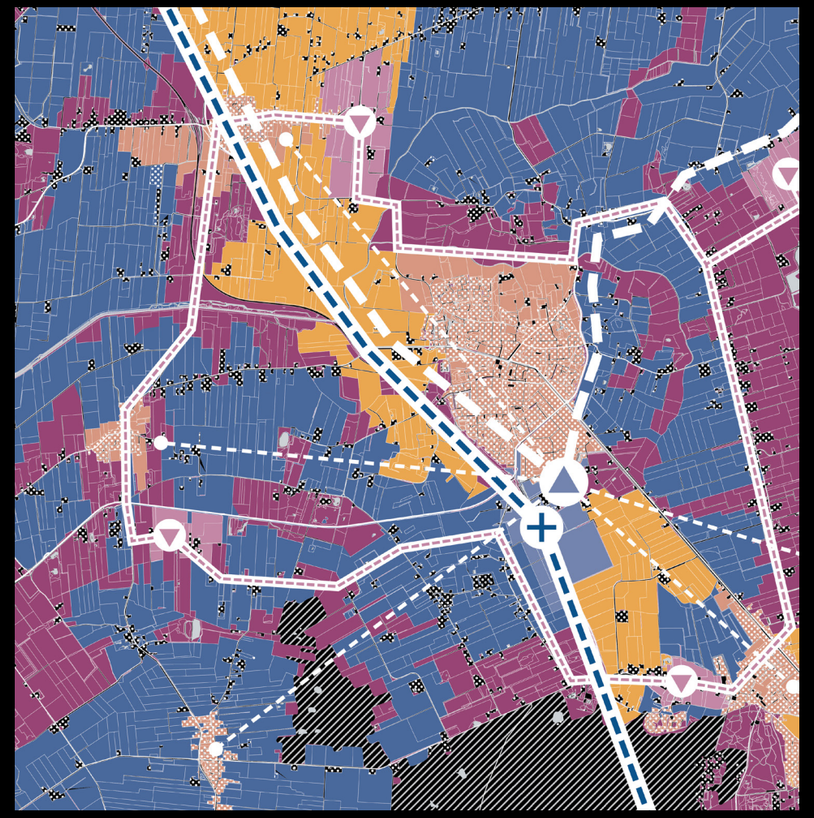


Figure 75: 2050 projections

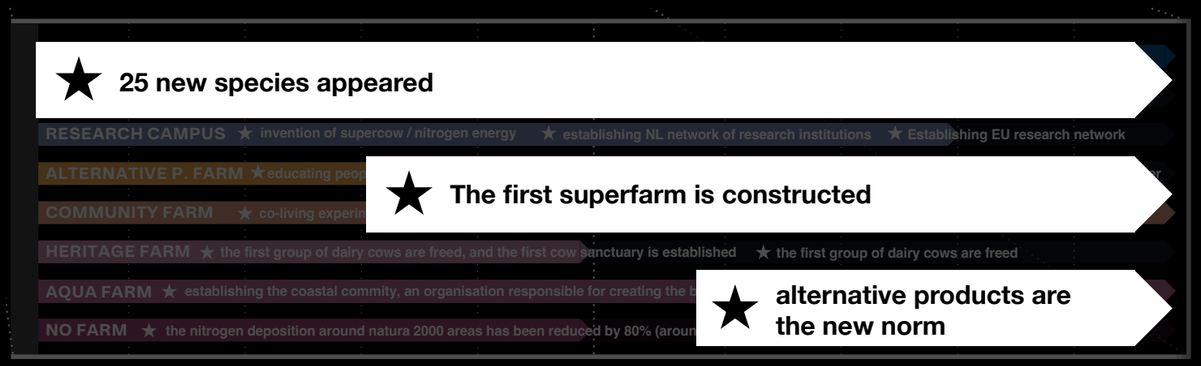
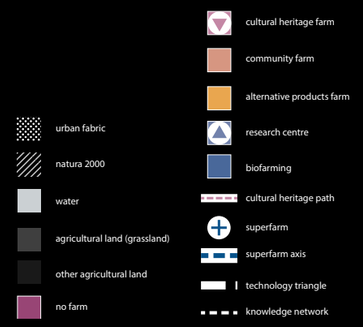


Figure 74: Transitioning landscape



In 2050 a connected network of natural areas has been established, with the prospect of expanding even further in the following years. The research campus has evolved, also being a major point of the “knowledge triangle”. Oosterwolde’s character has started changing from a small rural city to a technological and industrial hub, since a superfarm has also been placed there, making it a place where the two most important axes intersect. We predict that the area will attract people from the nearby towns and villages. Therefore, it is the most logical thing to estimate that the limits of its urban fabric will also be expanded, yet there is a necessity for us to ensure this urban growth will be sustained. Alternative products will have become the new norm, with the land allocated for their production mostly running along the superfarm axis, while along the other important road axis of the area biological farming is located interspersed with the expanded natural areas of no farming.

Figure 76: Lessons learned

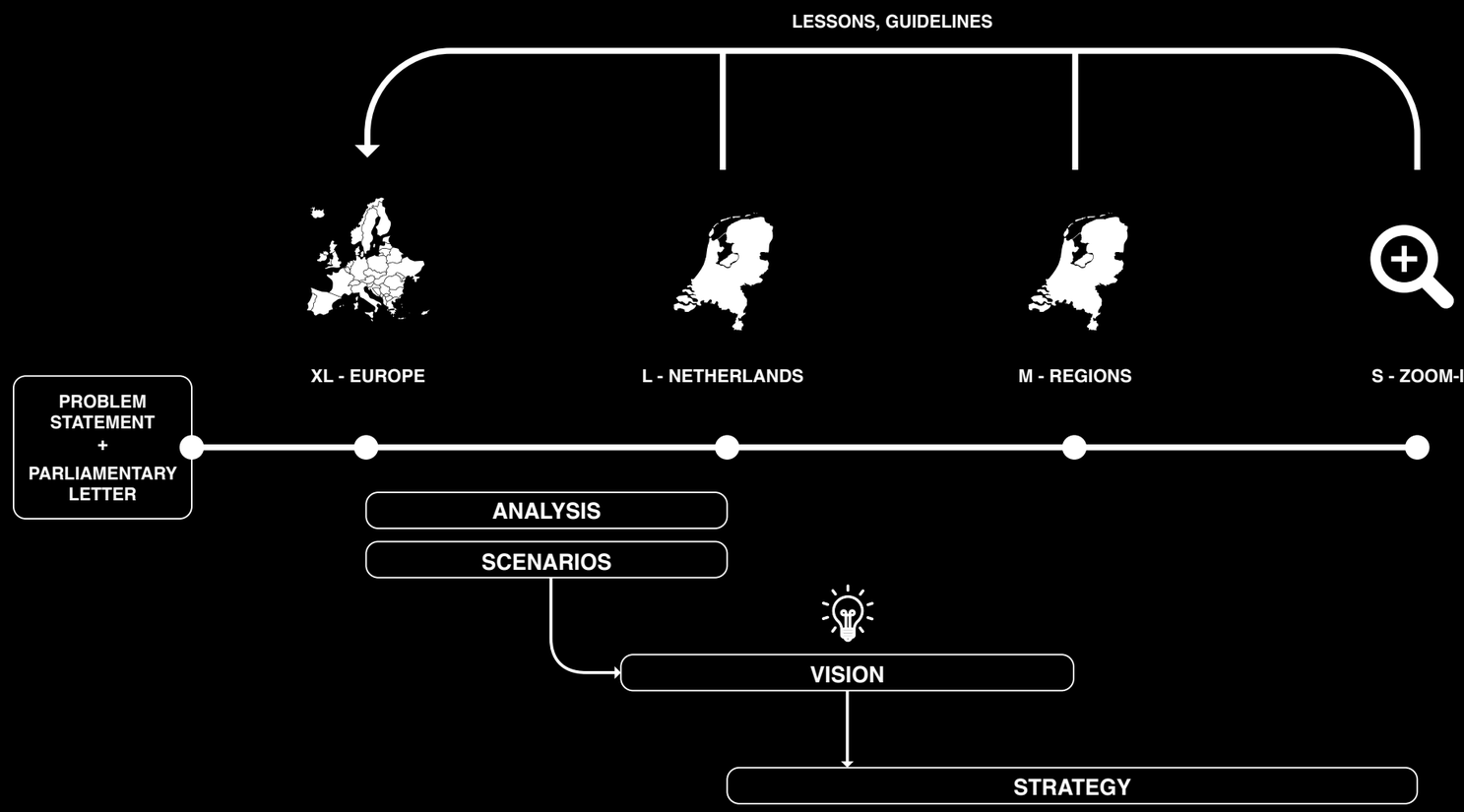


Figure 76: Lessons learned

The multi-scale nature of the project allowed us to discover the meaning of our vision and strategy on three different layers, from concepts to spatial interventions, drawing conclusions from each. This study, combined with the D.A.R.S. and F.O.R.T. approaches, can serve as a pilot project for similar areas in Europe that have high amounts of nitrogen surplus combined with farmlands and social pressure. By developing and using the Groningen Charta 2100 previously detailed in the chapter of Policy conclusions, we can establish a network of knowledge and support in these often neglected areas.

Figure 77 shows the possibly similar regions that we pinpointed on the map of North-Western Europe, based on the combination of the maps we previously made in the analysis phase on this scale and the elements of our vision. The areas of Flanders, Münster and Lower Saxony could be the first ones where the new policies and tools are implemented after the test-phase in the Netherlands, as they are situated at close proximity and are areas tackling extreme nitrogen-related emissions and depositions.

The most important lessons learned throughout the process we followed in the Netherlands that could be applied on the European scale are:

The current dairy farming practices need to change urgently to provide a sustainable future for generations to come. This change has to be a transition on both spatial and social levels.

Technological shift and behavioural shift are not enough on their own, a gradient has to be created in order to achieve a feasible mix of the two, calibrated to the local conditions (using the F.O.R.T.-approach with different configurations and goals).

Protecting natural areas and reversing biodiversity loss have a high priority, which is closely connected with the idea of using farm-free buffers in the first phases of the development, as was originally stated in the ‘National Rural Area Program’ (2022)

Shifting land use in a multi-purpose way by layering different functions (e.g. food production, water defence, nature) can give answers to more problems at the same time, providing a flexible and diverse environment

Multi-stakeholder, as well as international collaboration and engagement is crucial for catering to the needs of all affected groups of society. Giving voice to silent actors and offering compensatory solutions to powerful stakeholders is required to achieve a well-accepted result.

Figure 77: Locating areas of interest

Conclusion
Reflection

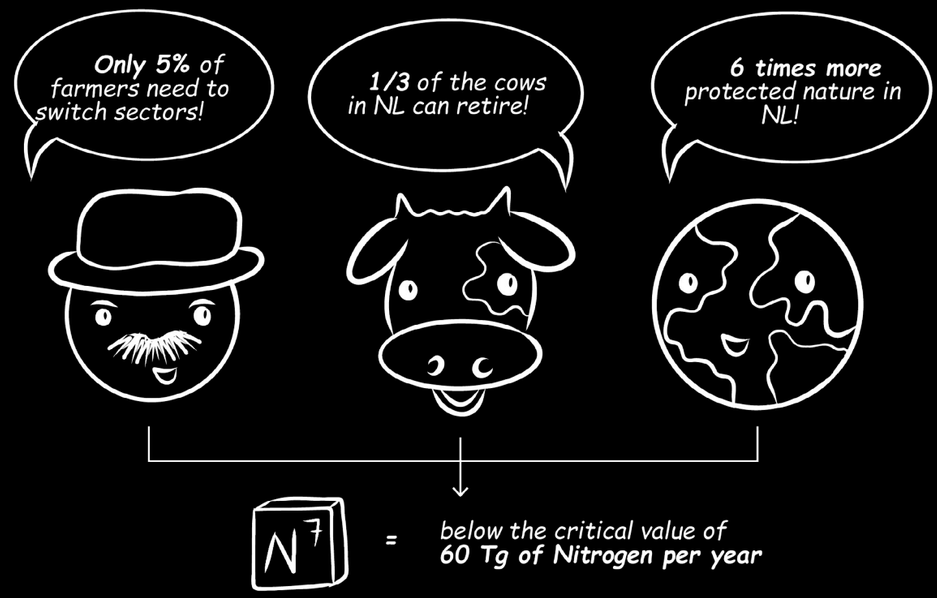


Figure 78: Bold statements

Our project “Nitrotopia” deals with the very current issue of nitrogen. During the last years, and especially after the nitrogen crisis in 2019 there has been a lot of discourse about nitrogen and how its surplus caused mainly by agricultural practices could be reduced. Efforts have been made by the European Union as well as the Dutch government in order to tackle this serious problem. However, the implemented policies are often met with resistance since they propose limiting farming operations, therefore resulting in the eventual unemployment of a large number of the population, which of course is a reason for public outrage.

One of these policies – and also the starting point of our project – was the ‘National Rural Area Program’ Parliamentary Letter (2022), in which three strategies were proposed aiming to protect the biodiversity of protected natural areas most affected by the nitrogen issue. These strategies were quitting, transforming, and relocating current farming practices. In order to achieve our main goal of recalibrating the disrupted nitrogen cycle, we decided to re-evaluate the official proposals of the Parliamentary Letter, and especially focus on the quitting and transforming strategies, as we concluded that relocating in a way was included in what we understood as “transforming”. We focused specifically on dairy farming since it is the biggest source of harmful nitrogen emissions.

Our research question, “How can the combination of transformation and quitting strategies towards transitional landscapes and practices recalibrate the nitrogen cycle in North-Western Europe?” was a constant that we tried to always keep in mind. It was accompanied by our sub-questions which we decided to try to answer one by one. The concepts of transitional landscapes and socially just transition enclosed within the planetary boundaries calibrated and directed the focus of our work.

“The multi-scalar approach we followed was necessary to really spatialise our vision.”

We started our process by analysing the existing situation relating to the nitrogen crisis and the farming industry, also considering the socio-political circumstances. Through this analysis we tried to locate the overall problematic “hotspots” in the Netherlands and then by following a process of clustering and setting criteria, we created a conceptual gradient between “quitting” and “transforming”. At the same time we also took into account the stakeholders that will be affected in each case and with our policy-making tried to include top down as well as bottom up approaches to ensure that all the involved parties will be acknowledged and that there is a framework to regulate the transition to avoid unfair outcomes and provide viable alternatives for the people with the least amount of power, yet also the most interest: the farmers.

We organised our strategic interventions in a toolbox of eight new “farm types” in order to make the gradient between “quit” and “transform” less abstract. The multi-scalar approach we followed was necessary to really spatialise our vision. Going from the Dutch context to the regional context and then again zooming in on an area functioning as a “case study”, we tried to tackle the problem in multiple levels focusing on different things every time, such as policies, phasing, and the human experience. Lastly, after figuring out a specific design solution for our S Area of focus, we zoomed out again in order to apply the lessons learned to a European context, by locating areas of similar character where analogous solutions could be implemented.

Consequently, we feel that we achieved what we set out to do, and that is restoring the balance of the nitrogen cycle by completely transitioning the dairy farming industry. Our goals of economic viability, environmental sustainability and social justice were achieved through the efforts of introducing alternative practices in order to keep the “new” dairy market competitive within the global economy, preserving biodiversity by expanding the protected natural network and providing alternative employment options while ensuring a balanced and fair decision- and policy-making process. A reflection of our process and the relevance of our project follows in the next chapter.

Groupreflection

Creating Nitrotopia during the past nine weeks led our group on a complex and challenging journey of ups and downs, with unwavering enthusiasm, extreme scenarios, bold numbers, complex research and creative hand-drawing sessions. In our final reflection we would like to talk about our approach to answer the research question, the scientific and social relevance of the project, an ethical reflection on values and the place of the study in the academic discourse, closing with a small paragraph on group dynamics.

We tried to find answers to the main research question of how to transition dairy farming with the help of the two strategies (quitting and transforming) by first answering the sub-research questions. We identified main lessons and interrelations which led us to the gradient of new farming typologies, policies and frameworks, resulting in spatial and social transition. Throughout the process, we were constantly reevaluating the decisions we made, yet we were able to create a clear narrative, a coherent story that stretches over scales, space and time. Our limitations showed in the fact that we could only tackle the issue of dairy farming, seemingly ignoring other forms of current agricultural practices connected to the nitrogen surplus.

The scientific relevance of this work is the way we came to our vision by following a very strict methodological process. This made the spatial translation of our project evidence-based rather than an abstract concept, offering concrete solutions but also not being afraid to tackle the extremes. This is nicely illustrated by the coexistence of superfarm and natural areas without any production activities in our strategy..

As for societal relevance, we were trying to make the problem of nitrogen-surplus more understandable for everyone, showing ways to include every group of society in the process and to manage groups with opposing interests. The farmers are especially important actors in this question, inviting them to the table by offering viable alternatives could be the way to convince them about the change.

Our project is experimental, so taking the role as urban planners and designers means to be mediators of change, yet the idea of a superfarm for example is an extreme concept. It is hard to explain and justify, especially from the perspective of an individual, which begs the question of how far we can go with our experiments without breaching ethical norms. Even though we have the “backbone” for the social layer, we struggled to implement it practically and to create tools or activities for stakeholder engagement. Without conducting qualitative research on site, our conclusions can be influenced by underlying stereotypes. On the other hand, all five of us come from different backgrounds and hold different values, which makes our view on the problem more diverse.

The study fits into the academic discourse through using a current, very relevant document that tries to mitigate the nitrogen crisis as its backbone: the National Rural Area Program (2022). By re-evaluating this parliamentary letter we can give an insight to policy makers on what their policies mean socially and spatially.

To conclude, we would like to reflect on the group dynamics. We tried to set expectations and goals from the beginning, stressing the importance of clear communication. We had our ups and downs as a team, which is natural in any group process. In the end we were all very passionate about the project, keeping everyone up to date with the process, trying to create something that we can be proud of, while also having some fun.

Marina Deffner

Overview
The course “Spatial Strategies for the Global Metropolis” was a very intense and challenging journey throughout the whole quarter, but in the end the result for me was extremely rewarding. Coming from an architectural background, I never focused on the regional scale during the duration of my bachelor studies, but I was highly interested in it from the beginning, and it was one of the reasons I chose the Master Track Urbanism in TU Delft. Personally, it was eye-opening to see how research can be implemented into the design process especially in such a big scale as that of North-Western Europe and how to concretely spatialise concepts that would otherwise remain abstract. Furthermore, it was also very intellectually stimulating and a new experience for me to work together in a group setting on such a complex project.

Lectures and workshops
However, due to my non-Dutch background, in the beginning I struggled to understand the actual effect of the nitrogen crisis as well as how the process of policymaking works in the Netherlands. Thankfully, the Capita Selecta lectures in the first week were extremely helpful to orient myself within the topic and providing me with the necessary background to begin the research process. The intense SDS workshops, even though they seemed intimidating at times and proved to be conceptually challenging, put us into focus and were the source of productive discussions, facilitating the advancement of our project. I also appreciated the workshop about the “Tools for community engagement”, but in my opinion, a better placement for it would be closer to the beginning of the course, so we could use the findings in our analysis phase. Nevertheless, it is a tool that will be very helpful next year during my graduation project.

The groupwork
I was very lucky to be part of a diverse group coming from different backgrounds. Through the duration of the course, it amazed me to see how much I was learning not just from the material provided to me but also from my peers, who were extremely motivated and hard-working. Even though we had our difficult moments, we stressed on clear communication, and we really put effort in being open with each other about our strengths and weaknesses. I really enjoyed being part of this group since I felt safe and trusted, but I also could put my trust in my fellow colleagues, and I was never disappointed. The atmosphere in our group was always optimal, we worked hard but did not forget to enjoy ourselves during the process and make the project our own. At this point, I would also like to acknowledge that our tutors, Caroline Newton and Irene Luque Martin, provided valuable feedback throughout the duration of the course which led to engaging discussions both with them and between ourselves. They were very encouraging and organised which motivated me to work even harder.

In conclusion, I am very proud of the result of our project and the knowledge I gained from the process as well as the way I improved my practical and communication skills.

Fruzsina Kovács

About regional design
The task of the course “Spatial Strategies for the Global Metropolis” was to create a regional design for North-West Europe, which was a scale previously unfamiliar to me. Even though I had previous experience with urban design projects on provincial scale, working on complex problems in an international context, learning about the theoretical background connected to the design process and managing a vast amount of data seemed intimidating at first. Thanks to an always motivated and hard-working team, we could tackle all questions and problems together, finding solutions in an outstanding, out-of-the-box way. An important tool for me to understand better the scope of regional design was the use of hand-drawings, through which we could internalise and simplify concepts in an efficient way.

About vision and strategy
Creating a vision that is evidence based, relying on immense research, yet not shying away from extreme scenarios is complex, but I believe our approach to the task allowed us to achieve this combination of reality and fiction. Choosing guidelines proposed by the government as the backbone of our project and reevaluating them streamlined a clear narrative from vision to strategy. We were testing an utopia while offering concrete solutions with axonometric typologies, policy frameworks, timelines and collages. In that sense vision and strategy are intertwined, they compliment each other, showing the way towards transformative change. Throughout this process I was grateful to also talk about the dichotomy and interconnectedness of spatial and social aspects of the design. As a systemic thinker I often concentrate on the technological parts, but seeing the different interests of my groupmates, I was also able to get familiar with the human perspective, stakeholders and personal stories.

About lectures and workshops
During Q2 I was doing a system-design on the scale of a neighbourhood, which topic I really enjoyed. This quarter through workshops and lectures, like the ‘Material flow analysis’ workshop and the ‘Circular Economy’ lectures by Alexander Wandl, I was able to gain more knowledge on this way of thinking and broaden my skills on how to analyse systemic flows, even though our project was mostly about shifting land use. These occasions were often intense, forcing the group to solve problems quickly, to dare to experiment. The Capita Selecta lecture series kick-started the program, it made us see the broad spectrum of ways one can interpret a regional design project.

About groupwork
Having a diverse, enthusiastic team during this quarter made the process enriching, yet creative and fun. I was able to rely on and trust each member, allowing us to achieve an in-depth, complex result. Most of the members were used to being leaders in previous groupworks, so a challenge that I had to figure out is when to step up and when to give space to the others, especially in intense discussion moments. I thrived to improve my communication skills in such situations and to explain my ideas better. In this regard I gained valuable feedback from my group. I am grateful for this experience and proud of the work we managed to create.

Jakob Pesendorfer

Scope
Working on this regional design project within the course “Spatial Strategies for the Global Metropolis” as part of my master’s track in Urbanism at TU Delft was an exciting journey that not only deepened my understanding principles on the regional scale but also thought me the crucial importance of collaborative teamwork in our field. Especially because I had already gained experience in this scale during my previous academic education, the latter aspect was a particular experience through which I grew on a personal level. This also reflects the importance of teamwork in my opinion, as we later tackle complex urban challenges, always in teams and never alone. Therefore, I am strongly convinced that especially in these constellations of different individuals with different talents and perspectives, magnificent ideas can emerge that would not be manageable alone in this scope and complexity. Therefore, I am grateful to have the opportunity in this program to work with highly motivated fellow students on such tasks.

Process
Parallel to the design studio, there were also numerous methodology lectures, workshops, and exercises designed to assist us in developing the content of our project. Particularly worth mentioning here was the peer review, which personally helped me improve my communication skills within the team, as well as how to deal with feedback. Furthermore, there was an intense focus on spatial analyses using GIS tools. The results we obtained through topic-specific work in this area formed the evident framework of our entire concept. However, I must say that especially for individuals who had not previously dealt with GIS (I had it already in my bachelors), these workshops were sometimes difficult to follow due to the teaching methods. In contrast, in the “Tools for Community Engagement” workshop, it was evident that the feedback from students regarding the GIS workshop had been taken seriously, and a much better teaching method was applied by the lecturers, which then motivated me more. Unfortunately, the timing of this workshop was rather late in the process, and due to the complexity of the programs we used, it was difficult for us to integrate the findings into our current planning process. However, I can imagine applying this in my thesis to make community voices visible and better understood. Finally, I want to mention the kick-off with the “Capita Selecta” lectures, which was my personal highlight, as it gave me a motivational boost at the beginning and allowed me to gain a good insight into the crucial topics of our time in the Dutch scale and also on a global level, in a compact setting.

Teamwork makes the dream work
The intense interplay between research and design, especially in a team where some members have more analytical skills while others have more design skills, has enriched me a lot during the process. Here, I have particularly grown in areas that were certainly not my strengths before.
Through the always open and informal communication with my team, we were able to address these issues early in the project, which brought us even closer together and greatly pushed our progress. The open communication culture we always maintained benefited us throughout the project, and therefore I am proud of how we solved difficulties.

Floor Schepel

Process, methods and personal values
The Master’s course ‘Spatial Strategies for the Global Metropolis’ has given me a better understanding of the different levels of design, both on a European scale, on a Dutch scale and zooming in on regions such as Groningen, Friesland and Drenthe. The combination of the studio sessions, the workshops and the Capita Selecta lectures offered me some new methods and perspectives. For example, it was the first time that I had to deal with, apply, test and redesign policies, like ‘Nationaal Programma Landelijk Gebied’. Throughout our process, this was one of our common elements as a starting point for analysis and later as an argument for our vision.

Not all layers of society can be captured simply by mapping, this requires research into the atmosphere of an issue, an exploration of social behaviour and socio-geopolitics. This is where conversations about social justice, representation and finding nuance come in. The readings and lectures have made me think a lot about always being critical of certain viewpoints about groups of people. For example, newspaper articles are always politically coloured and it is human to be influenced by stereotypes. However, as a group and on a personal level, we tried to remind ourselves of this and be careful not to jump to conclusions.

Delving further into the social strata and applying them to the above scales was a learning challenge for me. For my personal development, exploring the comprehensive stakeholder analysis was a highlight. The lectures and our group discussions made us realise how powerful some stakeholders can be, such as the supermarkets and the fertiliser lobby. The course made me even more aware that, as a mediator, you will never make all stakeholders happy; the interests, mainly in making money, are too divergent. However, as a future urban planner, it is important to consider all interests, especially those of groups with little power, such as in our case the planet and the cows.
Also, in future projects I would like to use the method of drawing stakeholders and systems in a cross section as early in the process as I did during the workshop.

Another personal learning goal I have focused on is getting better at researching and writing, although I was able to practise this, I will need to pay more attention to it in future projects. However, I really enjoyed making signatures to clarify the role and position of stakeholders, this is another process method that will stay with me.

Teamwork
During this quarter I had the opportunity to work with some incredibly talented people. This was intimidating at first, but looking back, I learned a lot from my teammates. This includes hard skills such as new understandings of layout, storytelling and Q-GIS skills. As well as soft skills such as differentiating between different systems, having discussions and dealing with disagreements. I am very proud of the patient, respectful and open way in which we worked as a group. By working together and reflecting on each other throughout the process, we ensured that we not only understood our different characteristics/personalities better, but that we could use them tactically.

Yuhang Zhai

Process

Reflecting on my academic journey into the impact of dairy farming on the environment and its complex relationship with nitrogen pollution, I've experienced profound changes in my approach and understanding. Before this exploration, my design and planning methods were predominantly bottom-up, intuitively appealing but fraught with practical difficulties. Striving to integrate different key elements and analyse their interrelations, achieving meaningful outcomes was always a challenge. This project is my first time into the realm of large-scale planning strategies, tackling a complex issue aimed at transitioning the Dutch dairy industry towards a more sustainable nitrogen cycle, involving multiple stakeholders, thereby presenting a particularly challenging task.Our focus on North-West Europe, especially the Netherlands, highlighted the region's significant role in the global nitrogen cycle, exacerbated by dairy farming. The project began with an analysis of the "National Programme Landelijk Gebied," laying the foundation for exploring potential solutions for the dairy industry - whether through quiting, transforming, or relocating to address excessive nitrogen levels. Our multi-faceted approach included extreme scenario planning, stakeholder analysis, and the integration of geographic and socio-political data. This comprehensive method led us to conceive "Nitrotopia," embodying our vision for a sustainable future where the nitrogen cycle is balanced through radical changes in dairy farming practices.

This project propelled me into uncharted territories. Initially, under the guidance of policy frameworks, we began with an in-depth analysis of the current issues, later integrating this understanding with a variety of geographical data and societal insights. Relying on scientific methods and theories learned through lectures as our guide, we gradually transitioned the Dutch dairy industry towards a more sustainable nitrogen cycle. Through this iterative process of analysis, vision creation, and strategic planning, my understanding of environmental planning and management was enriched. The lessons learned extended far beyond the specific scope of nitrogen pollution and dairy farming. They spoke to the essence of addressing any large-scale environmental challenge - the need for a balanced approach, respecting the nuances of policies, the realities of geography and society, and the valuable perspectives of stakeholders. It expanded my capabilities, prompting me to balance theory with practice, ideals with what is achievable. I realised the importance of embracing complexity rather than avoiding it and the power of synthesising different inputs into a coherent, actionable plan.

Teamwork compensated the individual effort

I learned a great deal from working with my team. In my usual approach, design was often bottom-up and too readily reached conclusions. Undertaking extensive analyses, integrating information from various aspects, and analysing the relationships between them have always been challenging for me. However, collaborating with my teammates enhanced my skills. At the same time, I also learned to slow down, akin to focusing solely on the destination during a journey, neglecting the scenery along the way, which constitutes the essence of the journey, thus missing out on what requires attention. Group collaboration, much like urban planning work itself, requires patience, mutual understanding, and cooperation from multiple parties, and that is where its significance lies.

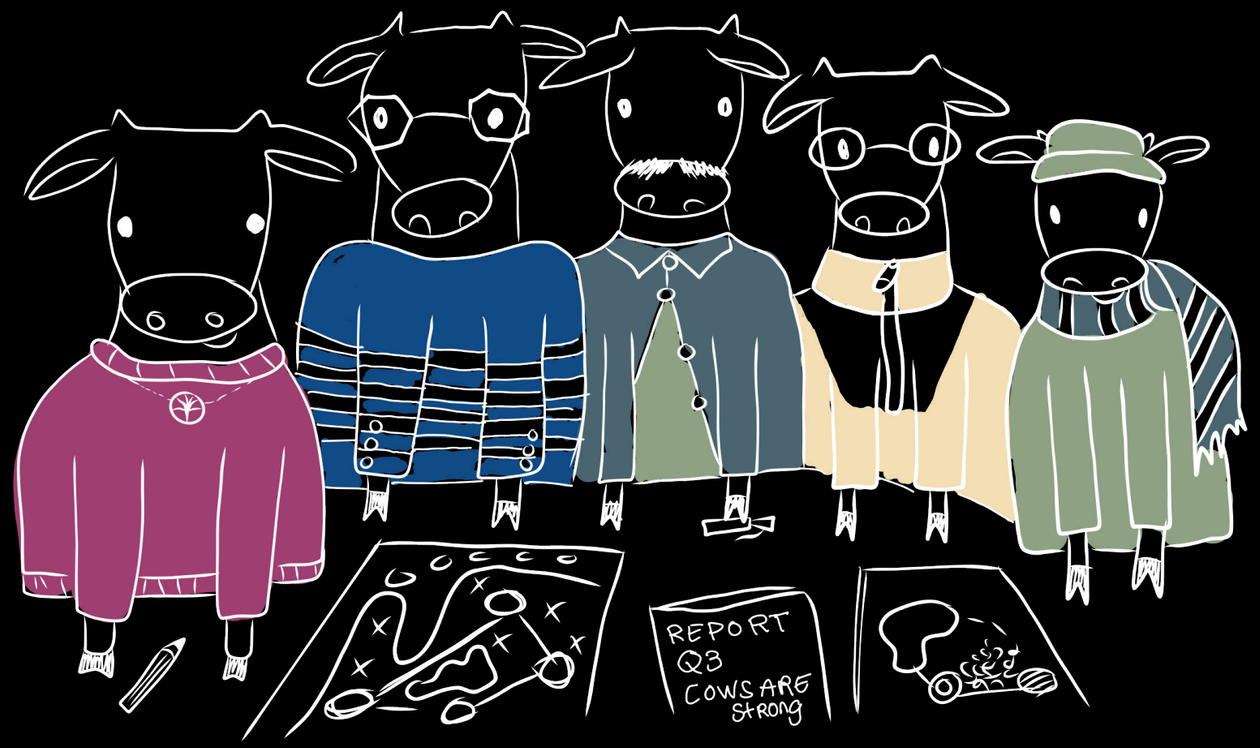


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Figure 2: Human share in the nitrogen crisis

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Figure 3: The disrupted nitrogen cycle

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Figure 24: Dutch import of dairy products

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Figure 25: Dutch export of dairy products

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Figure 29: Status quo system flows

Figure 30: Status quo systemic section

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Figure 32: Status quo stakeholder power-interest matrix

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Figure 33: The life of the cow

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Figure 34: Experimentation process
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Figure 35: Quitting system flows

Figure 36: Quitting systemic section
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Figure 37: Stakeholder projections for quitting
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Figure 38: Transforming system flows

Figure 39: Transforming systemic section
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Figure 40: Stakeholder projections for transforming
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Figure 41: Planetary boundaries
Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S. E., Donges, J. F., Drüke, M., Fetzer, I., Bala, G., von Bloh, W., Feulner, G., Fiedler, S., Gerten, D., Gleeson, T., Hofmann, M., Huiskamp, W., Kummu, M., Mohan, C., Nogués-Bravo, D., … Rockström, J. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, 9(37). https://doi.org/10.1126/sciadv.adh2458

Stockholm Resilience Centre. (2023). The 2023 update to the Planetary boundaries. Licensed under CC BY-NC-ND 3.0. Credit: “Azote for Stockholm Resilience Centre, based on analysis in Richardson et al 2023” Retrieved from: https://www.stockholmresilience.org/research/planetary-boundaries.html

Figure 42a,b,c: Instances of agricultural life

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Figure 43a,b: Conceptual framework
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Figure 44: Recalibrated nitrogen cycle

Figure 45: Overlaying of the analysis
CORINE Land Cover 2018 (vector/raster 100 m), Europe, 6-yearly. (n.d.). Retrieved from: https://land.copernicus.eu/en/products/corine-land-cover/clc2018

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Figure 46: Combinations of nitrogen, farming and flood risk
Authors work in combination with the sources of Figure 45.

Figure 47: Initial clustering
Authors work in combination with the sources of Figure 45.

Figure 48: First application of the quit-transform gradient
Authors work in combination with the sources of Figure 45.

Figure 49: Fine-tuning clusters with Natura 2000
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Figure 50: Vision map
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Figure 51: Stakeholder projection for transition
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Figure 52: X-curve

Figure 53: Multi-scalar approach
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Figure 54: Policy conclusion
Ministry of the Interior and Kingdom Relations Housing and Planning. (2022, July). *Housing an Planning / Novex Programme.*

Figure 55: Toolbox
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Figure 56: Superfarm
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Figure 57: Biological farm
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Figure 58: Research campus
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Figure 59: Alternative products farm
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Figure 60: Community farm
Authors work in combination with the sources of Figure 55.

Figure 61: Heritage farm

Authors work in combination with the sources of Figure 55.

Figure 62: Aqua farm
Authors work in combination with the sources of Figure 55.

Figure 63: No farm
Authors work in combination with the sources of Figure 55.

Figure 64: Policy timeline

Figure 65: M-Region selection
Authors work in combination with the sources of the basemap.

Figure 66: Nitrotopia landscape
Google. (2024). Google Maps. Retrieved from https://www.google.com/maps

Figure 67: M-scale vision
Authors work in combination with the sources of the basemap.

Figure 68: Change in the farming labourforce
Icon creators: © Milinda Courey - Nounproject (marriage)
CBS StatLine. (n.d.). *Agriculture; crops, livestock and land use by general farm type, region*. Opendata.cbs.nl. Retrieved April 9, 2024, from https://opendata.cbs.nl/#/CBS/en/dataset/80783eng/table?searchKeywords=keyword:livestock

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Statistics Netherlands. (2018, March 8). *Stable share of female farmers*. Statistics Netherlands. https://www.cbs.nl/en-gb/news/2018/10/stable-share-of-female-farmers

Figure 69: S-scale selection
Authors work in combination with the sources of the basemap.

Figure 70: Current landscape
© Ricardo Noltenius – Flickr, © Pisut Tardging – Vecteezy, © Muhammad Mustafa – Vecteezy, © Cajaflez – Vecteezy, © matthiasboeckel – Pixabay, © 12019 – Pixabay, © MabelAmber – Pixabay, © GDJ – Pixabay, © saddako – 123RF, © Gouwenaar – Wikipedia, © NZO - https://www.nzo.nl/en/nieuws/responsible-sector-development-after-the-milk-quota-ends/

Figure 71: 2025
Authors work in combination with the sources of the basemap and the following sources:
Top10 NL. (2024). *Top10 NL Terrein [Data set]*. Dutch Cadastre, Land Registry and Mapping Agency (Kadaster). Retrieved April 10, 2024, from https://service.pdok.nl/brt/top10nl/wms/v1_0?service=wms&request=getCapabilities

Figure 72: Shifting landscape
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Figure 73: 2035 projections
Authors work in combination with the sources of the basemap and the following sources:
Top10 NL. (2024). *Top10 NL Terrein [Data set]*. Dutch Cadastre, Land Registry and Mapping Agency (Kadaster). Retrieved April 10, 2024, from https://service.pdok.nl/brt/top10nl/wms/v1_0?service=wms&request=getCapabilities

Figure 74: Transitioning landscape
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Figure 75: 2050 projections
Authors work in combination with the sources of the basemap and the following sources:
Top10 NL. (2024). *Top10 NL Terrein [Data set]*. Dutch Cadastre, Land Registry and Mapping Agency (Kadaster). Retrieved April 10, 2024, from https://service.pdok.nl/brt/top10nl/wms/v1_0?service=wms&request=getCapabilities

Figure 76: Lessons learned
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Figure 77: Locating areas of interest
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Figure 78: Bold statements

Appendix

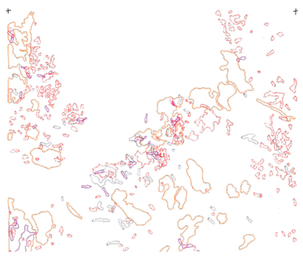
1. N-W Europe Analysis

Nitrogen

Nitrogen Conclusion

Nitrogen Clusters

Farming Industry

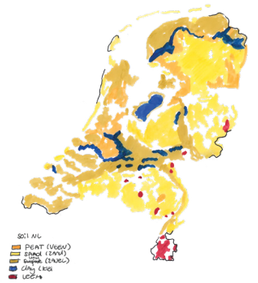


Farming Industry Clusters

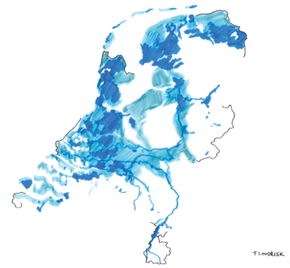
Nature 2000

2. NL Analysis

Soil types

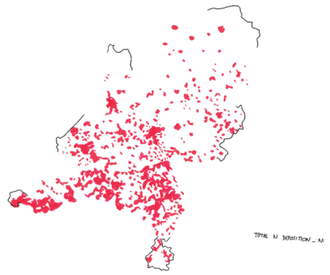


Floodrisk

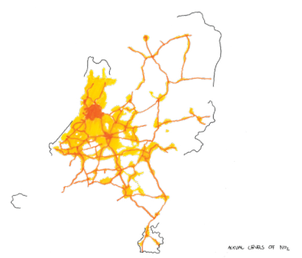


Nature 2000

Nitrogen deposition

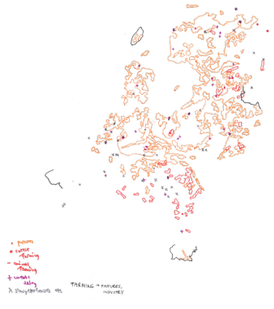


Nitrogen in air

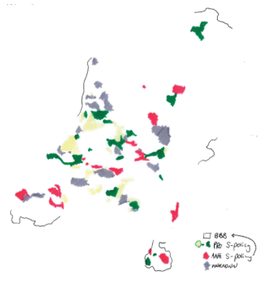


cattle density

Pastures and industry

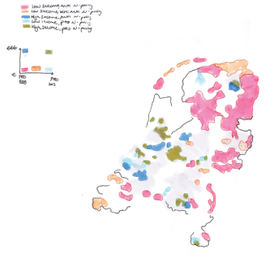


political layer_position in politics

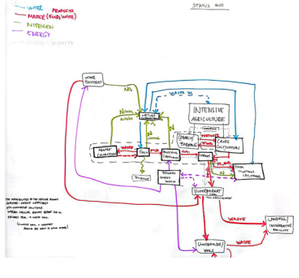


Social layer

Geo-political analysis



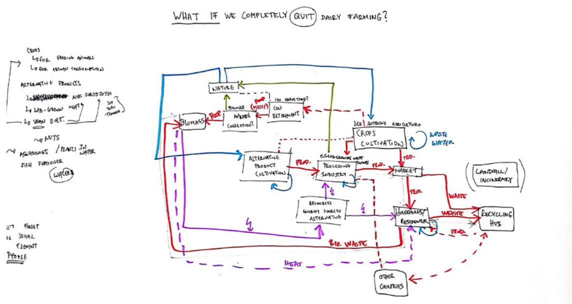
Status quo system drawing



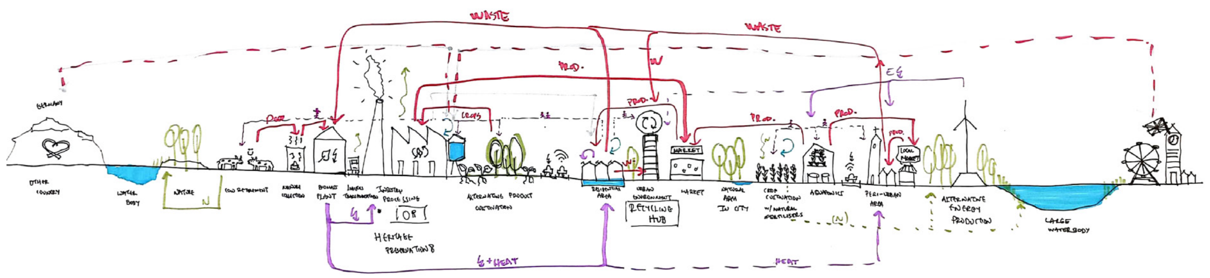
Status quo systemic section

Extreme “scenario” experimentation

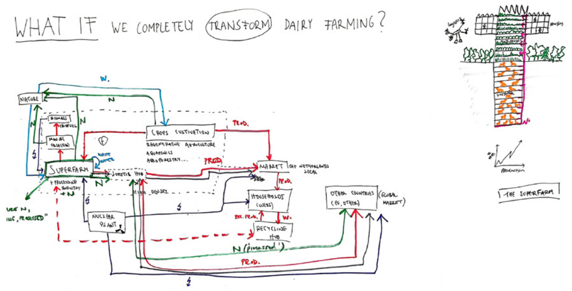
Quit system drawing



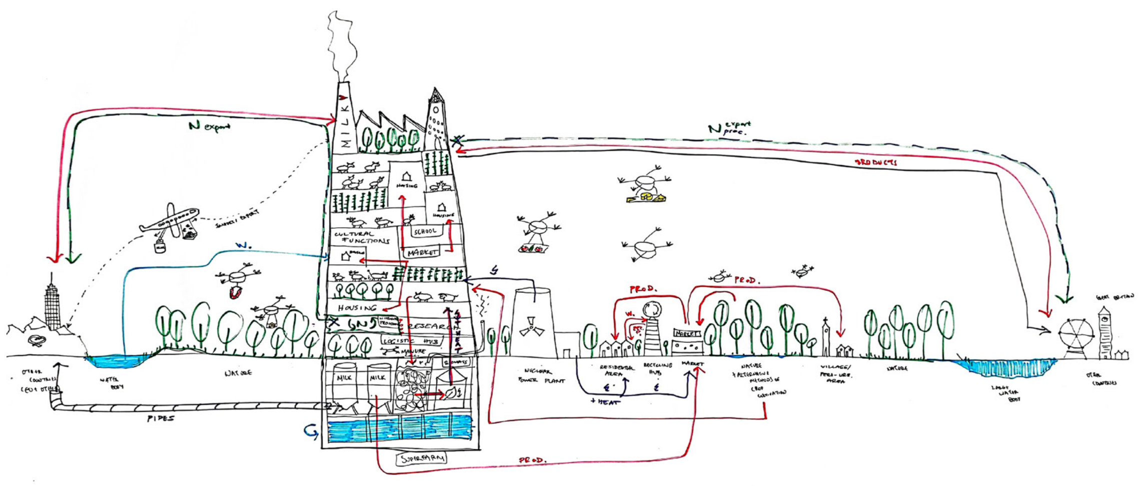
Quit system section



Transition system drawing

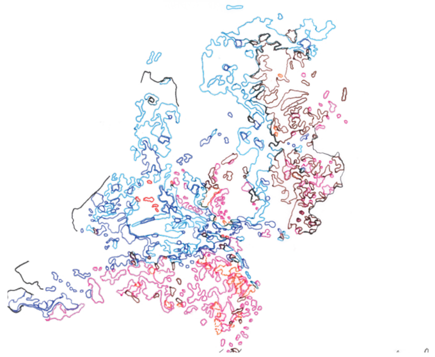


Transition system section



Vision process & vision

Combinations

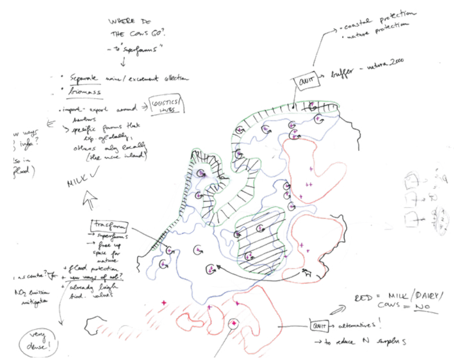


Conclusion clusters

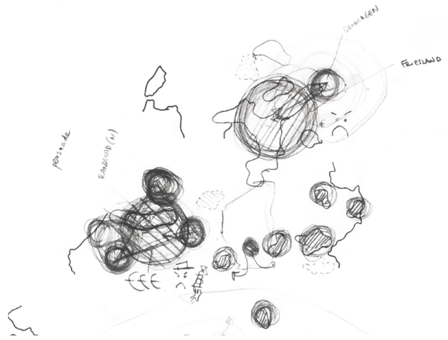
Quit +T

Quit +T after Nature 2000

Frist vision sketch



Location of areas of interest



Strategy

AI Inspirations

aqua farm

superfarm

bio farm

no farm

community farming

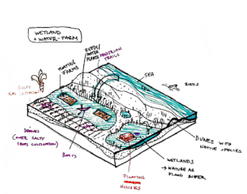
alternative products farm

research centre

cultural heritage farm

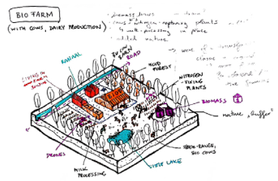
hand-drawing strategy

aqua farm

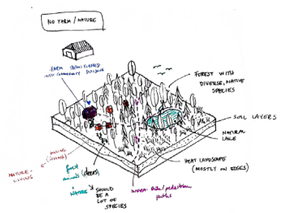


superfarm

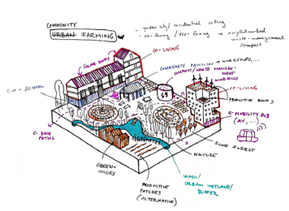
bio farm



no farm

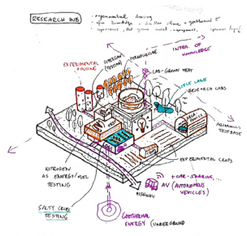


community farming



alternative products farm

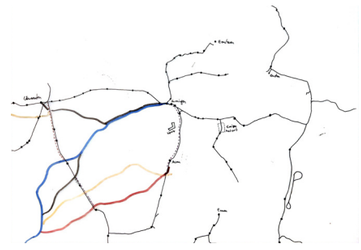
research centre

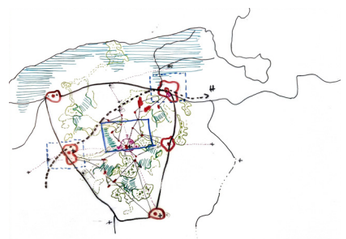


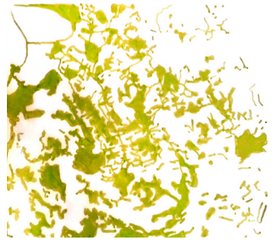
cultural heritage farm

Strategy

M scale Analysis

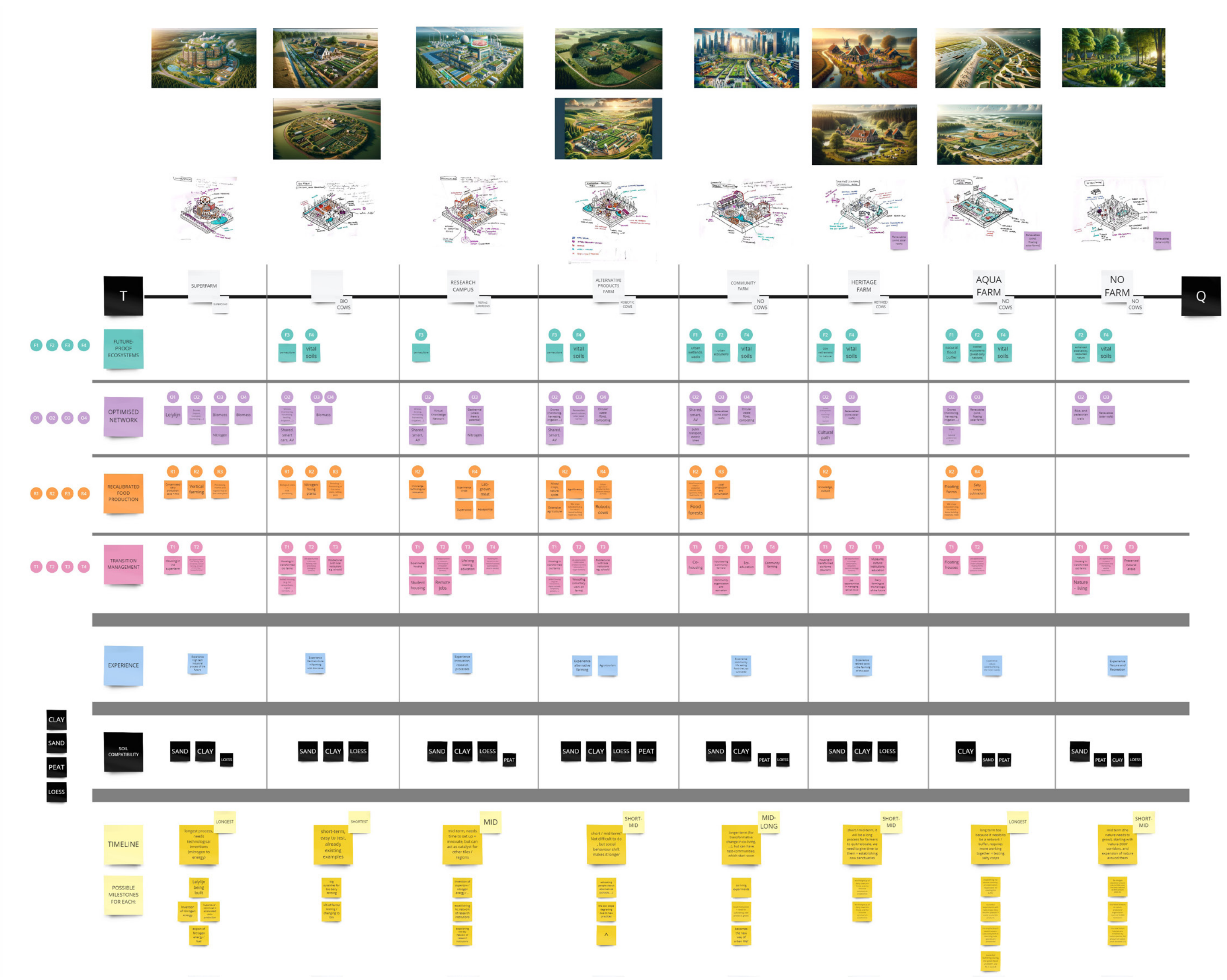




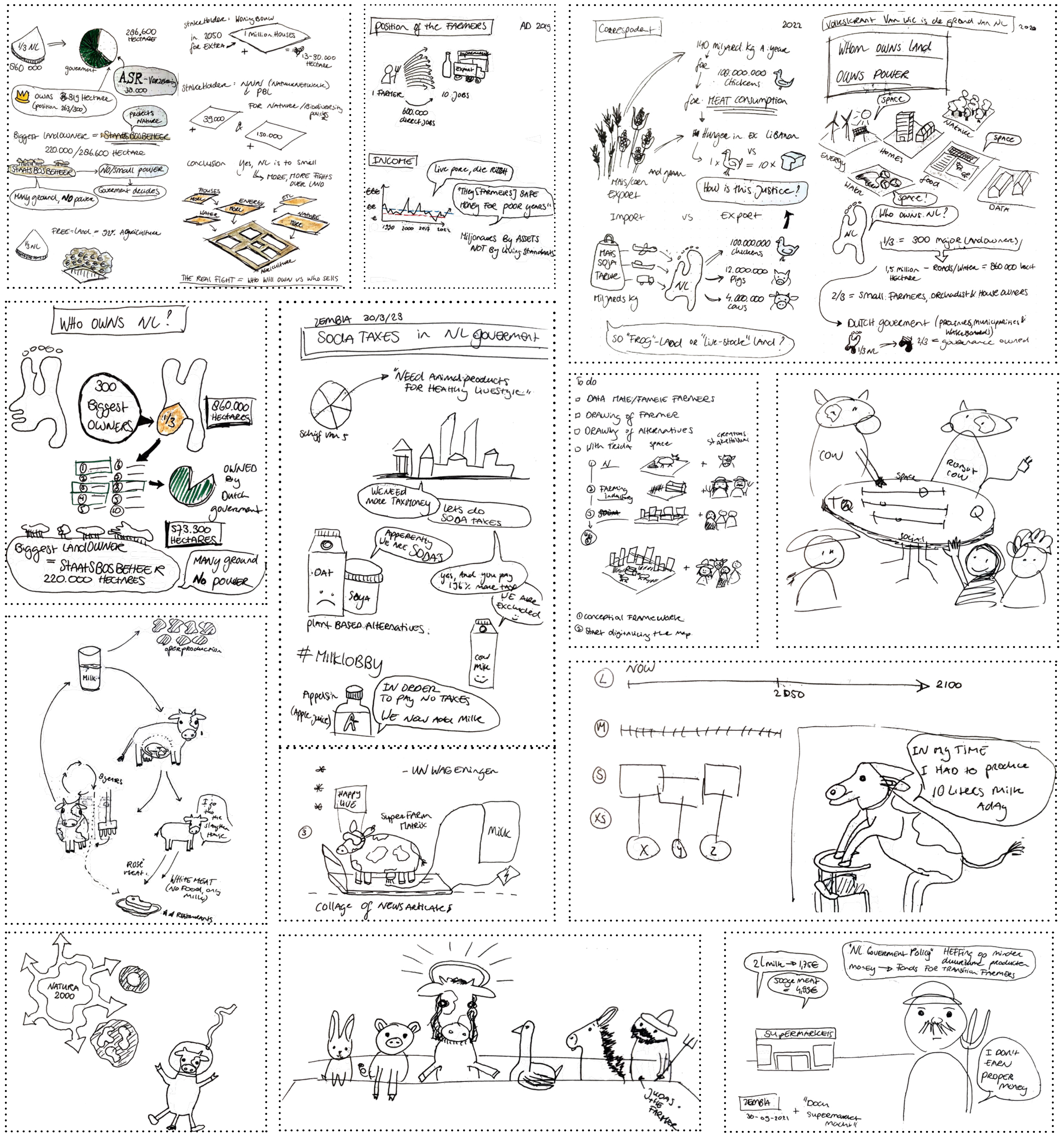


S scale Analysis

Strategy




REPORT Q3 Cows ARE


WHO OWNS NL?
Biggest OWNERS
860.000 HECTARES
Biggest LANDOWNER = STAATSBOSBEHEER 220.000 HECTARES
Many ground No power
SOCIAL TAXES in NL government
#MilkLOBBY
IN ORDER TO PAY NO TAXES WE NOW HATE MILK
Collage of News ARTICLES
NATURA 2000
NOW
2050
2100
IN MY TIME I HAD TO produce 10 Liters MILK A day
Supermarkets
Position of the FARMERS
INCOME
WHO OWNS LAND
OWNS POWER
How is this Justice?
Import VS Export
COW
Robot COW