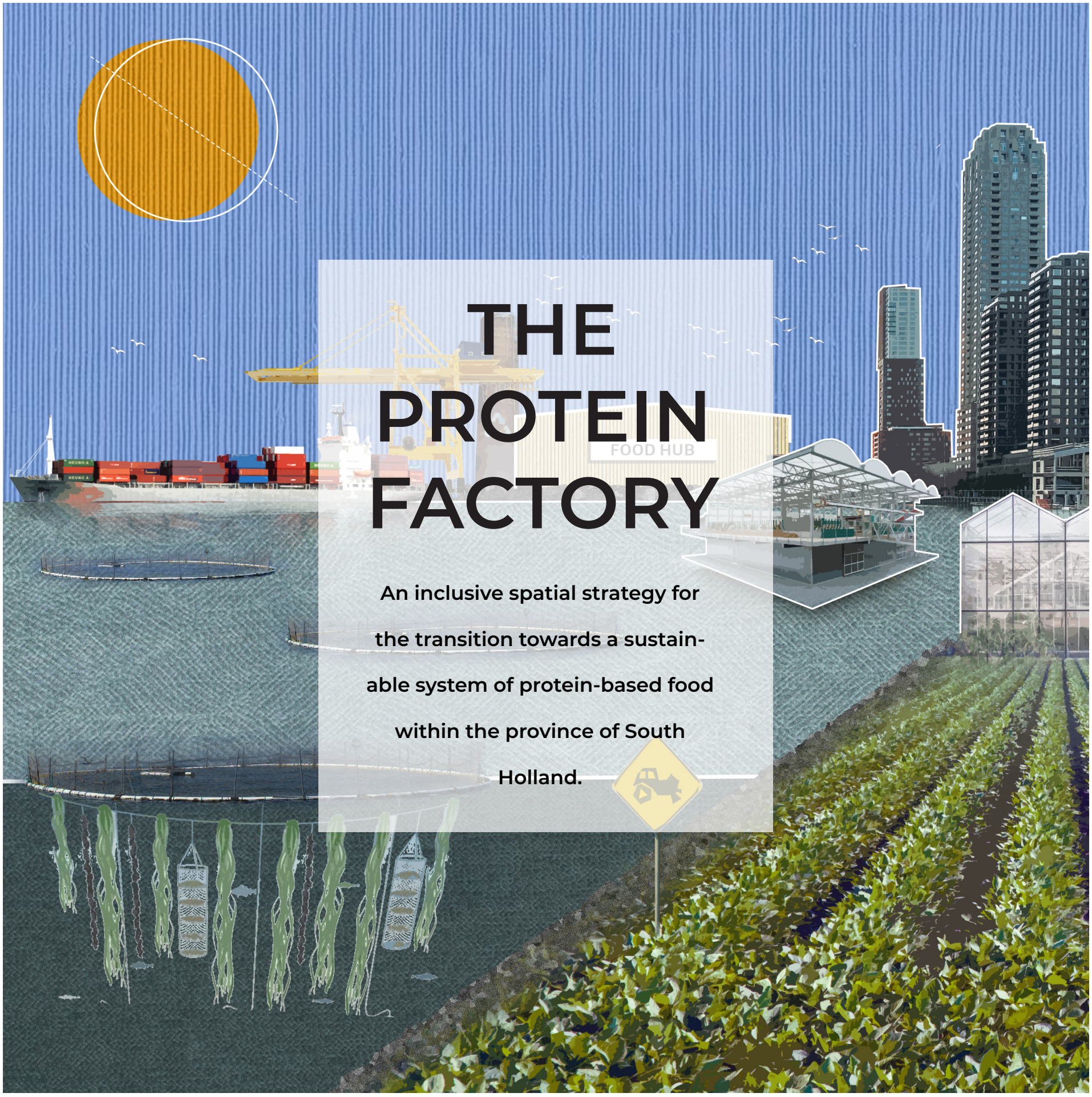
THE
PROTEIN
FACTORY
FOOD HUB
An inclusive spatial strategy for
the transition towards a sustain-
able system of protein-based food
within the province of South
Holland.

The Protein Factory

An inclusive spatial strategy for the transition towards a sustainable system of protein-based food within the province of South Holland.

Delft University of Technology
Faculty of Architecture and the Built Environment
Msc2 Urbanism 2021/22 Q3

R&D Studio Spatial Strategies of the Global Metropolis
Methodologies for Urbanism

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Preface

This report is the outcome of the R&D studio Spatial Strategies of the Global Metropolis and the Methodologies for Urbanism course at the Delft University of Technology.
It was written from March to April 2022 under the supervision of our tutors Lei Qu, Luisa Calabrese and Karel van den Berghe, with occasional tutoring from Marcin Dabrowski and Roberto Rocco.

This report combines research and design on the main topic of 'towards a bio-based economy' proposed by the coordination of the course. More specifically, it tackles the transition to the alternative protein-based food industry from the current disproportionated animal-based food consumption, production and export in the Netherlands and South Holland.
The Port of Rotterdam is placed in the centre of this transition as the 'core of the factory' that is the Dutch food chain.

Our project emphasizes the need for a systemic and planned approach to a transition that has already started as a response to growing societal trends. It opens discussions about climate change, global economy and ethics that should be embedded in current political agendas. We hope that this report throws some light on the reasons and methods to approach this current and urgent (but also fascinating) topic.

Content

Abstract

The Netherlands has a crucial role in the global animal-based food supply chain by the virtue of the Port of Rotterdam.
However, the current production process of meat and dairy products is not sustainable in the long term as it is dependent on global supply and also responsible for a vast amount of emissions and waste.
Moreover, the whole system lacks resilience to global challenges such as pandemics, wars, animal diseases, and other unpredictable events. What is more, in the Netherlands, the meat consumption trend is decreasing due to raising environmental awareness and ethical problems.

We tackled the problems firstly by analysing the current situation: conducting the site visit, mapping, analysing GIS data, and listing stakeholders. Furthermore, the research was conducted taking into consideration related literature and relevant documents. Research by design was used to experiment with strategic proposals. The project was carried away by carefully analysing and making proposals on various scales and taking into consideration environmental, economic, and social aspects.

Overall, both qualitative and quantitative research approaches were used when applicable.
This was used to make an inclusive, knowledge-based, and well-developed vision and strategy for the province of South Holland. The main goal of the project is to achieve a sustainable protein-based food supply chain that would be resilient to societal changes, adaptable to environmental challenges and would offer more locally produced protein alternatives.
With this vision and strategy, local production and plant-based protein cultivation would be encouraged. As a result, a reduced livestock footprint could be achieved. Moreover, innovative methods of energy production and waste management would be implemented.
This transition also aims to improve job accessibility, stimulate innovation and shift consumer behaviour towards more responsible consumption. Gradually, it should be implemented in other Dutch provinces to achieve a full transition toward a sustainable protein-based future in the Netherlands.

1. Introduction

The Protein Factory is a proposal to carry out the transition towards a sustainable and responsible food (and consumption) chain, focusing on the ongoing trend of decreasing meat (and other animal-based products) consumption and the environmental impact of the industry.

This chapter will start with a brief introduction about the location in which the project focuses and the main theme that will be discussed in the report.
Furthermore, the problem statement sets the most important starting points for the problem, followed by our goals based on the SDGs and the Port's vision.

The bases for the comprehension of the main theme and goals of the project of the Protein Factory, together with the rationale behind the problematic can be found in this chapter. It opens the way for the introduction of the research questions and methodology of chapter 2.

1. Introduction

The province of South Holland (Fig. 1) is a Dutch province situated on the southeast side of the country. With the Port of Rotterdam and extensive agriculture and horticulture activities, this province fosters the most important food production industry in the country (Fig. 2), making The Netherlands one of the first food exporters in the world (Government of The Netherlands, 2021).

About 20% of these Dutch food exports are animal-based products (OEC, 2021). However, the production of these foods creates high emissions. Moreover, the ongoing consumption trends suggest a decrease in the demand for these products in the future (Wageningen University and Resesarch, 2022).

In the project of the Protein Factory, we take these trends as an opportunity for a planned transition towards a sustainable and circular protein-based food industry. This transition is set in different phases for the coming 50 years, tackling three main aspects: economic, environmental and social. It has the ultimate goal of implementing a sustainable protein food industry in South Holland through the Port of Rotterdam, promoting responsible consumption and production of protein foods and climate action.

This transition will be started and showcased in the province of South Holland, but it will be possible to extrapolate it to other provinces in the Netherlands to implement a national transition. This would be interesting since most of the animal-based production happens outside of South Holland (Fig. 3). However, South Holland is an interesting place to start the transition focusing on the production of alternative protein foods.

Figure 1. Provinces of the Netherlands

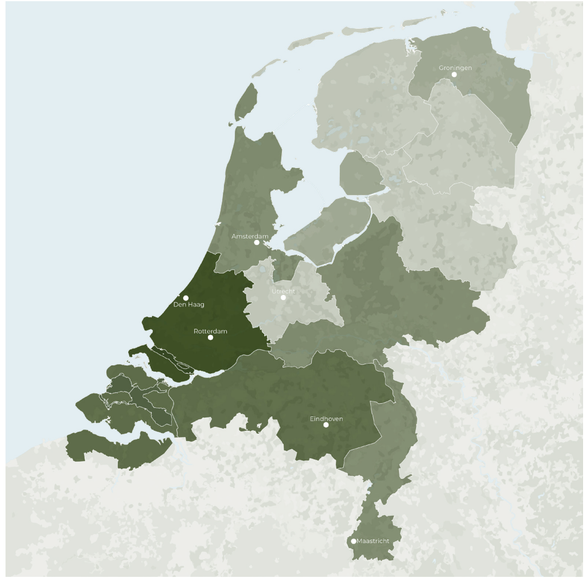


Figure 2. Number of Dutch crops companies

Figure 3. Number of animal production companies in the Dutch province.

1.1 Problem Statement

Import and export

The Netherlands is the number one EU animal-based food exporter (CBS 2021). While this might be good for the Dutch economy, it has a big impact on the environment.

Animal husbandry is a big part of the agricultural activities that are carried out in South Holland. Agricultural activities (which include horticulture, arable farming and greenhouse horticulture) create big revenues every year up to 95,6 billion euros last year (Lyddon, 2021), from which 18,2 are from animal-based products like meat, dairy and eggs (Wageningen University and Resesarch, 2022).

Animal husbandry

However, in the agricultural sector, animal husbandry needs a lot of resources such as feed, space, water and infrastructures, while it emits gasses like phosphate, methane and ammonia and produces waste that can harm the environment (United Nations, 2021).
According to the Paris Agreement, livestock in the Netherlands must be considerably reduced as well as greenhouse emissions to achieve the climate targets by 2050 (Government of the Netherlands, 2022).

Moreover, growing the feed that animals need promotes the use of chemicals, pesticides and fertilizers that can be harmful to the environment (van Grinsven H. J. M., van Eerdt M. M., Westhoek H., & Kruitwagen S., 2019).
The import and export of products related to this sector through the Port of Rotterdam also create waste and pollution regardless of the economical profit they provide. The yearly amount of animal feed needed is 1.3 million tonnes, which is mostly imported from South America (OEC, 2021).

Together with the already mentioned environmental consequences that animal husbandry entails, extensive animal husbandry also opens an ethical question for the industry regarding animal welfare and food safety

Agriculture

Other consequences of climate change are the changing weather conditions that will have a direct impact on the soil conditions and the growth of crops and the local food open field production, which entails mostly feed, potatoes and cereals (Government of the Netherlands, 2021).

Trends

Another factor that will impact the animal-based food industry is the changing consumption trends (Mathijs, 2015). The expectation of meat demand for the future is that it will decrease gradually in the Netherlands (CBS, 2021). As a matter of fact, this consumption trend is already noticeable in current statistics (Fig. 4). This behavioural change will have an impact on the Dutch production system. Research shows that the main reasons for this decrease in animal-based consumption lie firstly in animal welfare, secondly in concerns about the climate crisis and thirdly in health reasons.

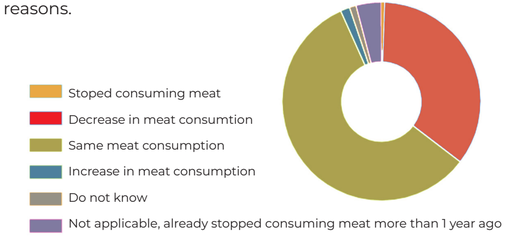


Figure 4. Development in meat consumption in the past 12 months (CBS, 2020)

However, globally the demand for animal-based products is expected to grow in the next decades. It is undeniable that animal-based products have great nutritional value as a rich source of high-quality protein that is currently hard to substitute. Nevertheless, protein foods are distributed unequally over the world (mostly consumed in rich western countries) (Wageningen University and Resesarch, 2022).

This opens the need and the opportunity for a protein transition in which a new sustainable food system is implemented where the distribution and quality of protein foods are balanced.

Port

The Port of Rotterdam is a very important facility in the current Dutch food industry as the centre of international import and export of processed and unprocessed animal-based products.

Currently, there are significant initiatives and infrastructure to improve the animal husbandry and animal-based food production industry by the port, such as the Food Hub and the animal checkpoint for internationally imported animals. The existing elements by the Port can be used to achieve circularity in the nutrient chain, providing sustainable, safe and environmentally friendly products.

Future challenges

However, the Port of Rotterdam and South Holland need a more clear plan for the future of the food industry. The province and the Port need to implement a resilient and sustainable plan for the future to suffice the climate targets from the UN and the EU and to adapt to future consumption trends, climate change, landscape changes and environmental changes.
To meet the expectations and needs of Europe and the Dutch society, a protein transition needs to start. With the vision and strategy of the Protein Factory presented in this report we make a proposition for this transition.

Opportunities

In conclusion, the most important problems found in the current animal-based food industry are:

· High emissions from animal husbandry
· Emissions and waste from feed and food production, imports and exports
· Animal welfare
· Behavioural change of consumers
· Unequal distribution of protein foods

The need for a transition from a social and environmental point of view opens the opportunity for research on the possibility of a new protein food supply system in South Holland with the Port of Rotterdam as the central point, which is the aim of this project. Through qualitative methods, we will identify the way to carry out this transition.

The current animal husbandry methods have to change and decrease while researching for new alternative protein food production systems that allow sustainable growth and create affordable and accessible products. Implementing a local approach to this transition allows for implementing circularity in the changing economic, social and environmental flows of this industry.

South Holland constitutes a complex industry of food production, processing and distribution that is changing. The protein transition takes the existing methods, flows and infrastructure to keep the importance of the Port and the production landscape of South Holland and adapt them to the future.

1.2 Our Goals

The 17 Sustainable Development Goals (UN, 2022) were designed in 2015 by the United Nations General Assembly (UN-GA) as a 'blueprint to achieve a better and more sustainable future for all'. The UN-GA aims to achieve these goals by the year 2030 (Fig. 5).
The UN Member states created a partnership to implement these goals globally through strategies and visions to fight against the climate crisis, economic and social inequality and improve global health and education issues.

In this report, we acknowledge the importance of these Goals to achieve a sustainable future and take them into account in our strategy. The project of the Protein Factory has this 'blueprint' as its backbone of values and targets. It works as a strategy to implement 10 of these goals. The main 2 goals that are steering the project of the Protein Factory are number 12 (Responsible consumption and production) and 13 (Climate Action). These goals also coincide with the primary goals in the vision for the Port of Rotterdam (see chapter 3.6 at page 34) (Port of Rotterdam 2021).

In the following pages, those Goals are presented showing how they relate to the project presented in this report.

Figure 5. Sustainable Development Goals (UN 2022)

12. Responsible consumption and production

Targets:

· Ensure sustainable consumption and production patternds

SUSTAINABLE MANAGEMENT AND USE OF NATURAL RESOURCES

By 2030, achieve the sustainable management and efficient use of natural resources.

HALVE GLOBAL PER CAPITA FOOD WASTE

By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.

ENCOURAGE COMPANIES TO ADOPT SUSTAINABLE PRACTICES AND SUSTAINABILITY REPORTING

Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.

PROMOTE SUSTAINABLE PUBLIC PROCUREMENT PRACTICES

Promote public procurement practices that are sustainable, in accordance with national policies and priorities.

SUPPORT DEVELOPING COUNTRIES' SCIENTIFIC AND TECHNOLOGICAL CAPACITY FOR SUSTAINABLE CONSUMPTION AND PRODUCTION

Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production.

PROMOTE UNIVERSAL UNDERSTANDING OF SUSTAINABLE LIFESTYLES

By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.

Targets in the project:

This is one of the main targets of the project. The social transition starts with communication and education about responsible consumption. This is tackled in different ways in the project, through local production and markets and production of alternative protein foods.

13. Climate action

Targets:

· Take urgent action to combat climate change and its impacts.

BUILD KNOWLEDGE AND CAPACITY TO MEET CLIMATE CHANGE

Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

STRENGTHEN RESILIENCE AND ADAPTIVE CAPACITY TO CLIMATE RELATED DISASTERS

Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

PROMOTE MECHANISMS TO RAISE CAPACITY FOR PLANNING AND MANAGEMENT

Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island

INTEGRATE CLIMATE CHANGE MEASURES INTO POLICIES AND PLANNING

Integrate climate change measures into national policies, strategies and planning.

Targets in the project:

This is one of the main targets of the project. The climate crisis threatens production landscapes, human health and ecosystems. This is addressed in different ways in this project, by decreasing emissions of industrial farming and creating sustainable agriculture with new resilient infrastructure.

2. No Hunger

Targets:
· End hunger
· Food security
· Sustainable agriculture

Targets in the project:
Alternative agriculture and local production are big parts of the vision. Furthermore, food security through checkpoints and regulations of import and export and a just distribution of the production are implemented.

3. Good health and wellbeing

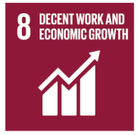
Targets:
· Ensure healthy lives
· Promote wellbeing for all at all ages

Targets in the project:
Healthy lives through accessible healthy food and promoting alternative protein food consumption. Moreover, reducing emissions and pollution will also contribute to the goals.

7. Affordable and clean energy

Targets:
· Ensure access to affordable, reliable, sustainable and modern energy for all.

Targets in the project:
In the project generating sustainable energy for new and existing functions is important. A transition to sustainable and local production, also includes the energy transition. The reuse of waste for energy is the main topic for this goal.



8. Decent work and economic growth

Targets:
· Promote sustained, inclusive and sustainable economic growth
· Promote full and productive employment and decent work for all

Targets in the project:
The vision is focused on the creation of new jobs by the Port and the province of Zuid Holland, professional education for and inclusive transition and enhancing export and import flows in the frame of the transition.

9. Industry, innovation and infrastructure

Targets:
· Build resilient infrastructure
· Promote inclusive and sustainable industrialization
· Foster innovation

Targets in the project:
The transition needs new infrastructure, connections and spatial configuration.
Moreover, innovation, research and education are the backbone of progress in the industry of protein foods.

11. Sustainable cities and communities

Targets:
· Make cities and human settlements inclusive, safe, resilient and sustainable

Targets in the project:
The project has a big social component. The wellbeing of people and we aim for its the implementation of the transition without hindering it in any way.
New transportation networks, local production and job opportunities for all are the main topics.

15. Life on land

Targets:
· Protect, restore and promote sustainable use of terrestrial ecosystems
· Sustainably manage forests
· Combat desertification
· Halt and reverse land degradation and biodiversity loss

Targets in the project:
In the project we aim to improve animal welfare, protect landscape and reinforce existing green networks.

17. Partnership for the Goals

Targets:
· Strengthen the means of implementation
· Revitalize the global partnership for global sustainable development

Targets in the project:
In the project multiple stakeholders and authorities are managed and activated through partnerships and other tools.

2. Methodology

In this Methodology chapter, the main research question and subquestions will be presented. Furthermore, the methodology used to shape the project will be discussed to finally present the conceptual framework which works as the backbone of the proposal of the Protein Factory and includes the main ideas and concepts used to shape the project.

The project of the Protein Factory aims to answer the main research question: 'How to implement a sustainable protein-based food transition in the current animal-based food industry in the frame of South Holland through the Port of Rotterdam?' through different research approaches. It focuses on social, economic and environmental factors and the way they are related to eachother in the frame of the province of South Holland, the Port of Rotterdam and with the ultimate goal of sustainability and circularity in the protein-based food industry.

The structure of this chapter is based on the Methods and Tools sheets from the course AR2U086 Research and Design Methodology for Urbanism (Rocco & Dabrowski, 2022).

2.1 Research questions

Main research question:

How to implement a sustainable protein-based food transition in the current animal-based food industry in the frame of South Holland through the Port of Rotterdam?

Sub-questions:

·What is protein food?

·Why do we need a sustainable protein food chain?

·What are current and potential alternatives to meat and dairy production?

·What are the infrastructure, landscape and/or space typologies needed for these alternatives and is it possible to implement them in South Holland?

· How will the protein transition change the import and export flows and the importance of the Netherlands in the international trade scene?

· What stakeholders and actors will be involved in the transition and how is it possible to engage them?

·How can the Port of Rotterdam stay relevant through the changes of a transition in the protein foods industry?

· How can a resilient, inclusive and sustainable protein transition be implemented in South Holland in the frame of societal, environmental and economic change?

*These questions will be answered with policy analysis, strategy and vision design and a qualitative and literature review approach

2.2 Research methodology

Different methods have been used to answer the main research question: 'How to implement a sustainable protein-based food transition in the current animal-based food industry in the frame of South Holland through the Port of Rotterdam?' through the mentioned sub-questions (see page 20).

Firstly, an extensive literature review and research have been carried out to answer the questions: (1) What is protein food?, (2) Why do we need a sustainable protein food chain?, (3) What are current and potential alternatives to meat and dairy production?, (4) What are the infrastructure and landscape and/or space typologies needed for theses alternatives?, (5) How can the transition be resilient to the future in terms of climate change and societal change?, and (6) How will the protein transition change the import and export flows and the importance of the Netherlands in the international trade scene?.

The research and analysis carried out to answer these questions were done through an internet and literature review. Furthermore, the use of the Lisa database with a license procured by the TU Delft was an important tool to map the information and get a spatial output from the outcomes of the qualitative research. With the inventory of all the data and with further research through design, it was possible to draw conclusions.

Moreover, an exploratory spatial vision and strategy were created together with a stakeholder and policy analysis to answer the questions: (1) How can the Port of Rotterdam stay relevant through the changes of a transition in the protein foods industry? and (2) How can a resilient, inclusive and sustainable protein transition be implemented in South Holland in the frame of societal, environmental and economic change?
The main concepts and their relations are set in the conceptual framework (see page 25) and are based on literature studies. Further reference research was carried out to support the feasibility of the conceptual proposals.

Finally, the questions (1) What stakeholders and actors will be involved in the transition and how is it possible to engage them? and (2) How is it possible to implement infrastructure, landscape and/or space typologies needed for alternative protein production in South Holland? were answered through stakeholder and policy analysis, together with spatial analysis and qualitative research.

Through the spatial vision and strategy, it is possible to get a more concrete grasp of what the conceptual and theoretical research outcomes will look like.
It was based on empirical analysis and related to space and time through timelines, maps and systemic sections. To showcase the conceptual and theoretical outcomes of the research, five key projects are presented in the strategy.

In the following page, the research methodology scheme is presented as an abstraction of the research process (Fig. 6).

Figure 6. Reserarch methodology scheme

Research Methodology

Research questions

How to implement a sustainable protein-based food transition in the current animal-based food industry in the frame of South Holland through the Port of Rotterdam?

Assignment

Towards a Biobased economy

Site Visit

Photo documentation
Observation
First Impressions

Problem statement

·Environmental change
· Societal change
·Economical consequences

1. What is protein food?

2. Why do we need a sustainable protein food chain?

3. What are current and potential alternatives to meat and dairy production?

4. What are the infrastructure, landscape and/or space typologies needed for these alternatives and is it possible to implement them in South Holland?

5. How will the protein transition change the import and export flows and the importance of the Netherlands in the international trade scene?

6. What stakeholders and actors will be involved in the transition and how is it possible to engage them?

7. How can the Port of Rotterdam stay relevant through the changes of a transition in the protein foods industry?

8. How can a resilient, inclusive and sustainable protein transition be implemented in South Holland in the frame of societal, environmental and economic change?

Methods

Literature review, GIS mapping, stakeholder and policy analysis, spatial analysis, research by design

Analysis

· Concepts, facts and figures
· Flows
· The animal-based food supply chain
· The role of the Port
· Future trends: challenges and opportunities
· Protein-based alternatives
· Province and Port
· Spatial analysis

Conceptual framework

· Social, environmental and economic aspects
· Port of Rotterdan and South Holland
· Sustainability and circularity
· Collaboration of actors
· Resilience
· Spatial justice

The Protein Factory

Goals

· Climate action and responsible consumption and production of protein foods

· A sustainable, inclusive and resilient protein food transition in South Holland through the Port of Rotterdam

Vision

· Production zoning plan
· Sustainable social transition
· Circular protein industry
· Local approach

Strategy

Key projects

· Social awareness
· Port as activity centre
· Alternative protein food production
· Innovation, technology and education
· Global to local
· Connections

Result

Conclusion

Reflection

2.3 Conceptual framework

In Figure 7 the conceptual framework for the Protein Factory is shown.

The project is based on three basic concepts: (1) social aspects, (2) ecological aspects and (3) economic aspects. These are related to each other through general goals that will be achieved with the project and with smaller concepts as a consequence of these bigger goals.

This way, between social and economic aspects we will achieve the collaboration of actors to create job opportunities, focus on education and innovation and create affordable products. With a correct stakeholder analysis of collisions and synergies private and public sectors can be activated through policies and other tools and implement initiatives that will promote the transition. This starts with education and innovation from which outcomes private authorities can profit. Timing and good stakeholder analysis are the most important dimensions of the analysis of this conceptual aspect of the framework.

Between ecological and social aspects we strive for spatial justice to create accessible working places, create a balance between nature and industry and improve animal welfare and food safety. The Protein Factory project presents a future in which there is a synergy between industry, nature and living environments. This way, the fauna, flora and inhabitants of South Holland will profit from the transition.

Finally, between economic and ecological aspects, we strive for a resilient transition that will allow new ways of food processing, alternative food production and the reuse of waste for energy. As stated in the Problem Statement, South Holland will have to face environmental and consumption changes that will affect its economy and the animal-based food industry (Wageningen University and Resesarch, 2022). All this spins around the ultimate topic of the project which is the creation of a local protein food transition.

All these activities and concepts happen in the frame of the Port of Rotterdam and the province of South Holland, with the ultimate goal (also from the Port, EU and UN ambitions) of sustainability and circularity.

Although this conceptual framework is spatially linked to South Holland, it would be possible to extrapolate it to other provinces of the Netherlands with the consequent previous theoretical research to implement a national transition in the future.

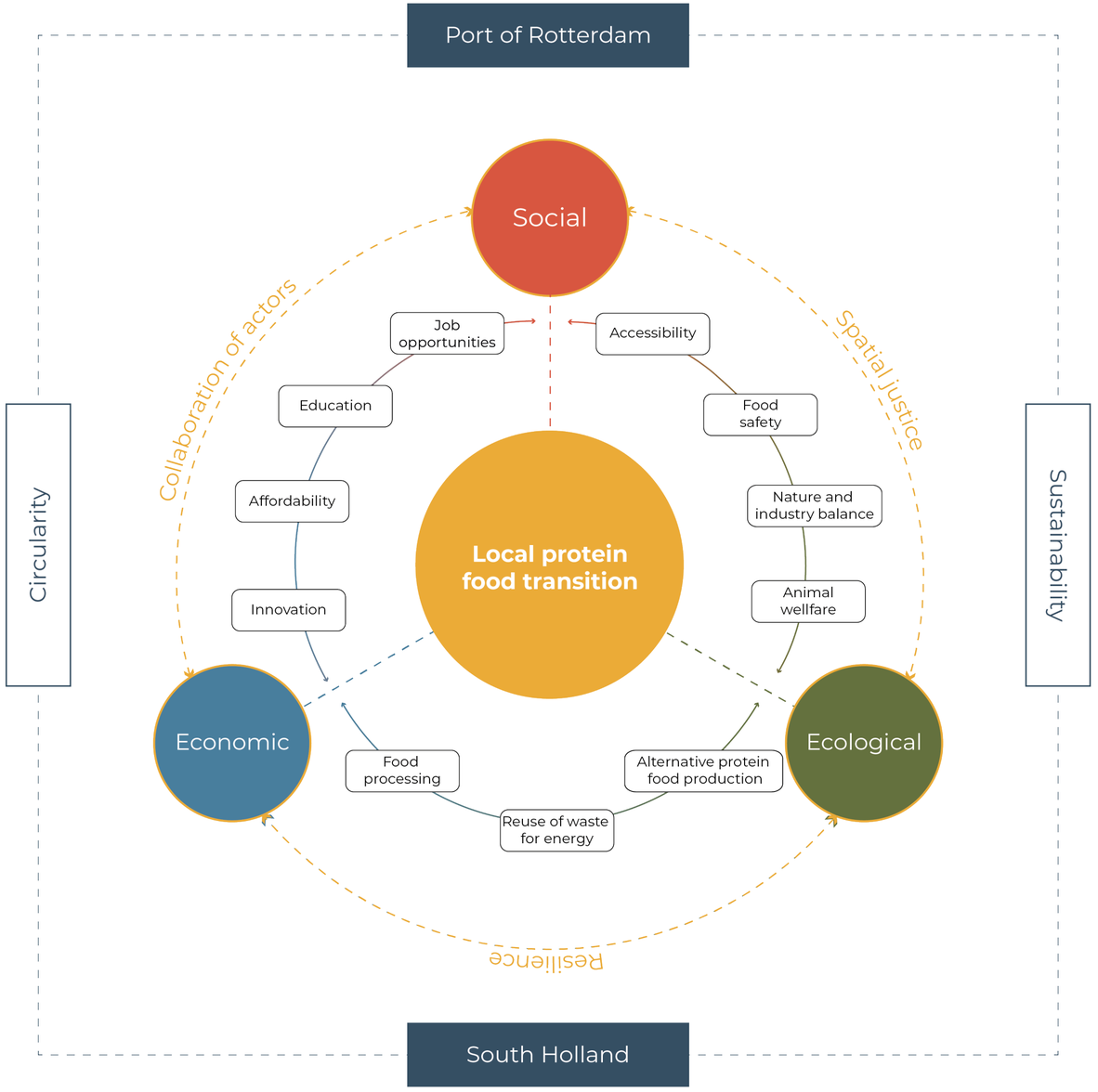


Figure 7. Conceptual framework for the Protein Factory

3. Analysis

In this chapter, we made a detailed analysis of the animal-based food supply chain to understand how the system works and why do we need to change it. Keywords such as protein-based food, livestock, animal feed, animal-based food processing and meat & dairy products will appear frequently in this chapter, as they are the main elements of the chain. It was important to lay the foundation of why do we need a change and what are the prioritized problems through this production process. The role of the Port of Rotterdam is crucial as emphasized in detail in the chapter. Further research is made on current trends and challenges to indicate the global dependency of the system. Alternatives to protein-based food and consumer behavior became critical discussions to elaborate on how we can make the transition. Then we proceed with spatial analysis of land use and typologies for the South-Holland, together with intensifying the emphasis on material flows in systematic sections. We complete the chapter with the swot analysis at the end to have a brief sum of all the research and how we used them for the vision.

3.1 Animal husbandry
Facts and figures

Animal husbandry is the largest built sector of agro-industries in the Netherlands. The production from this industry extends on a global scale and became one of the main drivers of Dutch economic growth. Moreover, the industry is directly related to many outflows of varied materials, forms of energy, jobs and innovations.

The industry is based on animals that are raised for meat and dairy products. This is called livestock farming and requires constant care and feeding. These animals are mostly cattle and pigs, and also chickens and horses. The process of maintaining livestock takes a lot of work, energy, space and investment. The food on our plates does not come through an easy process as one might imagine. Especially cattle and pigs require a lot of animal feed, and feed is mostly imported from abroad and not locally produced enough. Currently, soybean meal is the essential animal feed to provide protein nutrition. Approximately 1 million animals are kept in the province of South Holland for animal husbandry which requires 1.3 million tonnes of feed (Drift & Metabolic, 2018).

Although the industry is crucial and good quality nutrients are necessary, the current process is highly problematic in terms of nitrogen and phosphate emissions, manure surplus, and the requirement for animal feed, which is associated with illegal deforestation in South America (Drift & Metabolic, 2018). The Netherlands is a hot spot for nitrogen, where Dutch farmers contain four times more animal biomass per hectare than the EU average. In 2019, the Dutch government had an effort to reduce nitrogen emissions by some measurements, which ended up with farmers parking their tractors along highways to protest.

Figure 8. Main concepts related to animal husbandry

Figure 9. Photo of the protest of dutch farmers that curtails the expansion of livestock farming. Photo by: VINCENT JANNINK/ANP/AFP/GETTY IMAGES

3.2 Where does our food come from?
Import and export

The Dutch agro-industry sector has worldwide significance. The Netherlands is the largest animal-based food exporter in the world, with a $3.2 billion income in 2019 (OEC, n.d.). Maintaining its critical position in the EU for years, they are also exporting food to many further foreign countries. The largest international consumers of these Dutch products are Germany, Belgium, the UK and France. Distribution is made through the Rhine-Meuse Delta and railway networks.
For import flows, livestock from UK and meat from other foreign countries are imported. But the main import flow for animal husbandry is the soybean which mostly comes from South America. The Netherlands imported $819 million of animal feed, becoming the second-largest importer in the world (OEC, n.d.). This shows how the dutch industry is truly dependent on the import of soy to maintain their livestock and their critical role in animal-based food production.

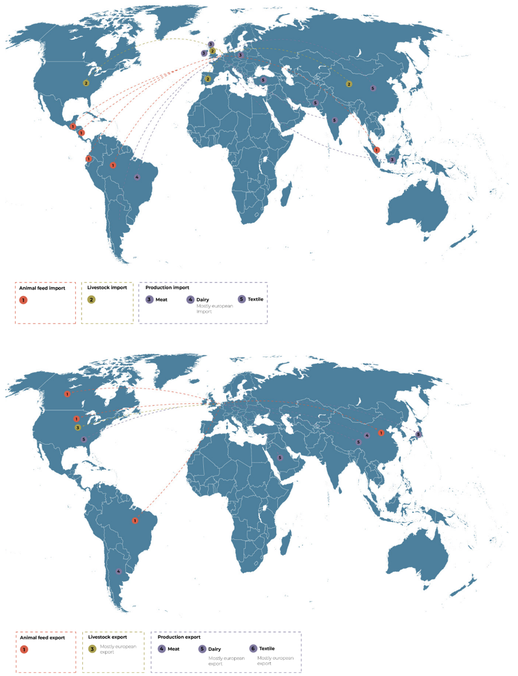


Figure 10. Map displaying the global import and export flows of animal feed, livestock and animal-based food production

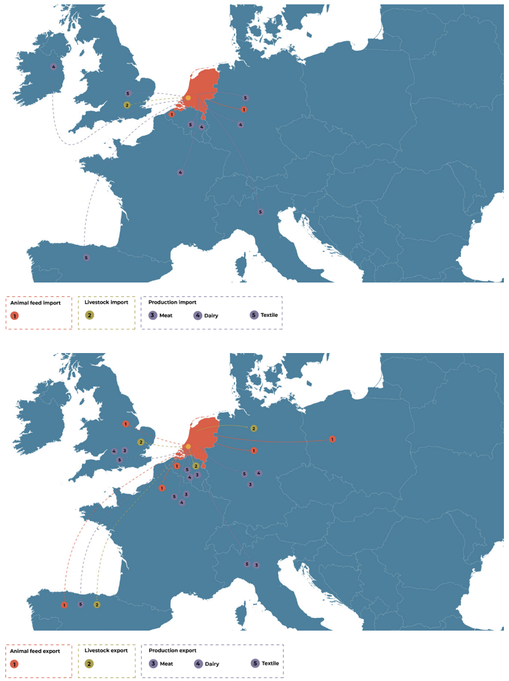


Figure 11. Europe map displaying the import and export flows of animal feed, livestock and animal-based food production

3.3 The animal-based food supply chain

Industry and main components

The animal-based food supply chain is a wide relation of the network of connections. The industry is directly related to many outflows of varied materials, forms of energy, jobs and innovations. The current supply chain is a linear one, and in this chapter, we made an elaborate discussion on the opportunities and weaknesses.

As mentioned previously, the Dutch animal husbandry indusry is highly dependent on the import of animal feed. Although some feed production takes place outside South Holland, it is not self-sufficient. Thus, the import of soybean meals from South America has a crucial role in the current flows. This becomes the primary problem even without further expression on how the chain works. The reason is that soybean production is associated with illegal deforestation in South America (Drift & Metabolic, 2018). Moreover, the whole import process causes a lot of CO2 emissions together with deforestation, implementing that there is a crucial problem from the start to feed the livestock.

The Port of Rotterdam has the biggest role in this chain. It is one of the essential elements of why Dutch animal husbandry has grown so far by the export and import flows. And also same can be said for how animal husbandry is a substantial industry for the Port to develop to maintain its position as the leading Port in Europe. The mutualistic relationship they have is a critical aspect that we would take into consideration for the following chapters of the report. In the current flows, the Port mainly plays a role in logistics, infrastructure, storage and customs checkpoint. Import and export flows are shown in the analysis for material flows on further pages.

The imported animal feed is distributed to farms. Livestock farming requires a lot of land use as Dutch maintained grazing-based production where lots of empty fields of green can be seen. In South Holland province, 60.000 hectares of the regional land area were used for this. Besides the import of soybean, the second most problematic element of this supply chain appears in this part. There are 3.8 million tons of manure produced by animals each year, and the province is struggling with the surplus. The emissions from livestock farming exceed the liability of the Dutch government and it becomes a global threat. Although nitrogen and phosphate are crucial for agriculture, the emissions from livestock are highly harmful to the environment, thus livestock in the Netherlands has to be reduced to achieve the climate targets according to the Paris Agreement (Drift & Metabolic, 2018). The Dutch government's effort to reduce the expansion of livestock in 2019 failed miserably and ended up with an outburst of farmers.

The whole system operates precisely and it is difficult to implement a transformation. But it is indeed inevitable that we need to find solutions and change the current way of animal-based food production. To achieve a transition towards a sustainable and resilient chain, closing loops towards local circular flows and reuse of waste would be feasible. But in the long term, the whole system should be changed to reduce livestock, practice sustainable ways for protein-based food production.

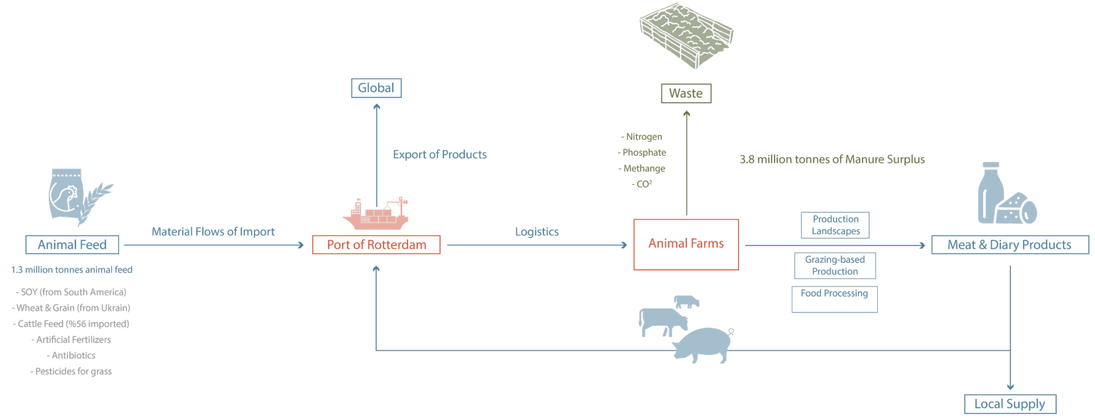


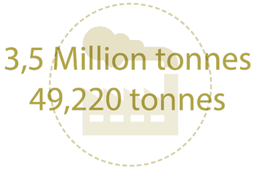
Figure 12. Animal-based food supply chain diagram, indicating flows and the process

Food Waste

In 2017, the total quantity of food waste in the Netherlands in the entire chain was between a minimum of 1,814 and a maximum of 2,509 kilotons. Meat and dairy products are among the top 10 kinds of food waste.

Manure surplus

In 2021, the total manure excretion is 73,395 kg, manure is huge source of pollution of water, soil and air.



Emissions from production

In 2016, the entire agrifood chain was responsible for a total emission of 3.5Mton CO2 for energy consumption and 49,220 tonnes of methane from livestock farming.

Emissions from logistics

In 2018, the CO2 emissions from ship activities at the Port of Rotterdam is 640 thousand tons.

Figure 13. Showing the main facts and numbers that are produced through the animal-based food supply process. These are food waste, manure surplus and gas emissions. The references for the data and numbers can be found in the appendix part.

3.4 Future trends

Challanges and threats

One of the other problems with whole animal husbandry is that the system is not resilient to the current challenges. It highly depends on globalization, where import and export flows constitute a delicate base for the whole system. With the rapid population growth, the consumption and demand for nutrients will increase. This would augment the need for an adaptive supply chain. However, the current primary challenges have a massive effect on global networks. The pandemic, wars & conflicts between countries and climate change are the prominent challenges. Although global networks provide a profitable system of connections, it is unstable. With the increase in gas prices, many greenhouses in the Westland area stopped working and the ones that use geothermal energy operate without any problem. This is one of the examples that intensify the emphasis on the need for change.

Consumer behavior is also transforming through changing diets that are affected by the current challenges. The demand for food will increase naturally with the increasing population. The Netherlands is one of the worldwide top-5 largest dairy exporters and research indicates that consumption of dairy products will increase in the next decade (OECD & FOA, 2020). However, one of the prominent research indicates that meat consumption is decreasing. Per-capita meat consumption fell by nearly 3% from 2020 (FOA, 2020). There are also ethical reasons for people to not consume meat, but the primary reason would be the rising meat prices, awareness of what livestock farming is causing and current challenges that pushed the transformation of changing diets. This enhances the discussion of the requirement for local and sustainable production, whereas alternatives for protein-food practices also started to stand out in past years.

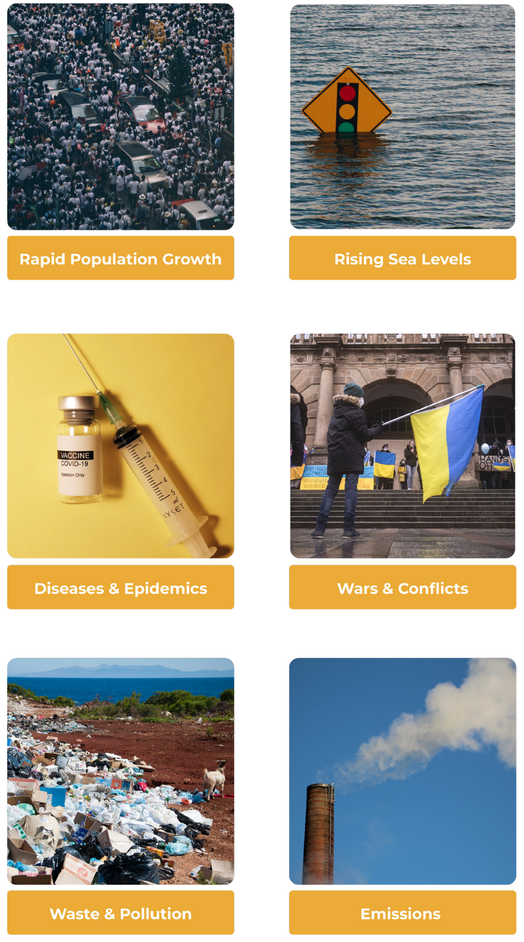


Figure 14. Images indicating the current challenges and threats that have direct effect on the protein-based food supply chain and consumer behavior & demand. Photos by: Unsplash/Multiple authors mentioned in the appendix

3.5 Protein-based food alternatives

Sustainable practices of protein production and consumption

Dutch animal husbandry mostly maintains grazing-based production, as mentioned in the previous chapters, this led livestock farming to cover an extensive quantity of land use. This method is advantageous for animal welfare and the quality of nutrients that we get from them. However, we have to consider the need for a transition toward sustainable food production, by reducing or transforming livestock. And currently, alternatives for protein-based food have risen to prominence to replace meat. Plant-based production is the primary alternative to animal-based protein, and it is already integrated into the diets by many consumers (Protein Transition, n.d.). Many agro-companies are maintaining plant-based production in South Holland, but most of them are for animal feed. This can have a crucial role in the long-term transition of this supply chain, by gradually shifting soy production from feed to food and reducing livestock by transforming it into plant-based production. Besides soy, oat and rice are also some implementations of this production method.

Another potential alternative production is already started to show up in the North Sea, close to the Haag. Projects for sustainable seaweed and algae cultivation are aimed from 2030 onwards, as the current state of cultivation techniques is inadequate (North Sea Farmers, n.d.). But it is another highly potential alternative for replacing animal-based proteins, as there are already offshore tests, and many actors are investing in further development for the transition of regional cultivation (A Circular Economy in the Netherlands by 2050, 2016).

Lab meat, also known as cultured meat is another production method for protein-based food. Directly related to research and innovation, this practice requires way less livestock as scientists started to produce hamburgers from tissue taken from cows (Moca-Grama, 2020). However, with the current technology, this method is high cost and effort, compared to grazing-based production. With further research and innovation, this method may be implemented for the long-term transition, to replace animal-based proteins.

According to the research, the Dutch government is already committed to improving the potential uses of insects as proteins for animal feed. The process needs high care and preconditions to prevent outbreaks, this method can be crucial for decreasing the import of soybeans from South America (A Circular Economy in the Netherlands by 2050, 2016). But the further question through this research would be the potential usage of insects farms to produce protein-based food for people. Considering that meat consumption is decreasing and production methods for protein-based food are changing, further research on the implementation of insect and mushroom farms to replace meat in the far future can be interesting.

Another alternative is for the distant future, where advanced artificially intelligent robots start the cultivation of humankind in large fields of capsules where all of our life is an illusion. Referring to the sci-fi movie The Matrix, the iconic scene of Cypher eating a juicy and delicious steak that does not exist flashes into our minds (Figure 15).

Figure 15. Wachowskis (Lana & Lilly Wachowski). (1999) The Matrix [Film]. Warner Bros. Pictures.

3.6 The role of the Port

Values and vision for a future resilient port

It is indicated at the beginning of the chapter that the role of the Port of Rotterdam has a crucial appearance in Dutch animal husbandry's dominance on the global scale. The whole system for protein-based production is dependent on import & export flows. We are aiming towards a transformation of the protein-based food supply chain, and one of the main goals is to achieve local circular flows. With the reduction of livestock farming, the import of soybean for animal feed would significantly decrease. Through this transition, many food processing facilities and logistics that are clustered at the center of the Port can be transformed through our future intentions. Another essential value is the Rotterdam Food Hub, which is being built on the Calandkanaal.
Developed by the Port authorities, the projects specify to optimally facilitate agri-food companies to maintain the port's important position in Europe (Port of Rotterdam, n.d.). We found this project very valuable for further development, which can play a central role in the transformation of the protein-based food supply chain. For further improvement of the role of the Port through our intentions, it is also critical to acknowledge the Port of Rotterdam's vision for a future resilient port. We approached their values under the three main concepts that we introduced in the conceptual framework.

Through the economic transition, Rotterdam authorities have critical intentions to maintain their position as a maritime capital, by implementing global hubs and spaces for development (Port of Rotterdam et al., 2019). These considerations are highly potential for our values for the transformation of the protein-based food supply chain, where the Port would play a centralized role to optimize transition.

Through the social transition, the Port authorities take into consideration the improvement of health and safety in living environments, thus increasing the quality of life. They aim to have more and better connections between the port, city and region (Port of Rotterdam et al., 2019).
In our case, this can be acknowledged through a better network of relations between education facilities, innovation, retail market and food processing facilities to gradually implement the transition, and search for alternative practices.

Through the ecological transition, their main goal is to achieve more sustainable logistic chains, and affordable & clean energy usage to limit emissions (Port of Rotterdam et al., 2019). As the Port already plays a critical role in the protein-based food supply chain, maintaining local and circular flows for a resilient supply chain would be in the same line as the Port authority's future intentions. Therefore locating clusters of waste management facilities and energy plants to have better network connections between them is crucial through this transformation process.

All these values are essential. They play an important role in our vision and strategy for the transformation. In this analysis chapter, it was important to emphasize the current role of the Port, and its potentials for us which are in line with the Port authority's vision for a future resilient port. We worked on a map indicating the use of functions and clustering of companies that are related to the animal-based food supply chain by production, process, distribution and logistics. This demonstrates that the main facilities that can play a role in the transition are mainly located in the center of the Port. Such implication gave us further ideas about the role of the Port in our vision, as these areas appear as strategically potential areas for future development for the transition.

Photo 16. Photo of the Port of Rotterdam from the excursion we had at the begginning of Q3. Photo by: Ruta Vitkute

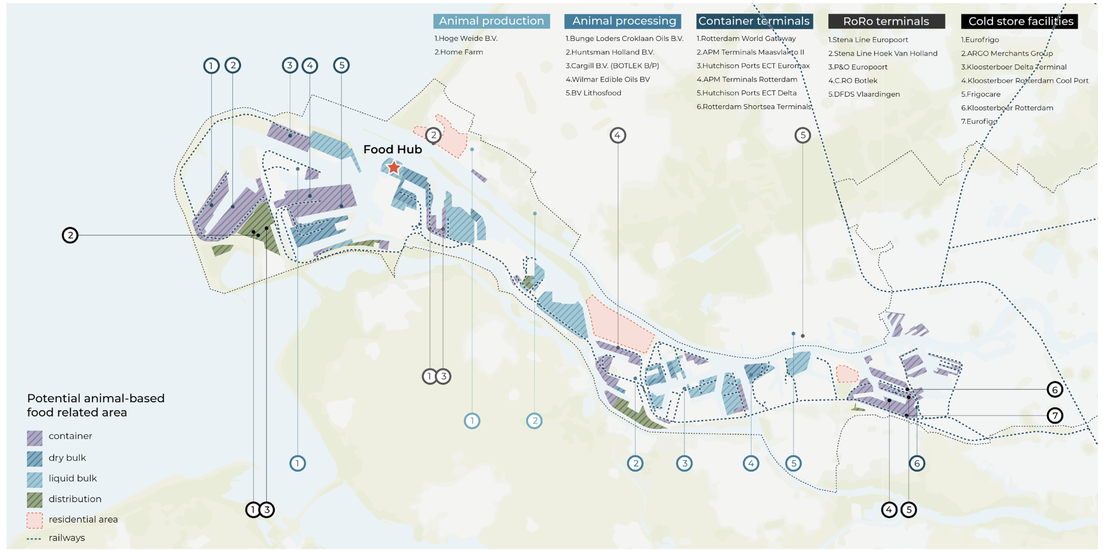


Figure 17. Map indicating the use of functions and clustering of companies that are related to the animal-based food supply chain by production, process, distribution and logistics.

3.7 Province of South-Holland

Spatial analysis on land use and typologies

South Holland is already the leading province in agro-industries due to large numbers of greenhouses, massive agricultural fields, the Port of Rotterdam and an advanced network of well-connected cities. The whole area is an optimized factory of food production, which appears as the center of innovation, infrastructure and social interaction. Thus, this gives a primary role to the region, that would emphasize the transition toward a sustainable protein-based food supply chain.

Interpreting on the land use map, we can say that the whole region is distinctly zoned. The Port of Rotterdam extends through the city center, which forms a clear separation between north and south. These areas lack connection. The south islands of the province appear as an agricultural zone, that contains large fields for crops due to their fertile soil. Here, a fragmentary configuration of urbanization is observed, where small towns are located discursively. The whole area is valuable for its soil type and can play a crucial role in the transition toward plant-based production.

Most of the livestock farming is located outside of the province, still large fields of meadow and farms are located in the eastern part, where 60.000 hectares of the regional land area were used for grazing-based production (Drift & Metabolic, 2018). These are integrated with small cities and the Green Hearth. This area appears as a mix-use between a lot of functions. Through the north side of the port, intensified greenhouse horticulture is located. These areas are the main production zones of the factory, where emphasizing the Westland as a strategic area would enhance the transformation of the factory. Nature reserved areas appear along the coastline in the west, and in some areas that are connected to the Green Hearth in the east. These areas are valuable for a resilient future. The well-established network of public transportation via train is visible, whereas in the south a train network for the distribution of goods from the Port is located. This suggests with future investments, it might become an advanced network that plays an essential role in the optimized distribution and material flows in the region and Europe.

It was important to zoom in to analyze the spatial typologies and locate clusters of current functions that are related to our subject. Proceed with more detail about where feed production, food processing and waste management facilities are located in the province, the clustering of the current function map (figure 18) emphasizes the indicated zones previously. This leads us to a vision of a transformation for the whole region as a protein factory. The islands in the south appear as a highly potential zone to start a transition immediately, with already existing agricultural fields due to its fertile soil. Many processing and waste management facilities are clustered in the center of the port. Here the Port appears as the center of functions, that operates and moderates the factory through its infrastructure and space for development. Also, the food hub has a crucial position due to its strategic position and would play a crucial role during this transition. The Eastern part is currently indicated as mix-use, where the transition would probably occur in the long term. Because there are many functions located in the large area, with many actors to take into consideration. The northern part of the Port appears as the main production area, where large numbers of greenhouses are located. Further research is done throughout the report, to indicate what could be the role of greenhouses through this transition. The coastline zone also includes Den Haag and Leiden. Sea farms in the future would create many job opportunities, where the connection to the city would form a better infrastructure network for sea farms. In the

Figure 18. Landuse map.

end, such representation of the types of zones we have in the province gave us a better understanding of how we can visualize a transformation of the factory towards a sustainable protein-based food supply chain. The most common spatial typologies that are essential for the transition in these zones are represented below. These axonometric drawings we made gave us a better understanding of the different types of scales that we have to deal with. These typologies are energy plants & waste management, sea farms, food hub, floating farms, greenhouses and livestock farming & agriculture. Implementation of more floating farms is discussed in the further process of our vision and strategy.

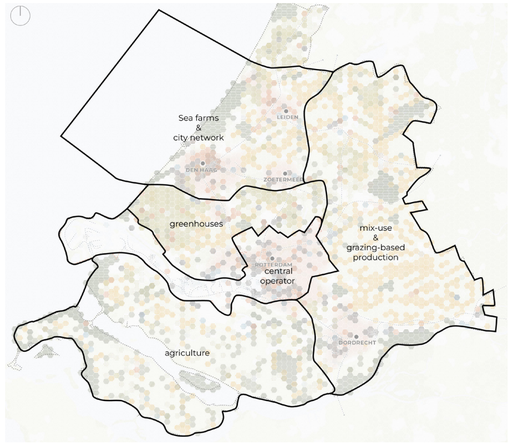
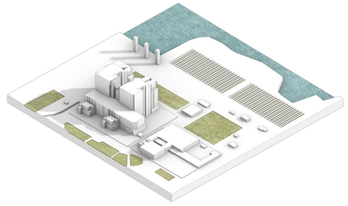
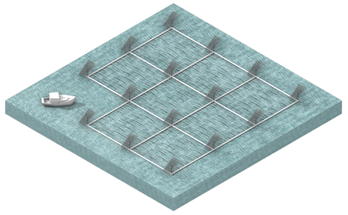


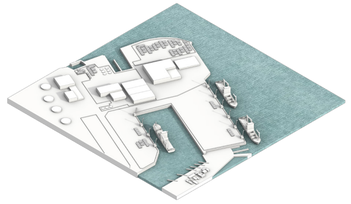
Figure 19. Map indicating the zoning for prominent functions



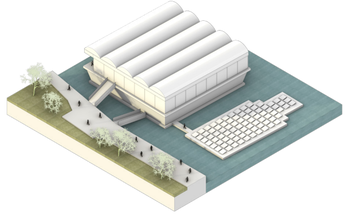
Energy plants & waste management



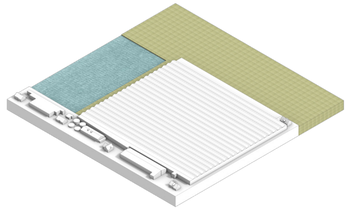
Sea farms



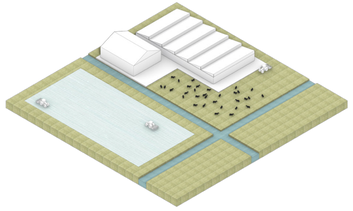
Food hub



Floating farms



Greenhouses



Livestock farming & agriculture

Figure 20. Axonometric drawings of the existing typologies related with animal-based food production

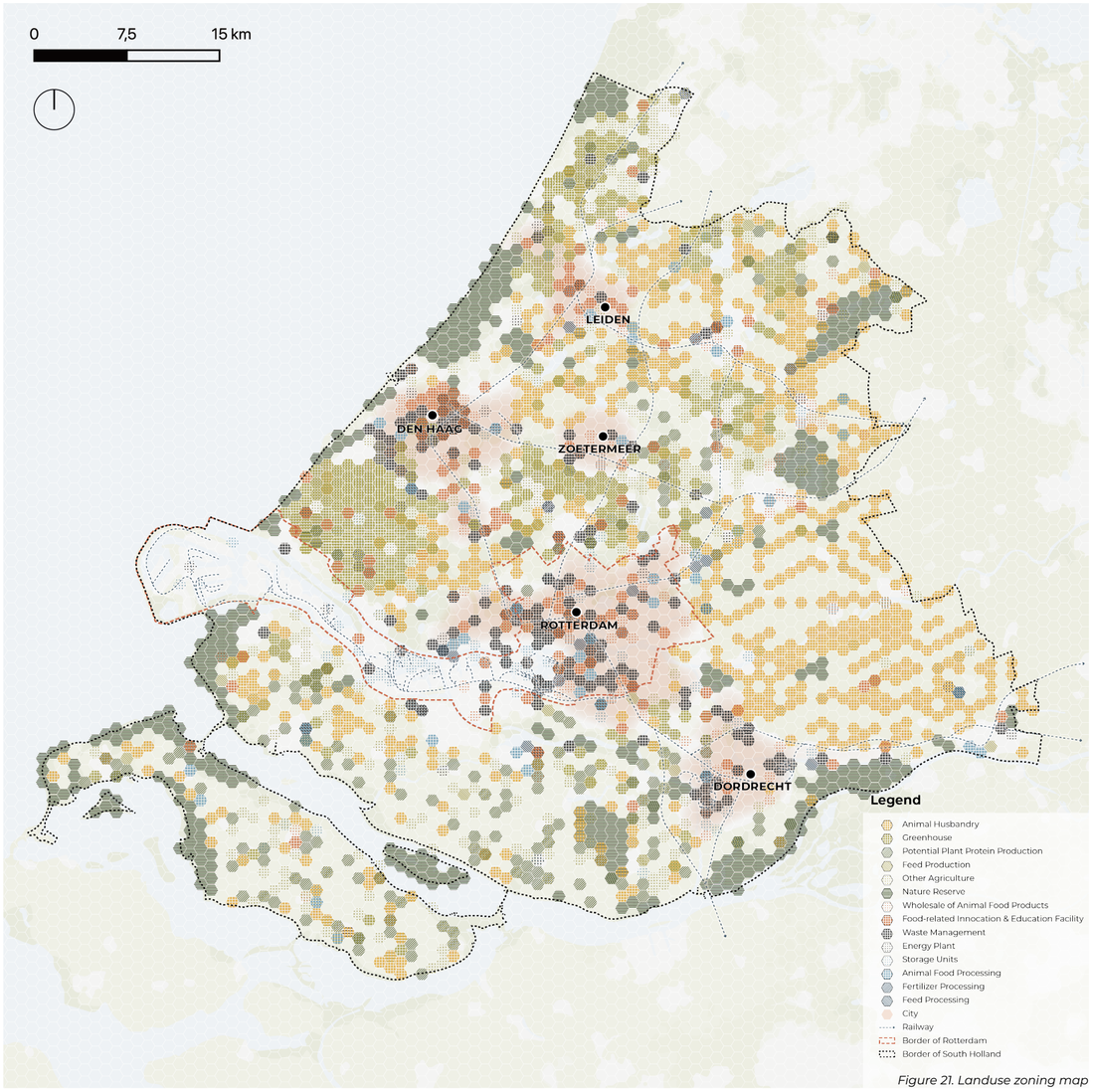


Figure 21. Landuse zoning map

3.8 Material flows analysis

Systematic sections

To have a detailed understanding of material flows and the spatial implementation of the current system, we worked on some systematic sections. We indicate these sections under three different concepts. Export & import flows signify that the Port of Rotterdam has the main role in the distribution. Clusters of waste management, energy plants, logistics, cold storage and inspections centers are located throughout the port. This already gives us information about some opportunities for further developments.

For the social transition, the systematic section implements that the livestock farms are located quite far away from where the consumption happens and the lifestyle of farmers is separated from city life. The role of retail markets in the system comes into prominence. Furthermore, many job opportunities are provided through food processing, waste distribution facilities, the Port and greenhouses. There is a gradual decrease in urbanization towards the Port and greenhouses (Westland).

Greenhouses can also be beneficial locally as they produce electricity that is used in nearby cities. For livestock, the manure surplus is the main problem, but it has a high potential to be used for agriculture as fertilizer. Food waste that emerged along the process is used for animal feed production. These form a direct connection between animal husbandry and greenhouse horticulture. Nevertheless, there is still a massive amount of manure surplus that causes nitrogen and phosphate emissions, and the methane gas from animals is also highly dangerous to the environment.

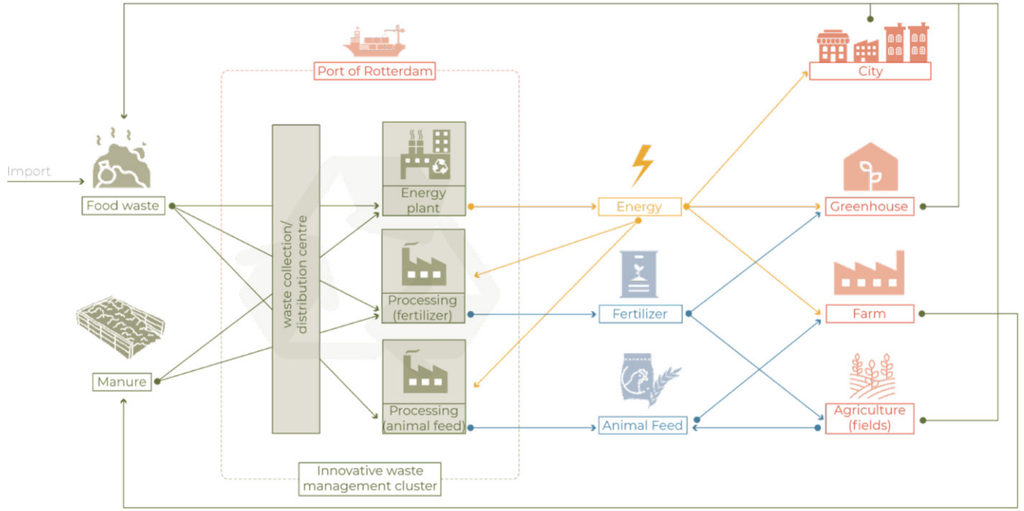


Figure 22. Diagram indicating the current waste management and reuse of manure and food waste through clustering of innovative waste management.

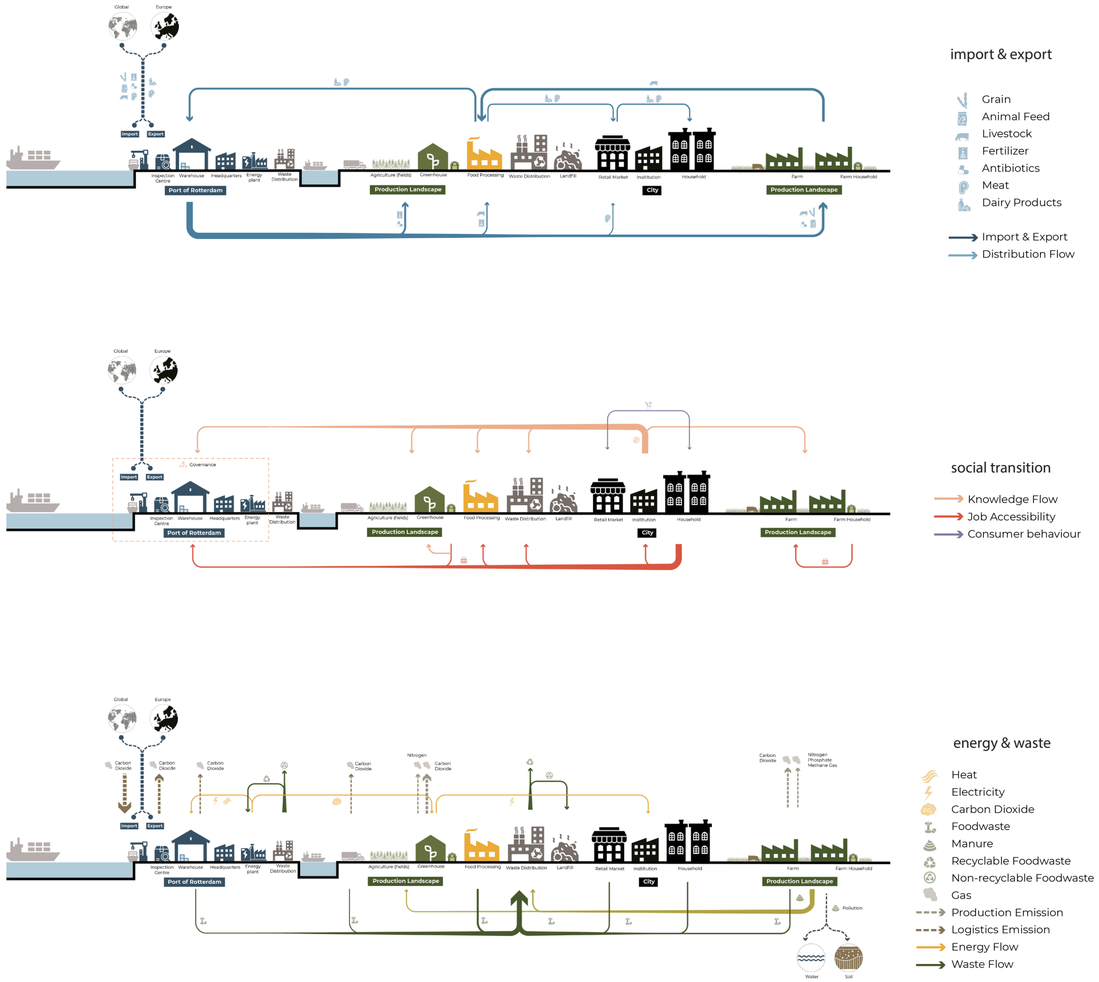


Figure 23. Systematic sections for the analysis of current material flows, indicated under three different concepts as import & export distribution, social transition and energy & waste

3.9 SWOT analysis

Thus far, we analyzed the animal-based food supply chain and have a detailed comprehension of how the current system works. To visualize all these problems and potentials, we prepared a swot analysis. These are the highlights in general for the province, through our intentions for a transition in protein-based food supply chain. Throughout the whole chapter of analysis, we had a clear understanding on how the current system of the province works as a factory that requires a change.

The main strengths are the location of food and feed productions that can play an essential role in the transition toward local material flows. Education institutions and job opportunities are highlighted, also export flows are indicated for acknowledging the future values of the Port of Rotterdam.

Throughout the report, we mentioned many opportunities. Here, the execution of sea farms and the location of the food hub can be seen. Potential areas for feed production are highlighted. This would be a short-term opportunity for a smooth transition since we are aiming to reduce livestock. We then want to emphasize the transformation of these feed production to food production in long term. Opportunities for clustering waste management facilities are highlighted to indicate an optimization to produce fertilizers, feed and energy.

For weaknesses, we wanted to illustrate the global dependency on animal husbandry, and that is the import of soybean. Areas that are responsible for emissions and waste are highlighted, where Westland appears as the leading actor. Here it is also visible that the grazing-based production in the eastern part is highly responsible for emissions and manure waste. Threats are indicated through rising sea levels where the nature reserved areas along the coast play an important role as a buffer zone.

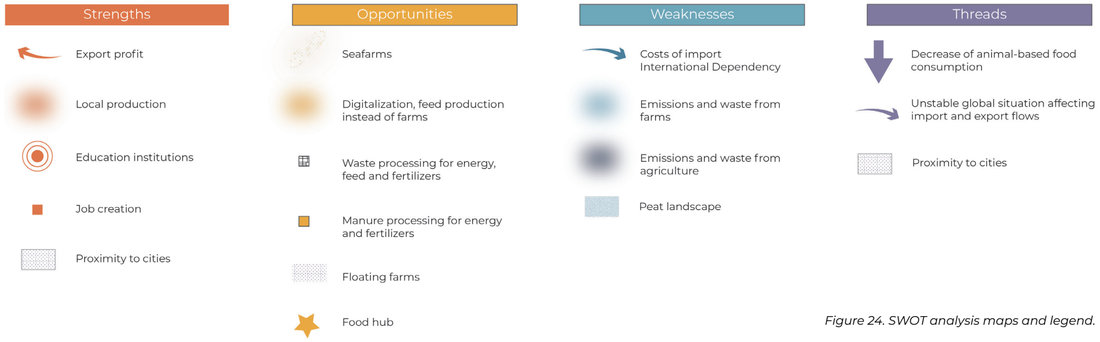
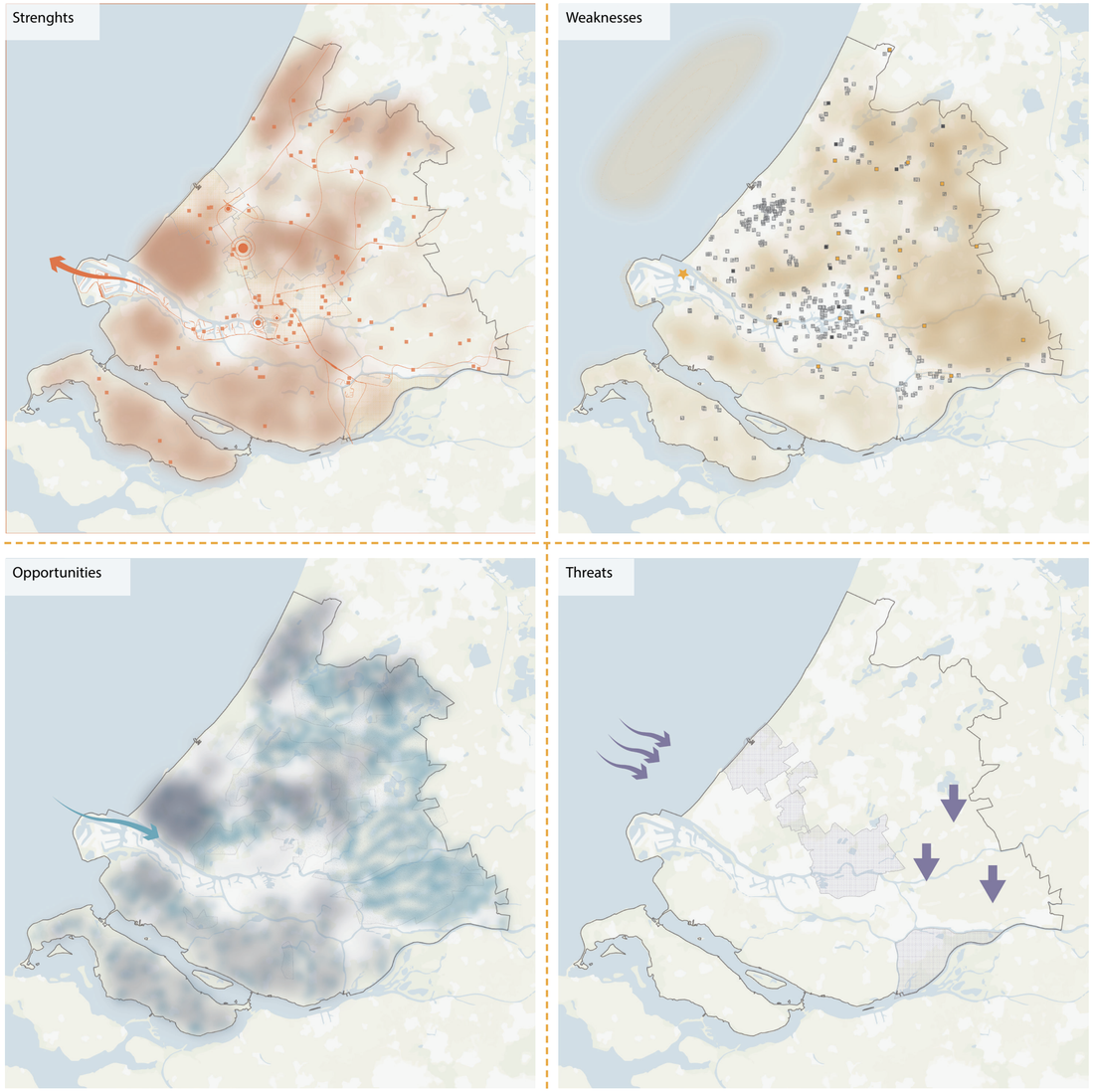


Figure 24. SWOT analysis maps and legend.



4. Vision

By 2070, the South-Holland province will achieve a sustainable protein-based food supply chain and the transition will gradually be implemented in other Dutch provinces. This vision is embedded in environmental, economic and social aspects and relates to national, regional and the port's scale, focusing on the synergy between the port, cities and the production areas.

4.1 Vision statement

Where does the vision come from?

The Netherlands has a crucial role in the global animal-based food supply chain by the virtue of the Port of Rotterdam. In 2019, the Netherlands was the 2nd largest importer of animal feed (Rintoul, 2020) and the 1st main exporter of livestock (Eurogroup for Animals, 2020). However, the current production process of meat and dairy products is not sustainable in the long term as it is dependent on global supply and also responsible for a vast amount of emissions and waste. Moreover, the whole system lacks resilience to global challenges such as pandemics, wars, animal diseases, etc.

Furthermore, current trends in the Netherlands show that meat consumption is considerably decreasing over the years (about 7.6% in the past decade) (Wageningen University and Research, 2021) which shows a need for a transition into a more prominent alternative protein-based food production. The current global trends demonstrate increasing meat consumption as the population is rapidly growing, however, for the far future, there might be a need to drastically reduce global meat and dairy consumption in response to solving

What is the vision?

The Netherlands should aim to become a sustainable consumption country in the future. Therefore, we introduce the transition towards a local, circular and sustainable protein-based food supply chain, which will be resilient to societal changes, adaptable to environmental urgencies, and will maintain sustainable consumption diets.

South Holland is a leading province in terms of agricultural activities due to fertile soil, therefore, it has a potential to play a primary role in the transition and work as a 'protein factory' in a innovative way to achieve this vision. Gradually, it should be implemented in other Dutch provinces to achieve a full transition towards a sustainable protein-based food future.

The Port of Rotterdam will retain its importance in food export but also plays a crucial part in achieving circularity and sustainability in the local protein supply chain. As new technologies and processing of food and waste will be centered in the Port of Rotterdam because of its well connection to local logistics network. The city, the port and the production areas will be closely connected in terms of job opportunities and accessibility.

How to achieve the vision?

To achieve this, our vision is embedded in environmental, economic and social aspects and relates to national, regional and the port's scale.

Environmental aspects: It promotes a transition into sustainable production systems of alternative protein practices such as sea farms, lab meat and plant-based protein to replace animal protein which will largely reduce the carbon footprint. New waste management facilities and energy plants are clustered by the Port, where main infrastructures and railways are located. In these facilities energy will be reused and produced as well as resources will be recycled.

Economic aspects: Local production will decrease the dependency of the Netherlands regarding Europe and worldwide import of feed and animal-based products. New circular systems will be focused on alternative production of protein, decreasing the need for animal-based food while maintaining the Dutch dominance over food export .

Social aspects: The trend of reduction of animal protein consumption entails a social movement to arise social awareness of reasonable consumption of the public, also supported by our vision, in which climate change and concern for animal welfare are the main drivers. Moreover, it is important to create preconditions that would allow farmers to adapt to decreasing meat and dairy consumption trends and gradually implement production of meat alternatives. This new industry will also create more job opportunities for different target groups and require further research and innovation.

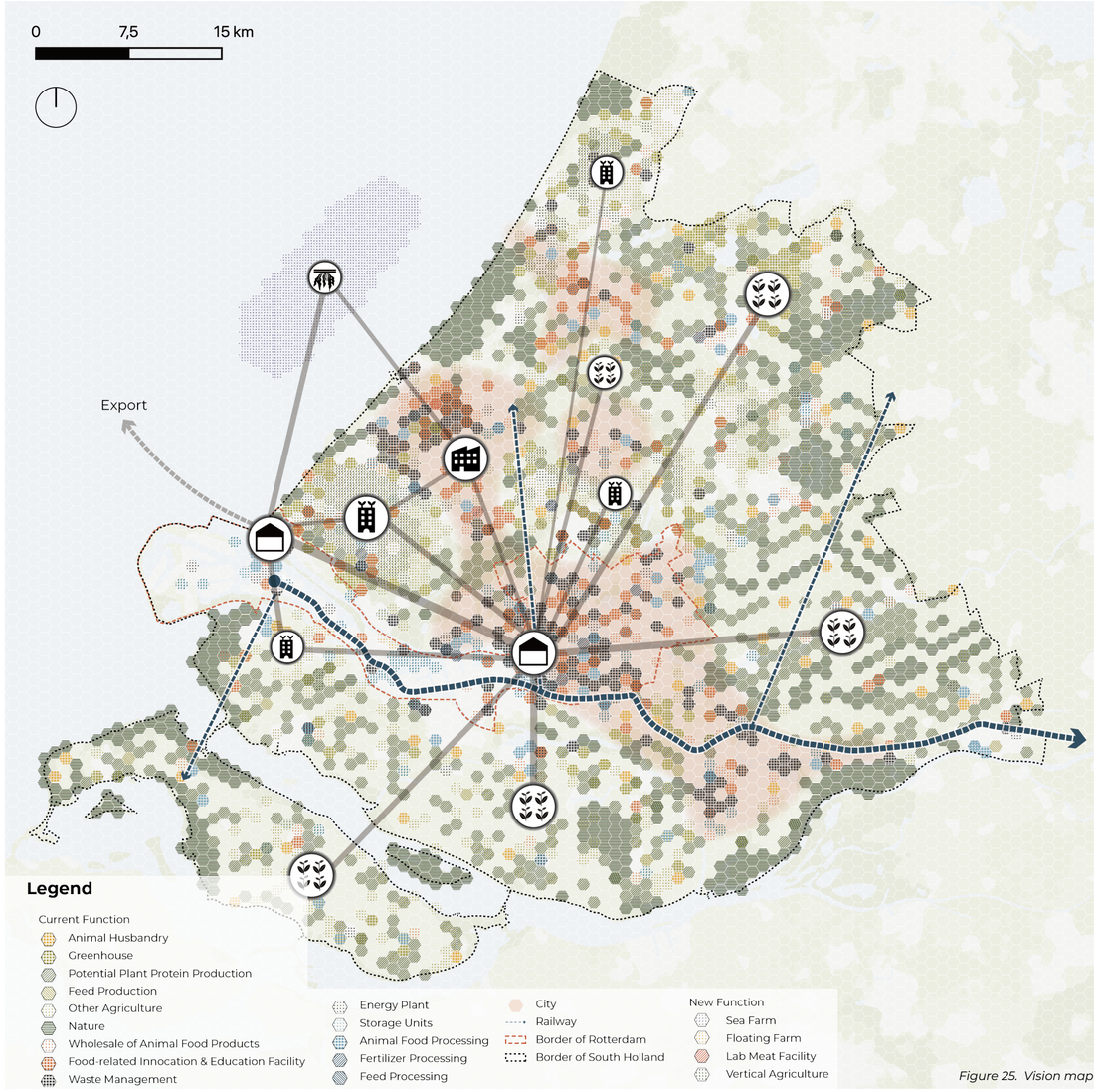


Figure 25. Vision map

4.2 The transition

Functional and spatial transformation

1. Clustering

Based on current function analysis, the South-Holland province can be classified into several clusters: the port, built-up area, greenhouse clusters, animal husbandry cluster and plant production landscape.

2. Transition

To achieve the sustainable protein-based food supply chain, the port, city and the production are three main factors. As population global trade grows, it can be estimated that the port and city will expand while production area will slightly shrink but increase production with more efficient methods.

The port will become the center of import&export, all kinds of processing, and education and innovation. The food hub proposed by the port will focus on import and export, seaweed processing, as well as waste management and energy production for greenhouse area. Innovation and education in the area is also important for staff training and contribute to production clusters. The eastern part of the port, where a lot of infrastructures are located, can be the second cluster for alternative protein processing, distribution and logistics, as well as innovation and education. A lot of facilities as slaughterhouse and meat-protein processing facilities can be reused for new function. The two clusters are the center of logistics and job creation, closely connected by railway system, they can be easily accessed and serve a bigger area.

For production, the animal husbandry cluster will gradually transformed in to a plant-base protein production area. Massive animal farms will be replaced by plant farms and nature, only local, small scale animal farms will remain. Local processing facilities and local markets will be implemented, to introduce more public activities. Greenhouse cluster will transformed into agri-city, greenhouse will be renewed and turned into vertical agriculture buildings according their built-year. In this way, while maintaining even increasing current production, some land can be released for greenery and contribute to the living environment. The southern part, will continuously be crucial in alternative protein production. With traditional farming and new production methods, such as insect farms, mushroom farms, and floating farms and synergy with innovation and education institutions, this area can be built into a showcase in order to raising social awareness of sustainable protein consumption. Sea farms on the north sea and lab meat facilities in major cities will also play an important role in alternative production and these facilities have strong connection with cities in terms of innovation, education and job creation.

The city is crucial for education and innovation, such as lab meat and seaweed research. It is also where social transition takes place. Local markets and Local processing are implemented between cities and farming areas in order to improve food accessibility and raise social awareness of where does food come from and sustainable protein consumption.

The railway system plays a key role in the transition. More emphasis will be put on train transportation over truck, which will be more efficient in both logistics and job accessibility. The well connection between port, city and production area make it possible for the port as the center of the supply chain.

3. Conclusion

The synergy between the port, cities and production areas as well as the railway network is needed for the transition towards sustainable protein-based food supply chain. The process will take part in a gradual way to ensure a smooth transition for all relevant stakeholders.

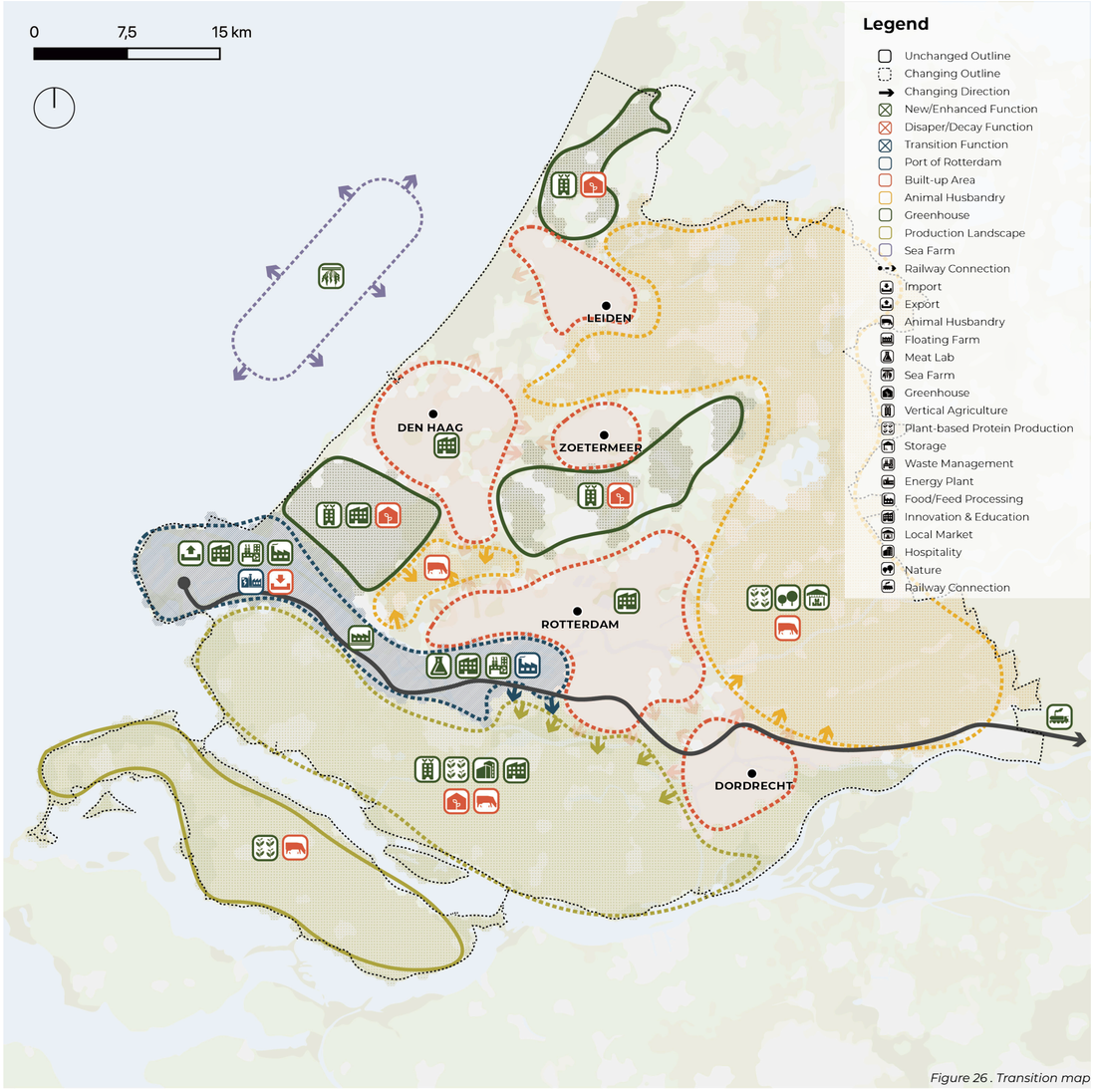


Figure 26 . Transition map

4.2 The transition

Transition timeline

The transition will be implemented gradually, starting from some pilot projects in typical port area, greenhouse cluster, and production area of South-Holland province. By 2040, all experimental area will accumulate enough experience and form a feasible procedure for the transition, and the projects can be applied to other area of the province. By 2070, the South-Holland province will fully achieve the sustainable protein supply chain and gradually implemented in other Dutch province.

Compared to current situation, in vision 2070 of South-Holland province, the built-up area expands and cities merge together. Most animal farms in the eastern and southern part will be replaced by plant-based protien production and nature, local market and local processing are implemented. Alternative protein procution like sea farms, floating farms, insect and mushroom farms, and lab meat will be implented accordingly and have a good connection with education and innovation facilities located in port and city areas. Greenhouses cluster will be transformed into agri-city, where vertical agriculture is built on old greenhouses, some land released for nature and facilities such as energy plants and innovation facilities. Two clusters locate in the port are the center of the supply chain. The one near north sea is resposible for import&export, seaweed process, and innovation for agri-city. The second cluster near Rotterdam is resposible for plant-based protein processing, lab meat innovation, waste management and energy production. The logistics rely on the enhanced railway system which has better with production area.

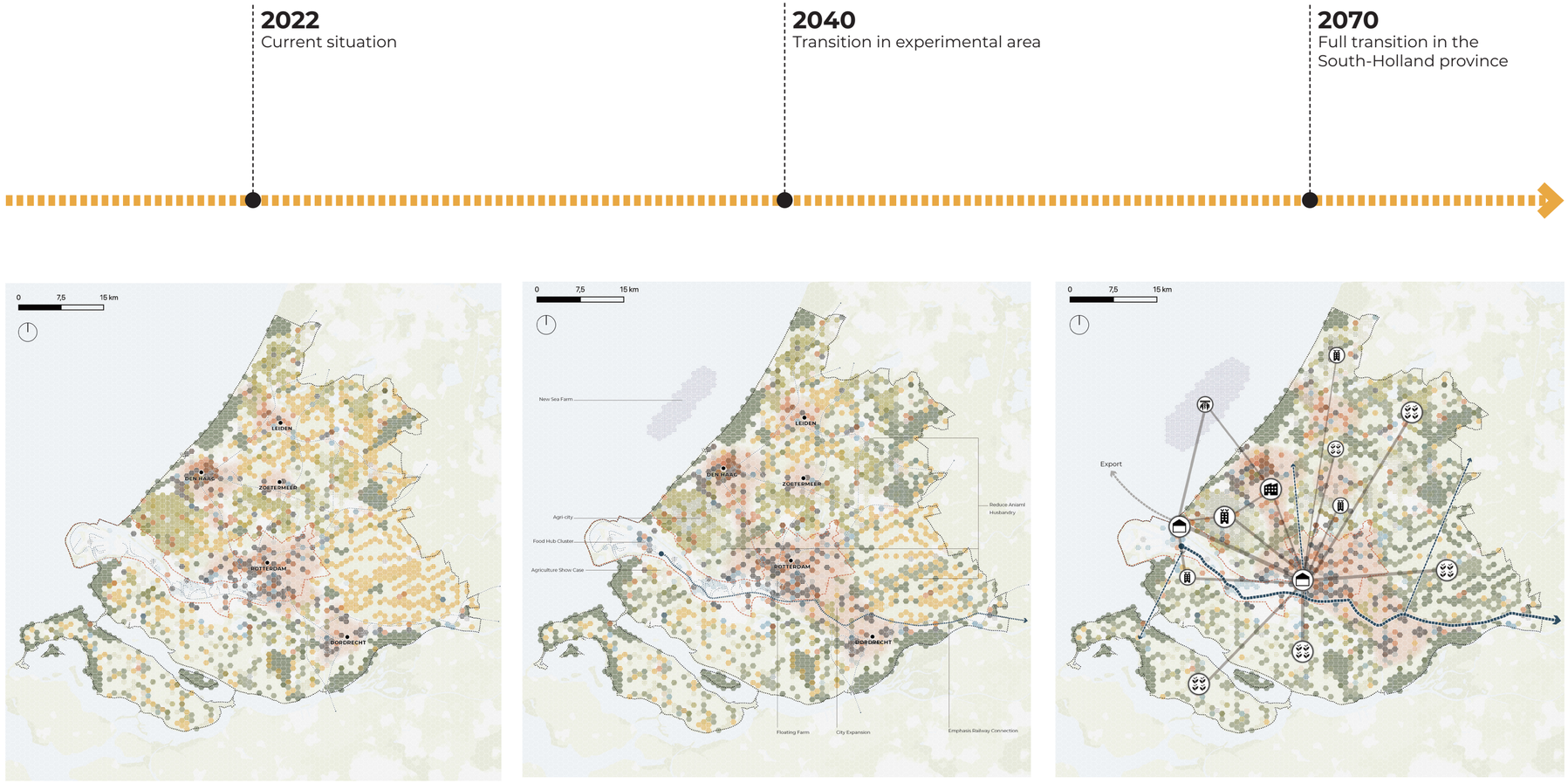


Figure 27. Vision transition timeline

4.3 Vision Flows

1. Economic flows

In the vision, the protein-based food supply chain of South Holland will be independent of global import, however, the port of Rotterdam remains important in terms of alternative protein-based food export. The port also serves as a center in the supply chain where processing and distribution facilities are clustered. Raw materials from sea farms, vertical agriculture and plant production areas will be processed in the port cluster to provide alternative protein products while floating farms, local farms and lab meat facilities will provide small amount of animal meat. The end products will be stored at the port, either transport for local supply or export to other countries. The well connected railway system plays an important role in logistics of raw materials and end products. Apart from large supermarkets in the cities, local market in rural areas and floating farms provide other choice to acquire food.

2. Environmental flows

Waste management facilities and energy plant will clustered in the port area. As introduced before (see figure 28), the waste management cluster provide a circular way for waste processing. Manure and food waste are gathered and processed to local animal feed and fertilizer, and also as biomass used for energy production. Through CO2 pipelines, energy produced at the port not only serve the port area but also the vertical agriculture and greenhouse clusters. In the meantime, the greenhouses produce electricity that can be used in cities.

2. Environmental flows

In the vision, as many functions cluster in the port area, many jobs can be created in the area. Local markets and local processing facilities will also provide jobs for rural area residences. Education and innovation facilities located in the port and city will research on alternative protein-based food and work closely with new production area such as sea farms, vertical agriculture and meat lab. These facilities can also be used as port staff training and combined with agriculture show case to educate and raise the social awareness of the public. Local market in rural area will provide a public center for farms to hold some social activities.

Legend

- Distribution Flow
- Processing Flow
- Waste Flow
- Energy Flow
- Job Creation Flow
- Innovation & Education Flow
- Social Interaction Flow
- Seaweed
- Mushroom
- Insect
- Plant-based Protein Crops
- Animal
- Alternative Protein
- Animal Protein
- Food Waste
- Feed
- Fertilizer
- Carbon Dloxide
- Electricity
- Job
- Knowledge

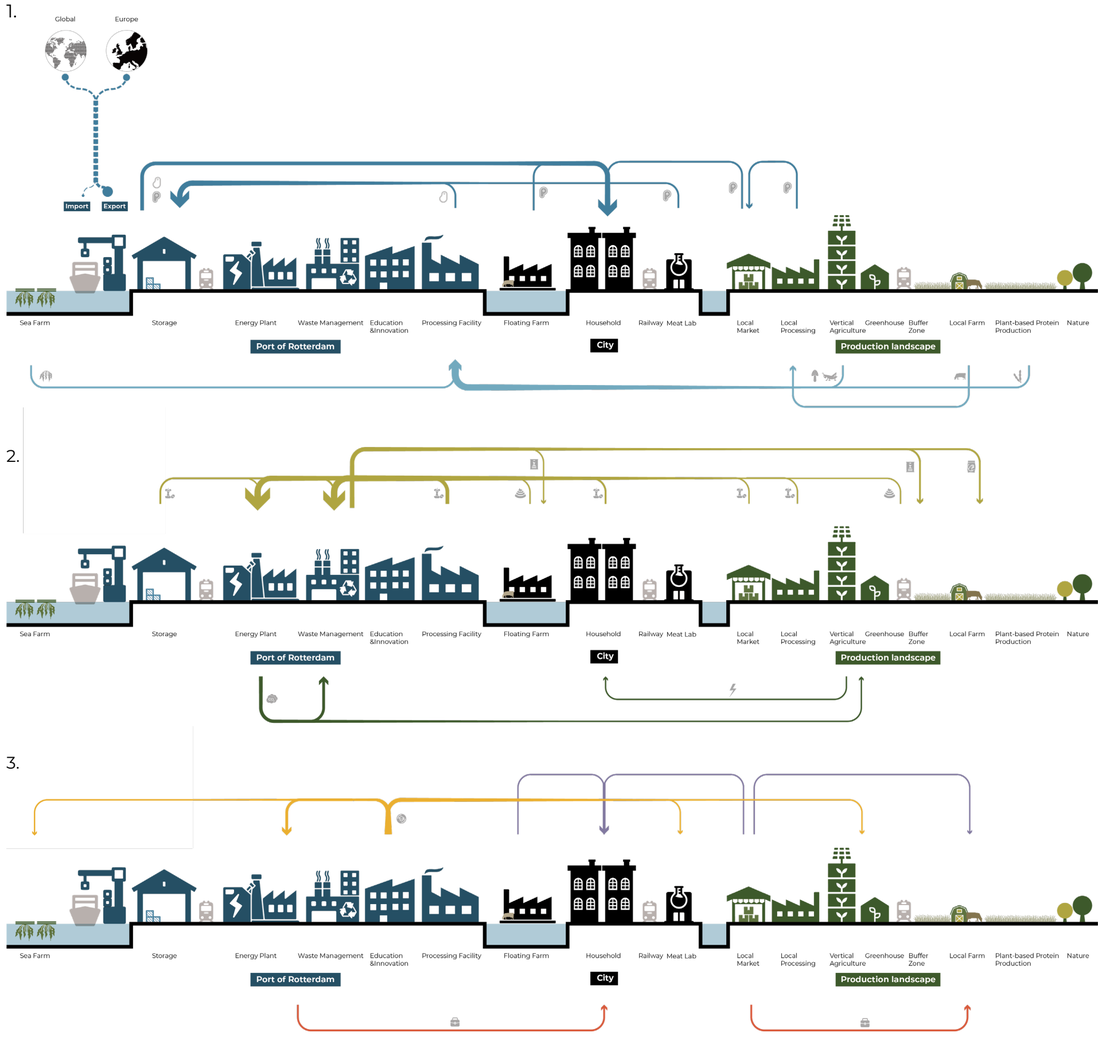


Figure 28. (1) Economic, (2) environmental and (3) social flows sections.

5. Strategy

In this chapter, we present the strategy that aims to achieve our vision. The strategy is made out of six main components that are explained within the concept of 'The Factory'. All of those components are crucial to achieving our main goal for the province of South Holland - a sustainable protein-based food chain.

Each of the six components has its timeline highlighting the main actions that need to take place throughout 50 years from now. Most of the actions are location-specific, therefore, the five main locations for the key projects are identified and presented in the sub-chapter 5.4. Strategic key projects.

Through stakeholder analysis, the power and interest dynamics are presented, allowing a further collision and synergy analysis in each key project. To achieve different goals and avoid various collisions, types of the instruments used to implement the project vary, therefore, the Manual is presented.

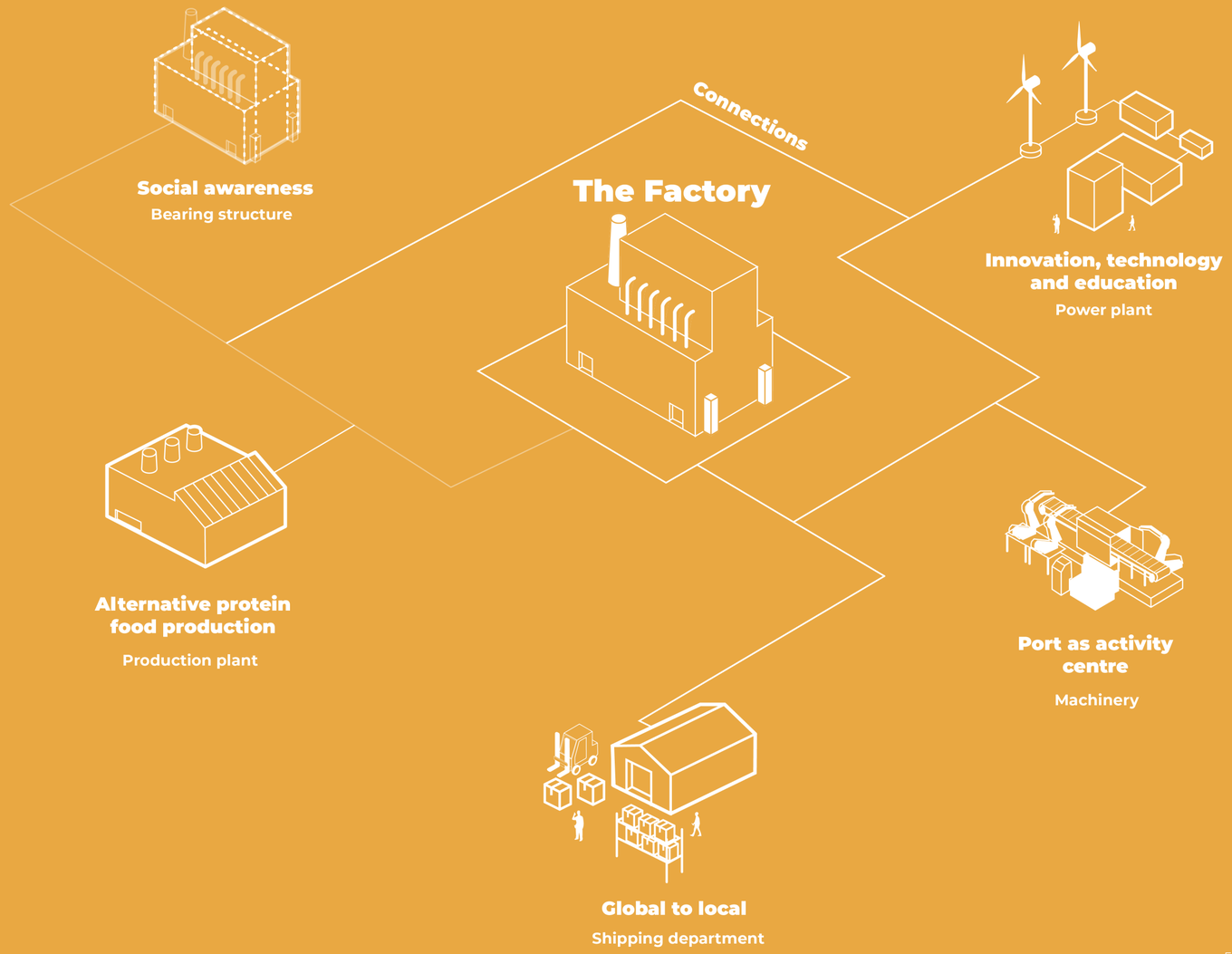


Figure 29. Components of the strategy.

5.1 The Factory

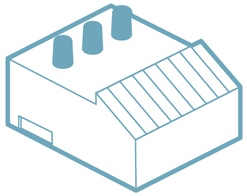
Main components

Our strategy to implement the vision is based on six main components that can be compared to different parts of a factory (Fig. 29).

The province of South Holland can be considered a food factory, in which food is produced, processed, shipped and consumed with a linear chain model. This strategy proposes a shift of the approach to create a circular and local production and consumption model for protein-based food in South Holland.

The 6 main components that will be further explained in this report: The Port as activity centre (Machinery); Innovation, technology and education (Power plant); Global to local (Shipping department); Alternative protein production (Production plant); Social awareness (Bearing structure); and the connections between these components.

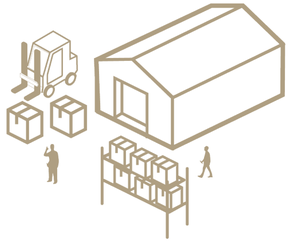
Following these components, all the economic, social and environmental aspects of the vision will be addressed in a qualitative and spatial way.



Alternative protein food production

Production plant

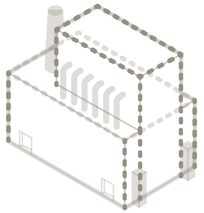
The production in the province of South Holland is extensive and fosters different types of farming. However, the lifespan of the infrastructure is limited, therefore, the changes needs to be planned accordingly. Different types of protein-based food production will be implemented in different ways throughout the province of South Holland. From mushrooms and insect farms to sea farms and vertical greenhouses, the current food production landscape has opportunities to implement new types of production.



Global to local

Shipping department

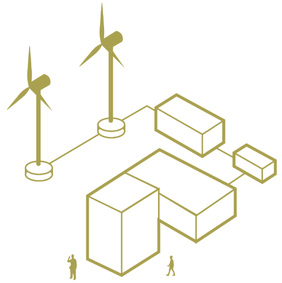
The scope of the flows has to change to a more local approach to make them circular and, therefore, more sustainable. The cycle of protein-based food and closing the related loops of waste and energy are topics that are addressed by this component.



Social awareness

Bearing structure

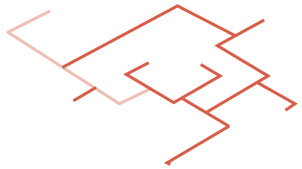
The transition has a crucial social aspect to it. In order to make all the components of the factory work, it needs the support and consensus between many different stakeholders. For this, a movement of social awareness is needed which will keep all the pieces together and allow the transition to happen without hindering any of them.



Innovation, technology and education

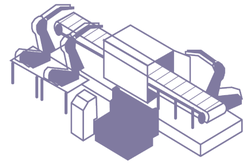
Power plant

The transition towards a sustainable future is powered by innovation, research and education that will allow changes and progress. The development of new types of protein-based food and technology to improve the productivity of crops are central, together with facilities for professional education on new techniques and production industries. It is closely related to the social awareness component.



Connections

All components are spatially connected to each other. Logistics facilities and infrastructure such as railways for an effective and sustainable transportation network are an important part of the spatial strategy. Moreover, the dissemination and outreach of knowledge are also part of this component. This allows for a quicker and smoother transition as it activates the public, private and civic sectors simultaneously in different areas of the population. The changes in the infrastructure network also allow the implementation of green corridors and green buffer zones.



Port as activity centre

Machinery

In the province of South Holland, a lot of activities of energy production, management of exports and imports, distribution, processing and innovation happen in the Port of Rotterdam area. In the frame of the strategy, these current Port activities are strengthened and embraced to optimize the use of infrastructure and logistic capacity of the Port. Moreover, the Port is kept as the core of this industry, opening the possibility of making the Netherlands one of the biggest exporters of protein-based meat alternatives in the context of a global transition.

5.2 Phasing

Timelines for the main components

Alternative protein-based food production

The experimentation stage focuses on pilot implementations of already planned and new innovative ways of protein-based production as well as preparing the soil for the transition. The second phase aims to improve and expand successful projects of the stage one and the third phase is focused on big-scale production in South Holland.

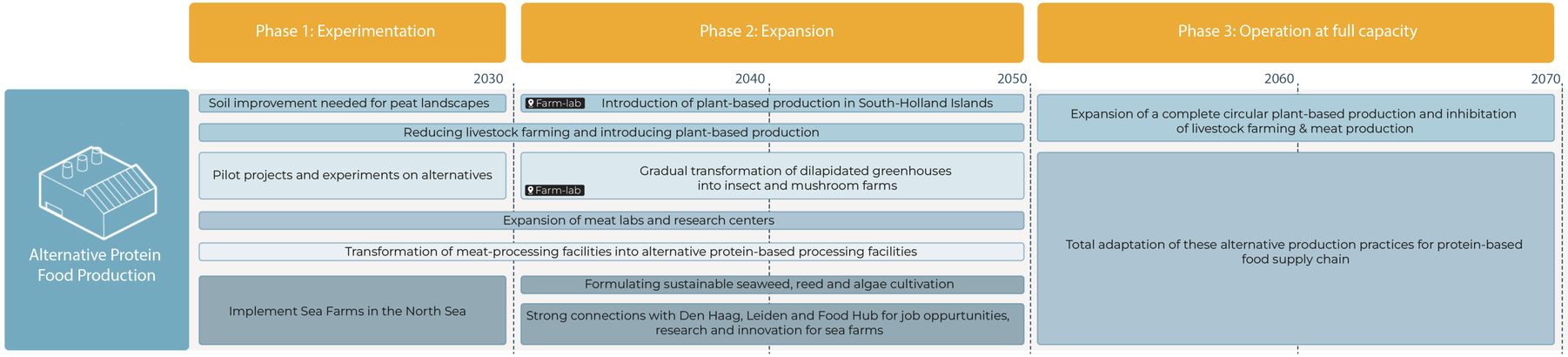


Figure 30. Timeline of the component 'Alternative Protein Food production'.

Global to local

In the first phase, conditions are created to produce animal feed locally as it is mostly being exported from South America. As livestock farming is decreasing gradually in the proposed future, a transition happens from the local animal feed production to local protein-based food production as many components such as soy or algae can be used for both.

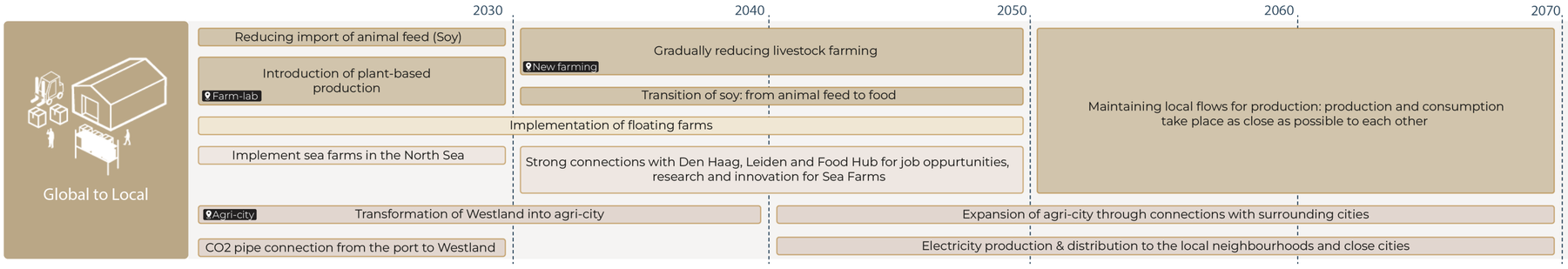
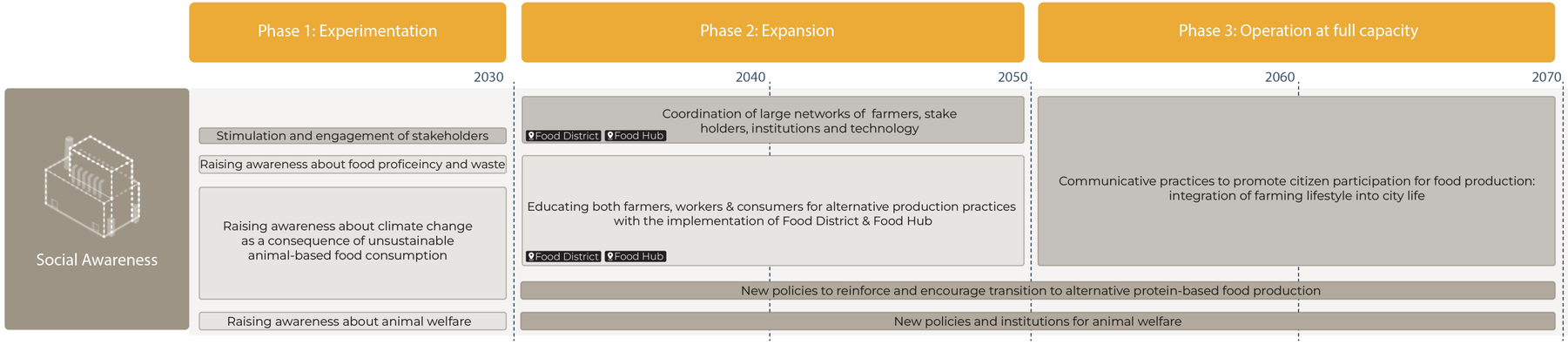


Figure 31. Timeline of the component 'Global to local'.

Social Awareness

For a successful transition, a shift in people's minds have to happen. First of all, all interested parties have to understand the importance of the transition. What is more, consumers need to be educated about the harm of the unsustainable food industries and the ways how they can contribute to a more sustainable future. Animal welfare topic already brings a lot of concern, however, there is still a need to implement policies to improve the situation.

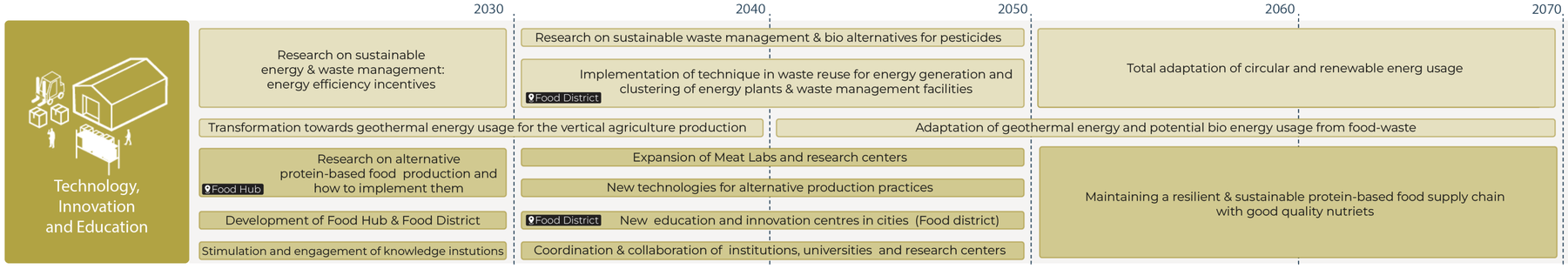
Figure 32. Timeline of the component 'Social Awareness'.



Technology, Innovation and Education

To achieve the transition, new methods and technologies need to be applied to change the current production processes. Innovations are needed to explore more alternatives to protein-based food that could be produced in the Netherlands. What is more, waste and energy management have to improve as well.

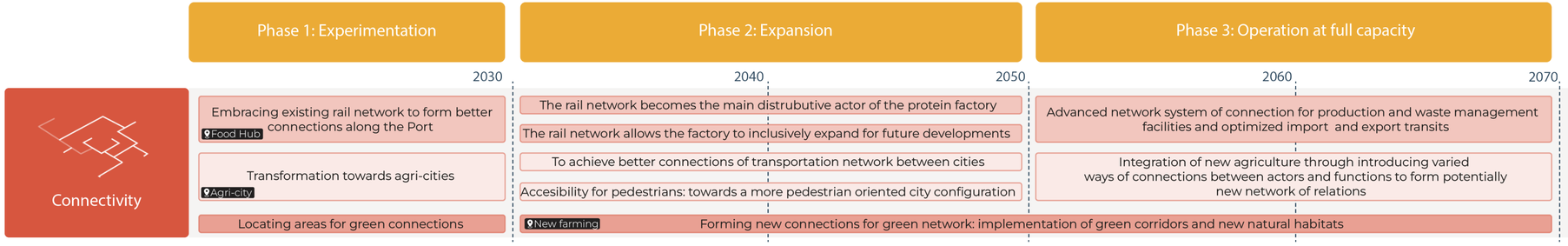
Figure 33. Timeline of the component 'Technology, Innovation and education'.



Connectivity

Changes in the connectivity starts from embracing and improving existing transport and green infrastructure and it gradually grows into a more advanced and well-developed sustainable network.

Figure 34. Timeline of the component 'Connectivity'.



The Port as Centre of Activities

During all steps of transition, the Port of Rotterdam remains a crucial component of the strategy, however, its role gradually shifts from the global import/export hub to a more sustainable production and innovation hub.

Figure 35. Timeline of the component 'The Port as Centre of Activities'.

5.3 Stakeholders

To implement the vision that would be not only sustainable but inclusive as well, it is crucial to pay attention to the main groups of stakeholders that would be most affected. Those stakeholders are mentioned in the graphs 'Public' and 'Society' (Fig. 36). It is important to realise that some of them, for example, plants and animals, as well as our future generations are not able to give their opinion, however, they, have to be taken into consideration. Public parties, that usually have more power to make the decisions can be divided into international institutions that do have indirect influence through more general policies and strategies. Different levels of the Dutch government have power depending on the importance and scope of the decision. Public companies such as the Port of Rotterdam have a lot of power in this scenario.

The power and interest diagram (Fig. 37) allows us to understand which stakeholders have the most power to make decisions and changes and which ones have the most interest, therefore, have to be taken into consideration, even if they don't have a decision making power. The illustrator 'Seat at the table' on the right page (Fig. 38) emphasizes the parties that hold most decision-making power and their main interests.

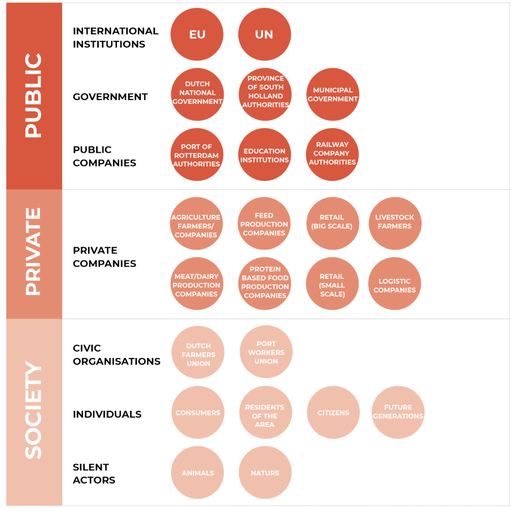


Figure 36. Stakeholders table is showing the main stakeholders in the each category.

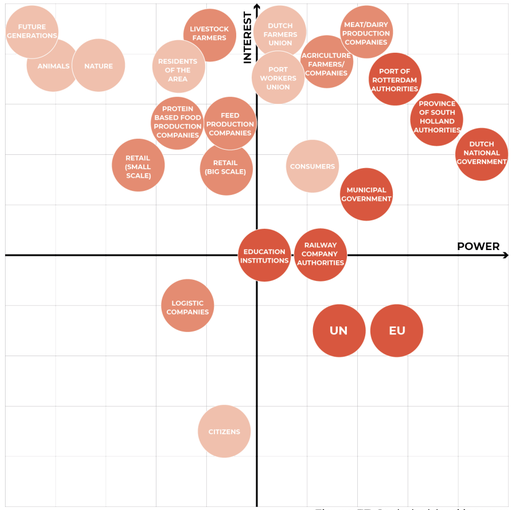


Figure 37. Stakeholders' interest and power diagram.

Figure 38. 'Seat at the table'. Stakeholders with the most power and interest usually are involved in the process, however, it is crucial to keep in mind all the stakeholders, especially the ones that do not have a chance to talk for themselves.

5.4 The Manual

Instruments for achieving the strategy

In order to achieve the transition we are aiming for, it is important to create agreements with all the stakeholders and come to a mutual understanding between potentially colliding parties to be able to actually fulfill every goal of the strategy.

As stated before in this report, the transition to an alternative protein-based diet has important economic, environmental and social consequences for the private, and public sectors as well as for society. To achieve a smooth transition in which none of the stakeholders are hindered in any way, it is necessary to anticipate potential collisions and synergies and to prepare instruments that would be most suitable for each case (see Fig. 39). The showcase how the Manual would be adjusted to the specific situation is demonstrated in pages 76-77.

Figure 39. The Manual of main instruments that are used in every key project to achieve a smooth transition for all stakeholders.

5.5 Strategic key projects

The five strategic key projects can be identified in different locations of the province of South Holland that are crucial for the implementation of the strategy. The Food hub and Food district are placed in the Port of Rotterdam, followed by the Agri-city in Westland, New farming in the eastern farmlands and the Farmlab in the south of the province (Fig. 40).

5.5.1. FOOD HUB
Port of Rotterdam

5.5.2. FOOD DISTRICT
Port of Rotterdam

5.5.3. AGRI-CITY
Westland

5.5.4. NEW FARMING
Eastern areas of the province

5.5.5. FARM-LAB
Southern areas of the province

Figure 40. Strategic key projects that will be presented further and their location in the map.

Port of Rotterdam

Food hub and Food district

The Port area has two important areas that cluster functions related to the vision. These are called the Food Hub and the Food district. Each has different functions related to its location and current infrastructure (Fig. 41). Moreover, they are related to each other and the other transition areas and key projects (Agri-city, New farming and Farmlab).

Food Hub

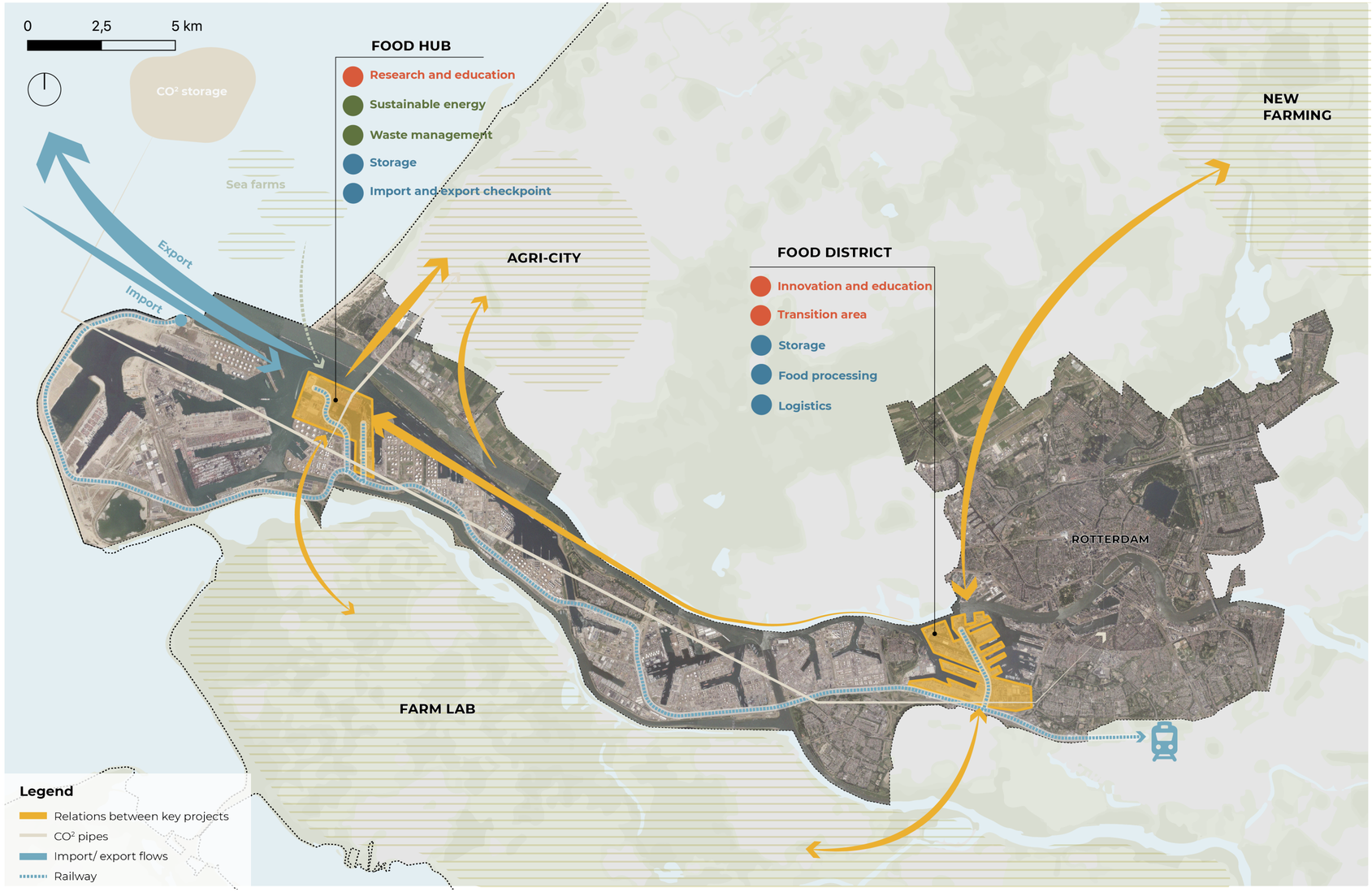
The Food Hub is an ongoing project that is already being implemented by the Port of Rotterdam authorities. For the strategy, we chose to follow the proposed location for the food hub, however, to present our own spatial plan of the area, that would allow activities related to the protein-based food industry to take place as well.

Food District

The Food District is more related to the Rotterdam in its activities (such current infrastructure of innovation and education) and is mostly linked to food processing of material flows coming from productive landscapes in the whole province of South Holland. The facilities in this area are clustered but spread in a larger area in which other industries are also taking up space.

Moreover, these areas are connected by their activities (some processed foods in the Food District are exported through the food hub), but also through the railway for distribution and logistics. The new project for Co2 storage 'Porthos' (Port of Rotterdam, 2021) can also be linked to the new industry. The CO2 can be reused in the vertical greenhouses of the Agri-city.

Figure 41. Strategy on the Port. The Food Hub and Food District have different functions and are related to each other and the other key projects.



Stakeholders analysis

Collisions and synergies

The Port of Rotterdam area involves multiple authorities and stakeholders that will have a crucial role in the transition. The stakeholder analysis is represented in the two diagrams that show Collisions (Fig. 42) and Synergies (Fig. 43) within these actors. 3 types of relations are identified: economic, environmental and social relations.

Most important collisions and synergies are highlighted in the diagrams and instruments from the Manual are used to reduce the risk of collisions.

Collisions

In the case of the Port of Rotterdam, the main stakeholders are the Port of Rotterdam authorities, the Province of South Holland authorities and production and processing companies (animal feed, plant-based protein and meat/dairy). It is possible to identify that the riskiest collisions (fig. 42) might happen between the Port Authorities and other parties involved in the process. Furthermore, the social dimension of the transition can potentially create collisions between consumers and protein-based production companies. Also, the decrease in the need for feed production companies can promote friction. Anticipating these collisions helps find the tools to decrease them on time (see Manual on pages 68-69).

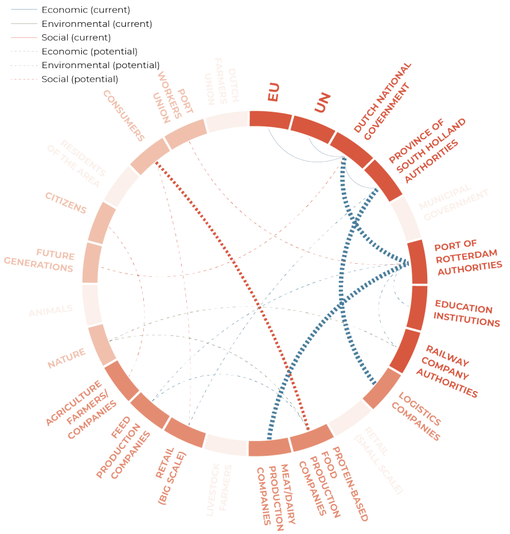


Figure 42. Current and potential collisions between stakeholders for the key projects in the Port of Rotterdam

Synergies

The proposed transition in the Port of Rotterdam area is based on mutual understanding and synergies between many different stakeholders, therefore, in the diagram (Fig. 43), all main stakeholder groups are identified as involved in the process. Important potential synergies need to happen between current and proposed production companies, workers' unions and Port of Rotterdam authorities to create a safe and fair working environment. What is more, a well-developed logistics network is very important for the proposed hubs, therefore, logistic company involvement in the process is crucial as well.

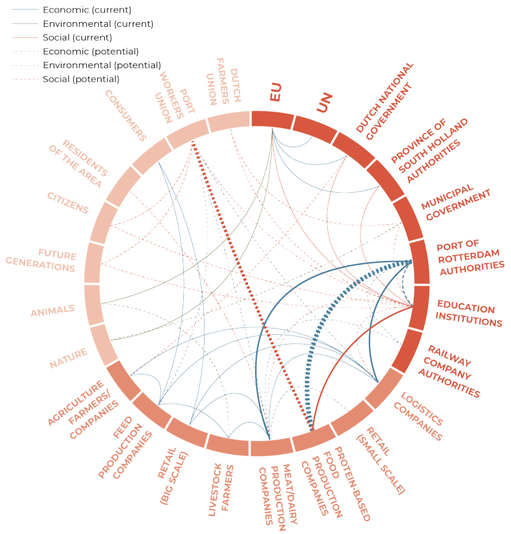


Figure 43. Current and potential synergies between stakeholders for the key projects in the Port of Rotterdam area.

The Manual

Various instruments presented in the main Manual on pages 68-69, are used to act on potential or current collisions between different stakeholders (Fig. 44). For the Port of Rotterdam area, the main identified collisions are between Port of Rotterdam and the Dutch national government, consumers and the province of South Holland, meat and dairy production companies and Port of Rotterdam authorities, logistics companies and the province of South Holland.

Figure 44.The Manual for the Port of Rotterdam area.

1 Port-Government

Main action: create a consensual plan for the transition regarding the impact of social, economic and environmentsl aspects in the country.

CITY-BRANDING

Communicate and advertize every step of the transition. Make municipalities aware of a need for change and the advantages of alternative protein food consumption.

DIALOGUE

Take citizen's need and opinion into consideration through conferences, surveys and interest sessions for a more just governanceof the transition.

INFRASTRUCTURE INVESTMENT

Invest in education and research to make the country strong in knowledge, production and processing of alternative protein foods, creating great economic revenue.

MUNICIPALITY ENCOUNTERS FOR ENTREPENEURS

Create opportunities for entrepeneurs to start businesses and research on the transition topics.

NETWORKING

Spread awareness of a need for transition and the a ctions for it through private, public and civil actors.

ENVIRONMENTAL IMPACT ASSESMENT

Research on location-specific impacts of indsutry, land and logistics change on the environment in the first stages of each project.

VISUAL QUALITY PLAN

Communicate to public unspecialized parties through logic and visual approaches to strategic projects.

NON-BINDING MASTERPLAN

Approach local and national authorities with a thought out plan that proposes a advantagous plan for all parties, but that is open for change and dialogue.

PERMITS

Come to agreements with local and national authorities to achieve gradual spatial, social and economic change towards the transition

LAND SALE

Make strategic plans through agreements with port, local and national authorities for a switch in land use by aquisition and sale.

LAND AQUISITIONS

Make strategic plans through agreements with port, local and national authorities for a switch in land use by aquisition and sale.

URBAN DESIGN

Approach authorities with thought out plans in different scales.

SPATIAL VISION

Approach authorities with a thought out vision that proposes a advantagous plan for all parties.

CITY DISTRICT MUNICIPAL MANAGEMENT

A local approach on governance to have a better grasp on location-binded social, economic and environmental issues and, therefore, make better decisions.

PUBLIC-PRIVATE AGREEMENTS

Make decisions through dialogue and agreements between public, private and civil sector.

INFRASTRUCTURE INVESTMENT

Investing in new public infrastructure to create an easier and resilient transition, and is related to industry and the common good.

BINDING LAND-USE PLANS

Changing or using land-use plans in new projects to favour the transition in logistics

SCENARIOS

Approach authorities with options or scenarios to open discussions and come to agreements.

2 Consumers-Province

Main action: educate consumers into the advantages of less meat consumption and the consumption of alternative protein food.

CITY-BRANDING

Communicate and advertize every step of the transition. Make the consumers aware of a need for change and the advantages of alternative protein foods consumption.

DIALOGUE

Take citizen's need and opinion into consideration through conferences, surveys and interest sessions for a more just governance of the transition.

INFRASTRUCTURE INVESTMENT

Implement education and innovation facitilities near the city to bring the transition closer to the consumers and spread awareness of new processes.

MUNICIPALITY ENCOUNTERS FOR ENTREPENEURS

Create opportunities for entrepeneurs to start businesses and research on the transition topics.

NETWORKING

Spread awareness of a need for transition and the actions for it through private, public and civil actors

Figure 44.The Manual for the Port of Rotterdam area.

3 Meat/dairy prod. companies-Port Authorities

Main action: gradually create alternatives for workers in the new industry to follow the transition and create space for change.

ENVIRONMENTAL IMPACT ASSESMENT

Research on location-specific impacts of indsutry, land and logistics change on the environment in the first stages of each project.

DIALOGUE

Take worker's need and opinion into consideration through conferences, surveys and interest sessions for a more just governance of the transition.

NON-BINDING MASTERPLAN

Approach companies with a thought out plan that proposes a advantagous plan for all parties, but that is open for change and dialogue.

SUBSIDIES

Support the transition of companies to protein-based alternatives with subsidies for new infrastructure, tools and education.

FUNDS

Support the transition of companies to protein-based alternatives with funds for new infrastructure, tools and education.

RELOCATION OF INDUSTRY WHICH CAUSES NUISANCE

Move and relocate companies strategically according to their new function in the industry (only where strictly necessary).

SPATIAL VISION

Approach companies with a thought out vision that proposes a advantagous plan for all parties.

TAX BREAKS

Support the transition of companies to protein-based alternatives with tax breaks for an easier finincial transition for pruvate and public parties.

4 Logistics companies-Province

Main action: create strategical plans for new infrastructure to encompass the need for new logistic flows.

INFRASTRUCTURE INVESTMENT

Investing in new public infrastructure to create an easier and resilient transition in terms of mobility and logistics.

BINDING LAND-USE PLANS

Changing or using land-use plans in new projects to favour the transition in logistics

NON-BINDING MASTERPLAN

Approach companies with a thought out plan that proposes a advantagous plan for all parties, but that is open for change and dialogue.

PUBLIC-PRIVATE AGREEMENTS

Agreements between the Province and logistics companies

PERMITS

Grant permits to encourage a smooth transition through private and public domains.

RELOCATION OF INDUSTRY WHICH CAUSES NUISANCE

Move and relocate companies strategically according to their new function in the industry (only where strictly necessary).

Figure 45. Collage of the Food Hub (page 80). The same landscape is shown in a dual image: the current situation (on the left) and our proposal (on the right).

5.5.1 Food Hub

Introduction

According to the plans of the Port of Rotterdam, The Rotterdam Food Hub is already taking shape along the Calandkanaal at the entrance to the Maasvlakte (upper left corner on the map (Fig. 46) (Port of Rotterdam, n.d.). The area is currently empty and being prepared for the Food Hub. However, our proposal aims to even expand the area connecting the proposed Food Hub to surrounding activities. An important component of the area is a railway line that goes to the end of the Maasvlakte. What is more, a large area below the proposed Food Hub location is taken by British Petroleum (BP) Refinery Rotterdam. Also, some dry bulk companies are located nearby in the area as well as two agri and biomass terminals (Port of Rotterdam, n.d.).

Figure 46. Aerial map of the proposed Food Hub location.

5.5.1 Food Hub

Current situation and phasing

The proposed Food Hub takes into consideration the proposal by the Port of Rotterdam, however, nearby functions open more opportunities to expand the hub as well as strengthen already existing activities related to protein-based food. First of all, Food Hub is used for the activities that are directly related to the North Sea: export and import of food as well as Sea Farms that are located nearby in the sea nearby. Processing of the Sea Farm's products could also happen in the Food Hub. The existing railway should be expanded towards the edge of the Food Hub and serve for transportation of goods as well as to improve job accessibility for Port workers. What is more, improved accessibility to the city would allow the creation of an innovation center related to port activities and innovative hydroculture. What is more, as the chemical plant by Indorama and two oil refineries by British Petroleum (BP) and Shell are already near the area (Fig 48), the Food Hub could contribute to their transition towards bio-based or another type of sustainable energy that would be later used for the Food Hub activities.

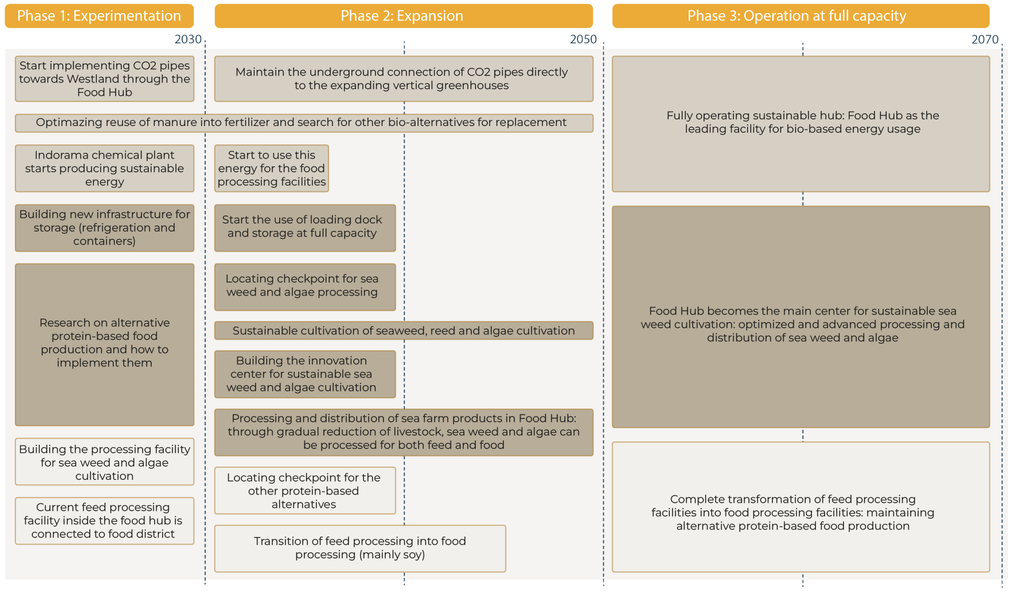


Figure 47. Timeline of the Food Hub implementation.

Figure 48. Map of the current situation in the future Food Hub area (page 83).

5.5.1 Food Hub

Proposal

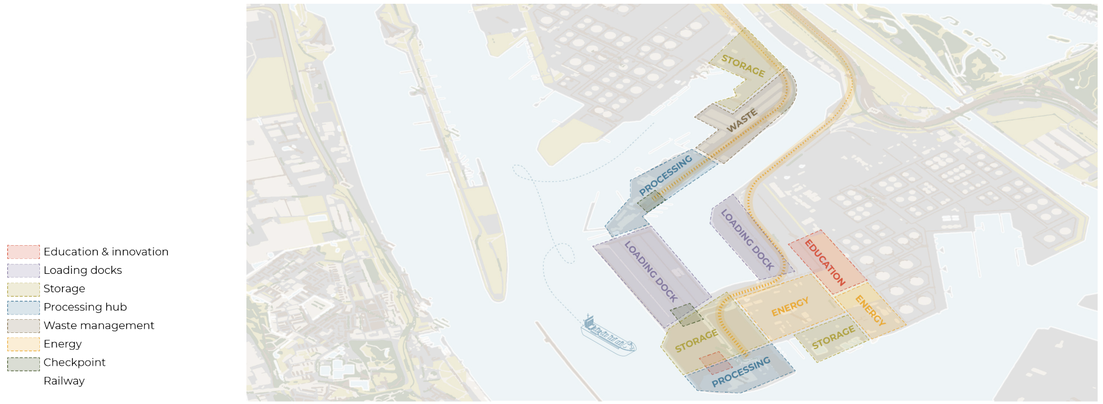


Figure 49. Axonometric view of the proposed Food Hub.

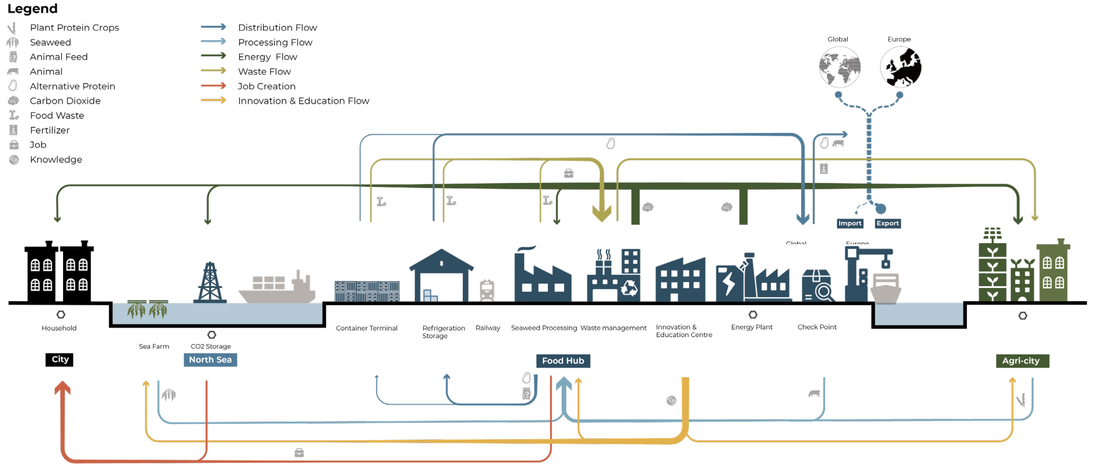


Figure 50. The systematic section of the proposed Food Hub and main flows.

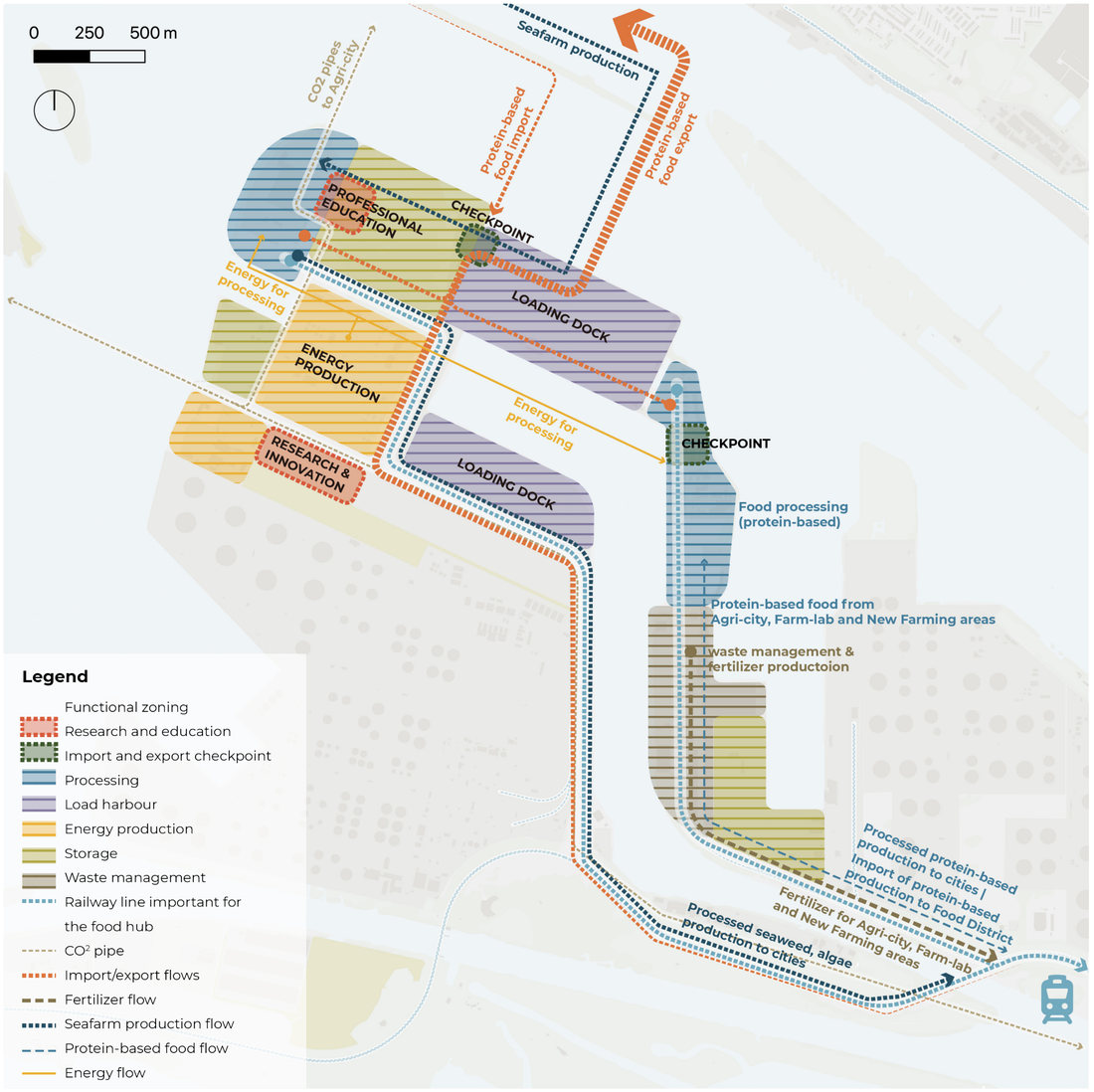


Figure 51. Proposed zoning map of the Food Hub (page 85).

Figure 52. Collage of the Food District (page 86). The same landscape is shown in a dual image: the current situation (on the left) and our proposal (on the right).

5.5.2 Food District

Introduction

The location for the Food District was chosen in the Port of Rotterdam area, on the Southside of Maas river, in close proximity to Rotterdam city. The main reasoning behind this decision was food-related activities such as Cold terminal and other food storage, processing and wholesale facilities. What is more, the area is well connected to the same railway line as the Food Hub. Moreover, a strong education and innovation cluster is already being formed by the Rotterdam University of Applied Sciences (RDM) campus. The campus is a great example of how former port buildings are being reused for other purposes.

However, railway connection is for shipping goods, therefore, the area is car-oriented, and lacks fast alternative transportation means for workers and residents of the area. One of the positive examples is a water taxi that connects the West part of the port to the RDM campus. Moreover, some electric bike-sharing stations are located in the area.

Figure 53. Aerial map of the proposed Food District location.

5.5.2 Food District

Current situation and phasing

The Food District is about clustering food-related activities that already happening in the Port of Rotterdam and areas nearby in order to use the benefits of shared processing facilities and a well-developed logistics network. The current RDM campus is expanded to create an even larger innovation and education hub where food-related experimentation could take place. To create a better connection between the city and Food District, the existing railway is used for passengers as well as goods. Protein food alternatives could gradually take place in the facilities currently used by the meat and dairy industries. The production for export easily could be distributed through the Food Hub. Moreover, the Food District should be powered by green energy produced in the Port of Rotterdam.

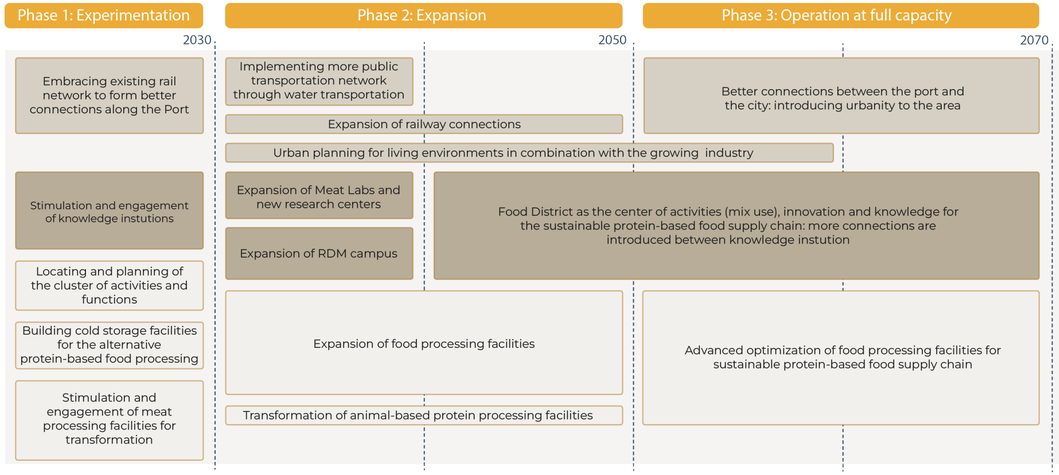


Figure 54. Timeline for the Food District implementation.

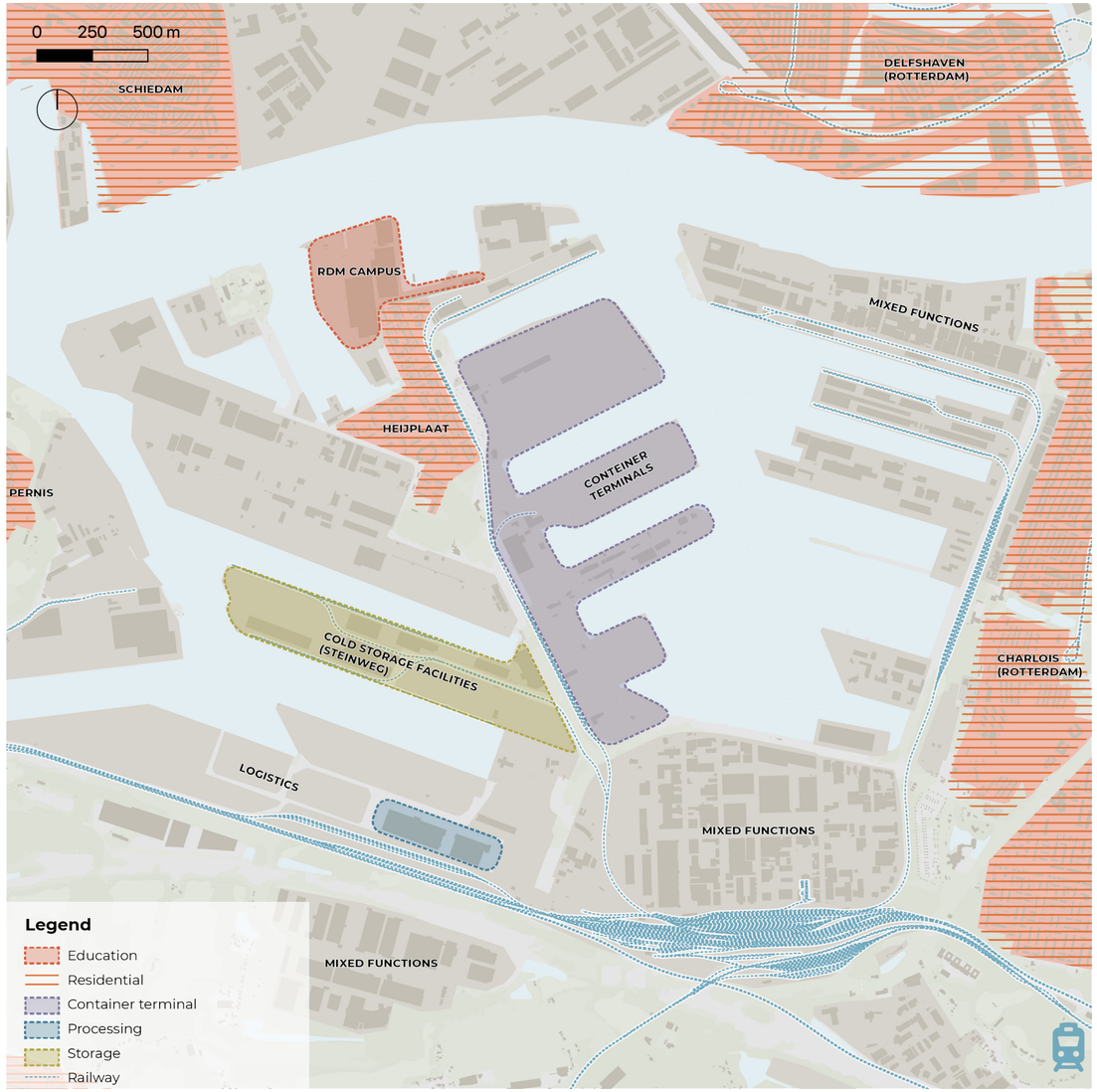


Figure 55. Map of the current situation in the future Food District area (page 89).

5.5.2 Food District

Proposal

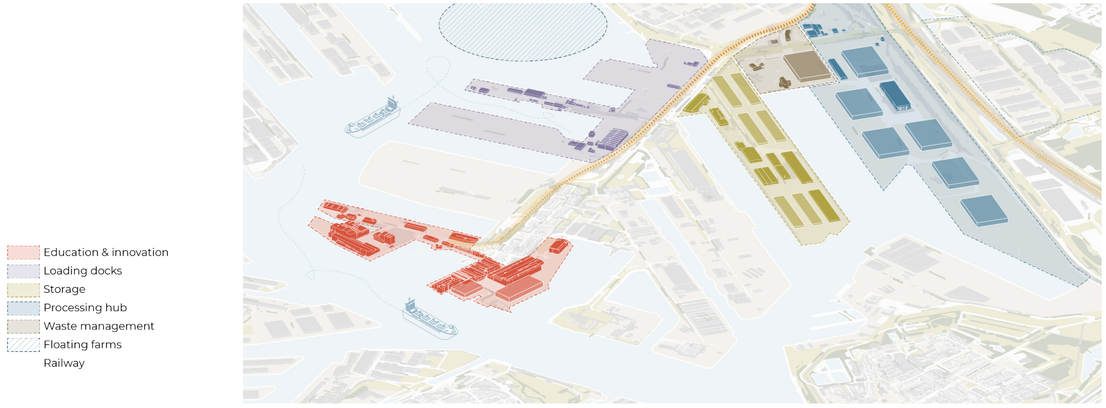


Figure 56. Axonometric view of the proposed Food District.

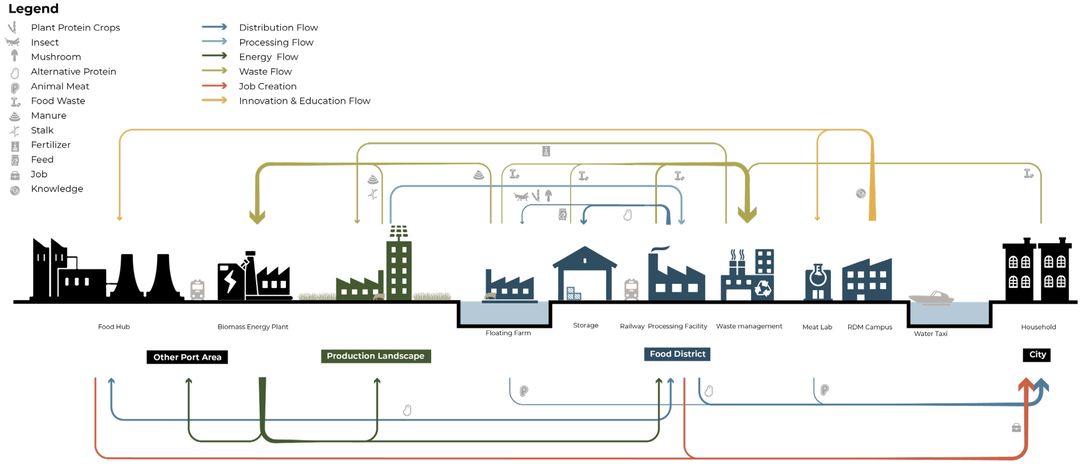


Figure 57. The systematic section of the proposed Food District and main flows.

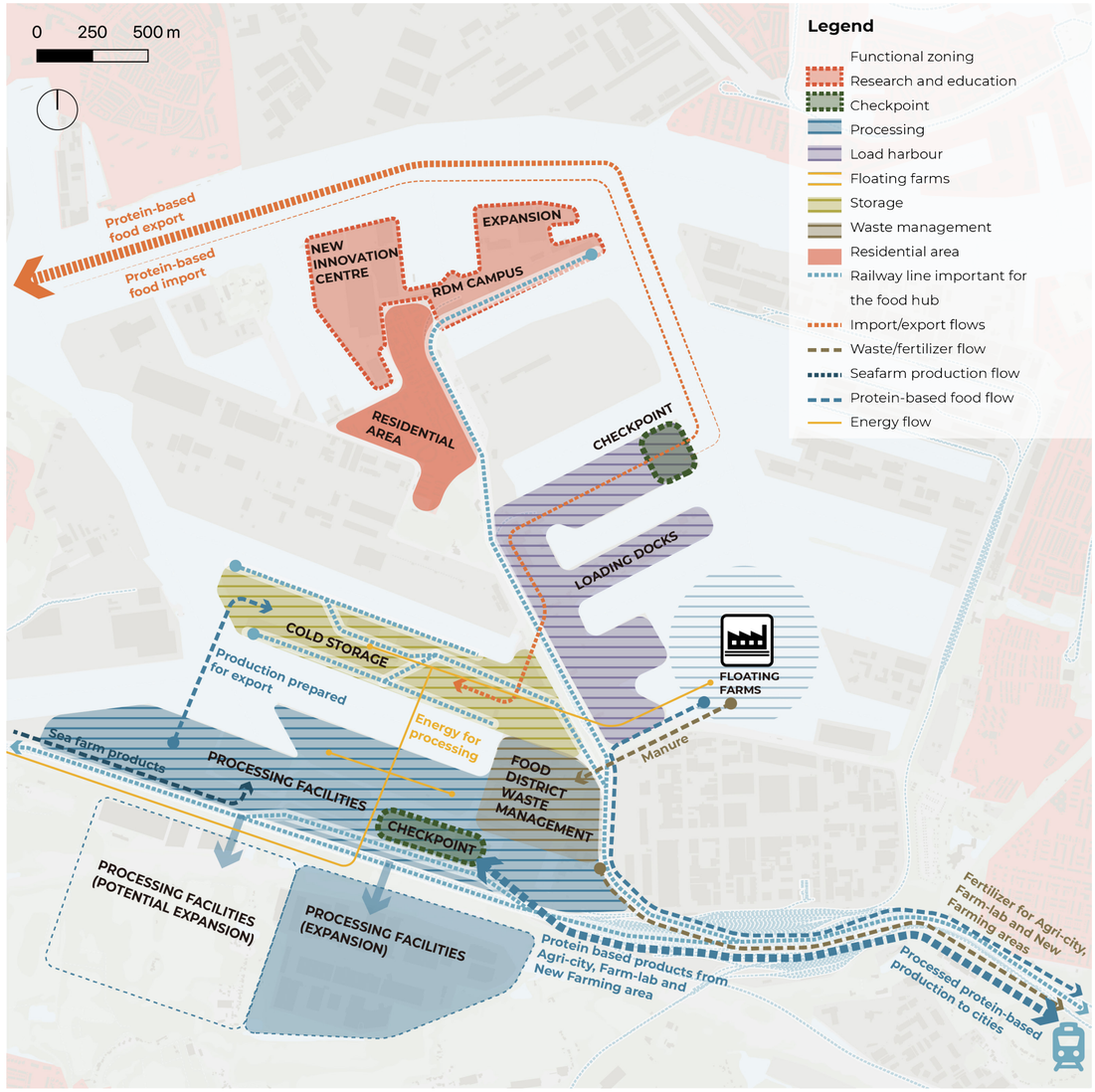


Figure 58. Proposed zoning map of the Food District (page 91).

Figure 59. Collage of the Agri-city (page 92). The same landscape is shown in a dual image: the current situation (on the left) and our proposal (on the right).

5.5.3 Agri-city

Introduction

The proposed location for the Agri-city is in the Westland municipality. Westland is located along the shore of the North Sea, between the Port of Rotterdam and the Hague. The area is known for horticulture in greenhouses, growing flowers and vegetables. There are some small towns in between the greenhouse areas, however, the whole area is dominated by industry, therefore, there is not much space left for nature. What is more, the whole area is car-oriented.

The area is driven by innovations in the horticulture sector, however, nowadays it still remains a major pollutant and requires a lot of energy to operate. Part of the greenhouses already uses geothermal energy, however, the transition is still in progress. Moreover, the pipeline connecting the port and Westland is being planned that would allow using CO2 produced in the port for greenhouses.

Figure 60. Aerial map of the proposed Agri-city location.

5.5.3 Agri-city

Current situation and phasing

A typical greenhouse has a lifespan of around 30-40 years. The Agri-city project is based on the idea that it is already time to change for the Westland area, therefore, the transition should happen not only in terms of energy but in the quality of the space as well. Currently, the area is car-oriented, large built-up structures leave little space for green corridors that are crucial for biodiversity. Moreover, the lack of shared spaces, human scale, and variety of functions, negatively affects the quality of life and work in the Westland.

The dark green color in the map (Fig. 62) indicates the greenhouses that were built over 40 years ago. Clusters of those greenhouses could be the first areas to transition. What is more, locations in between the most densely inhabited neighbourhoods would allow to mix functions on the ground floor of the newly proposed greenhouses as well as create a more green environment for residents and workers in the area.

We propose to change the current type of greenhouses to vertical ones. That would allow to free up space on the ground level as well as to have more space for production that could be used not only for the current horticulture activities but to grow more protein-based foods as an alternative to meat. What is more, the development project would be connected to CO^2 pipe from the Port of Rotterdam or use geothermal heating. The processing of the locally grown protein-based food would happen in the Food District.

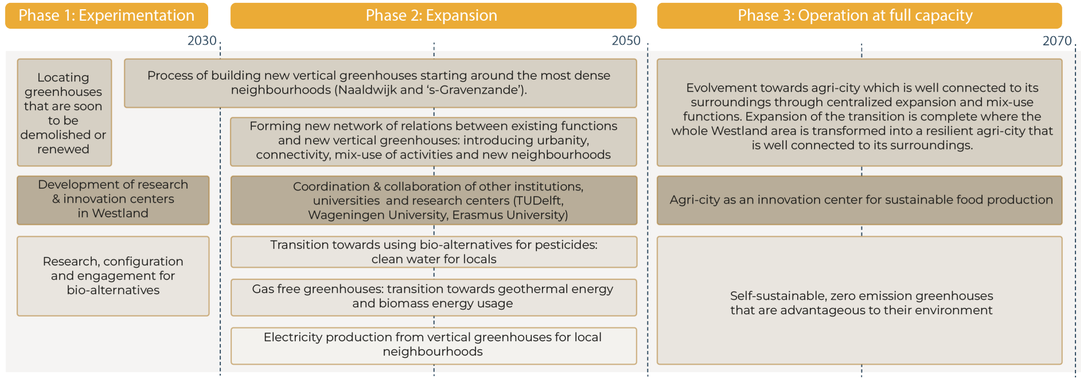


Figure 61. Timeline of the Agri-city implementation.

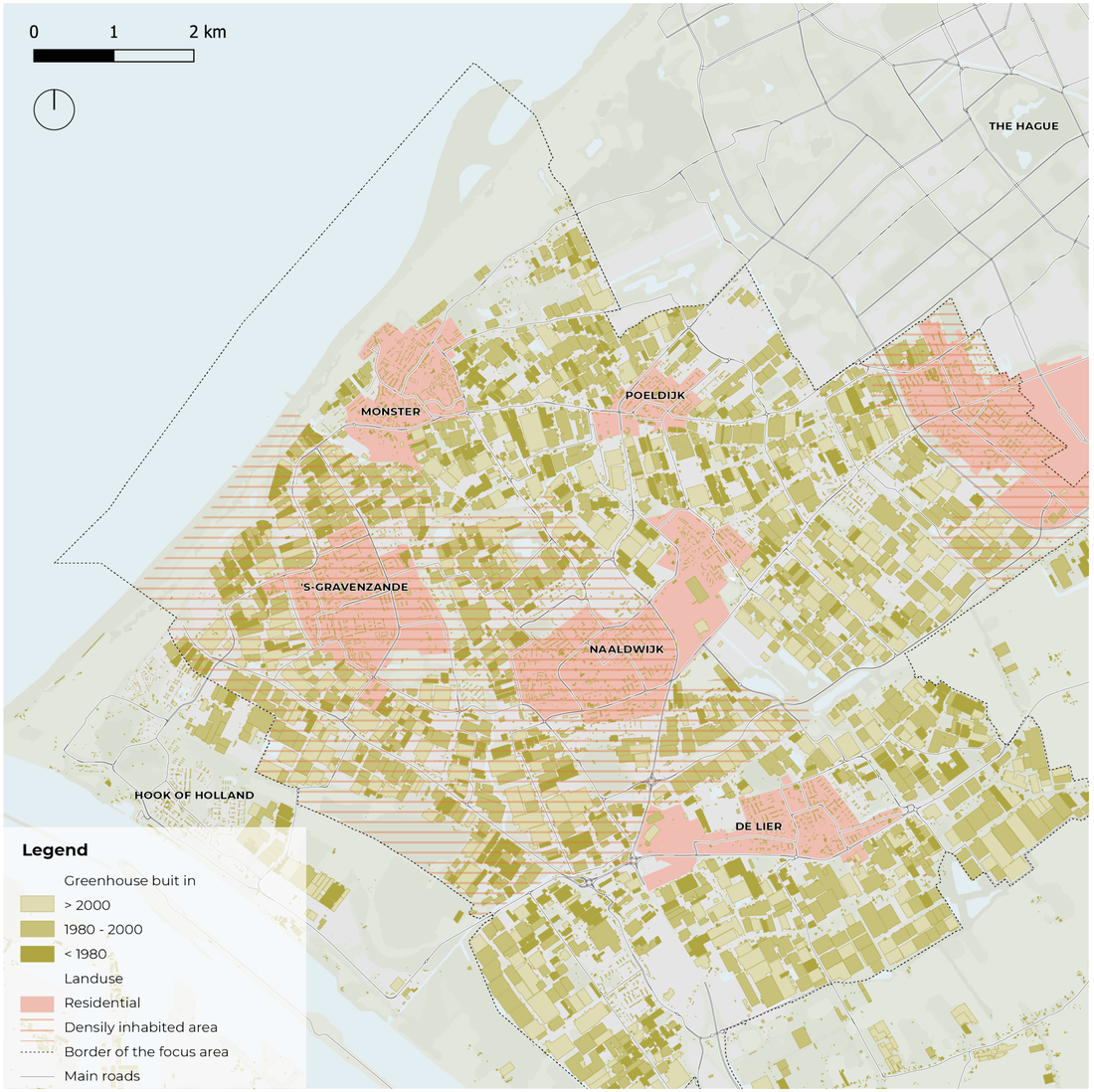
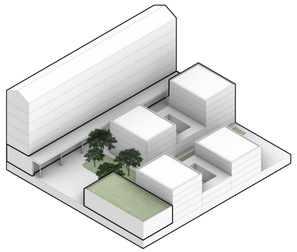


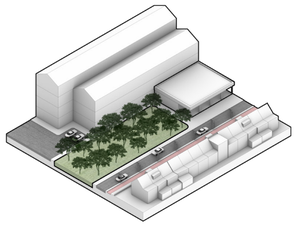
Figure 62. Map of the current situation in the future Agri-city area (page 95).

5.5.3 Agri-city

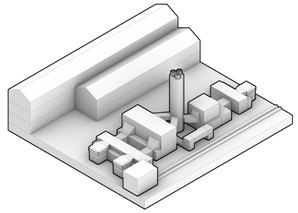
Proposal



Vertical agriculture in dense neighbourhoods



Buffer zone



Geothermal energy usage

Figure 63. Proposed typologies of the Agri-city

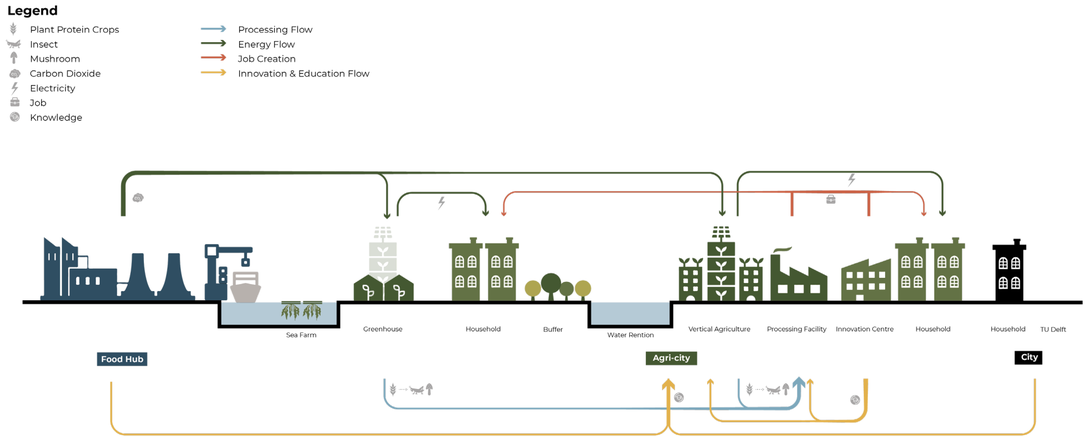


Figure 64. The systematic section of the proposed Agri-city and main flows.

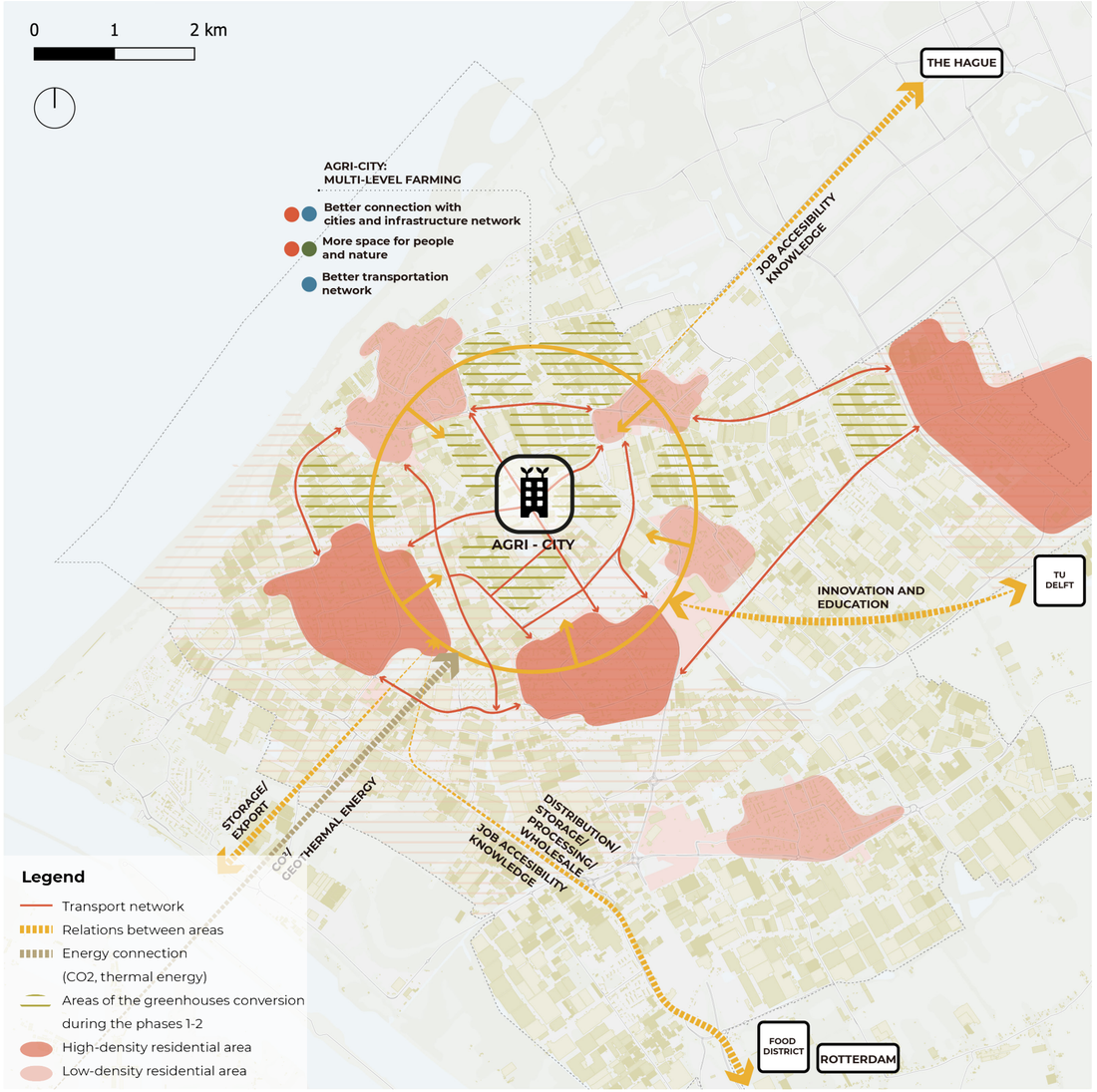


Figure 65. Proposed zoning map of the Agri-city (page 96).

5.5.3 Agri-city

Stakeholders analysis

Collisions

The current production at greenhouses already has a collision with the Dutch government through their intention to reduce CO2 emissions. Thus the transition toward geothermal energy usage plays an important role (Fig. 66).

Synergies

For the transformation towards agri-city, a synergy between greenhouse horticulture farmers and education institutions would play an important role. To form a new network of relations by introducing urbanity and better connectivity to the area, participation from the residents is significant (Fig. 67).

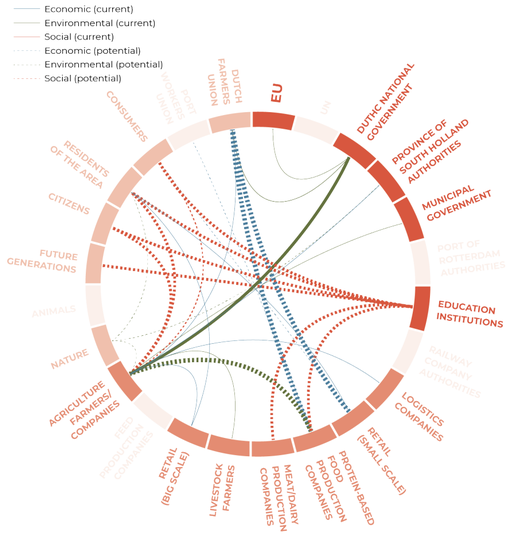


Figure 66. Current and potential collisions between stakeholders for the Agri-city implementation.

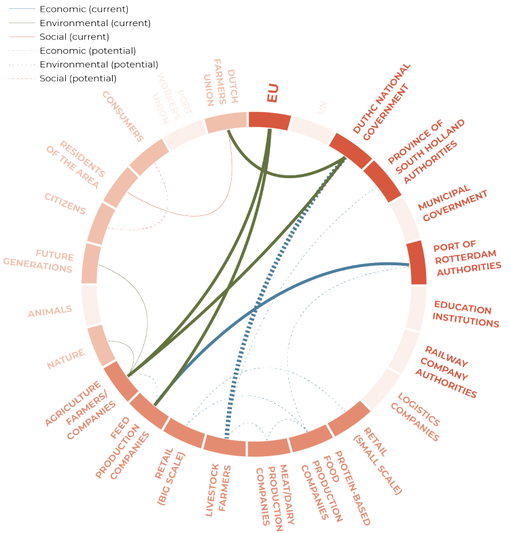


Figure 67. Current and potential synergies between stakeholders for the Agri-city implementation.

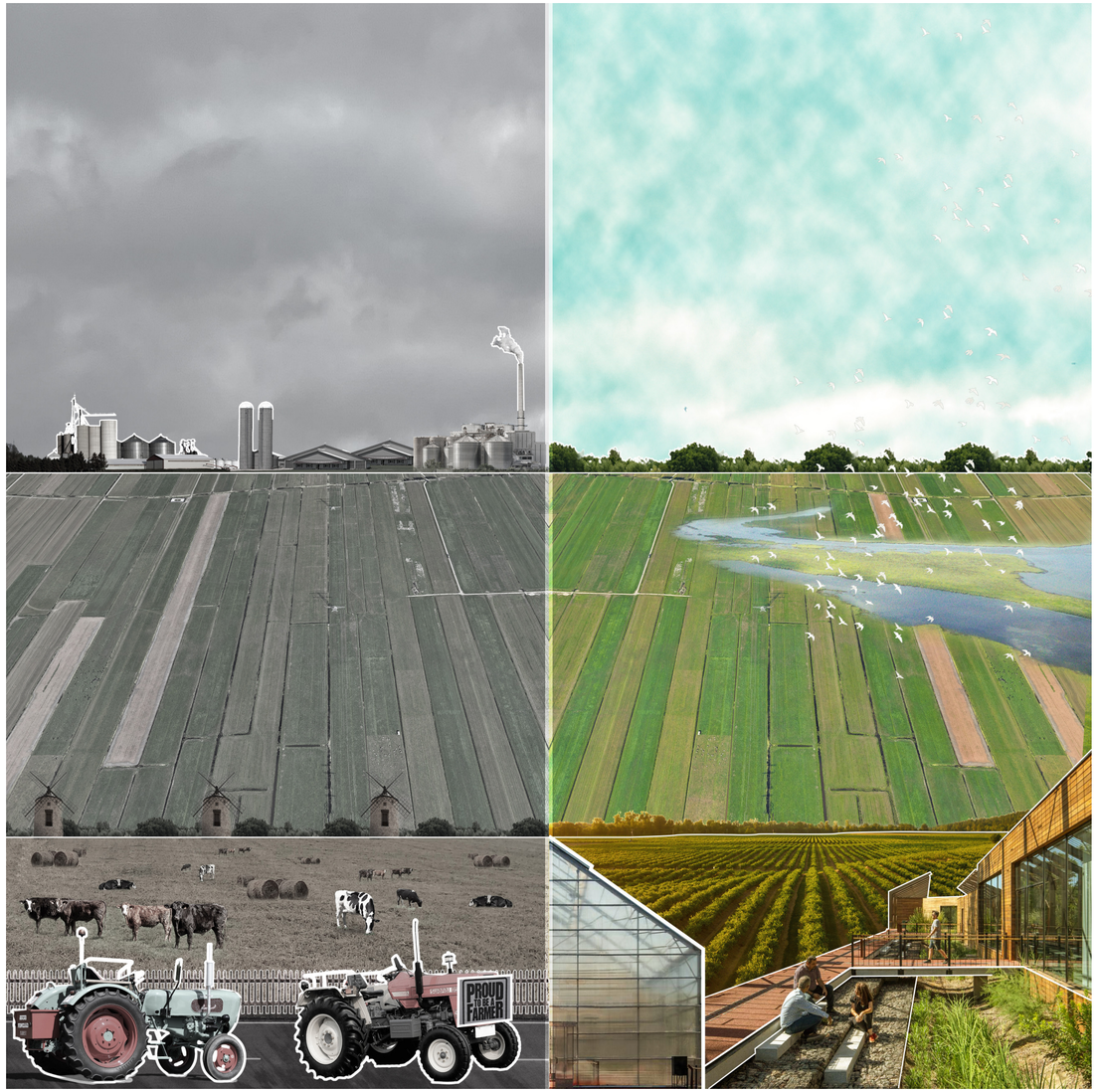


Figure 68. Collage of the New Farming area (page 102). The same landscape is shown in a dual image: the current situation (on the left) and our proposal (on the

5.5.4 New farming

Introduction

The eastern part of the province of South Holland is a part of the Green Heart which is a large nature area surrounded by the Randstad. Activities in the Green Hart area are limited by the Dutch government, therefore, the rural character of the territory is still intact. In order to respect the environment, the proposal focuses on the functions of the land that does not require additional build-up.

What is more, the landscape of the area is a typical Dutch peat landscape, therefore, the area is less fertile and more suitable for livestock farming rather than agriculture. However, innovative methods and new types of agriculture could change that. Moreover, the current linear peat streetscape and segregation of the plots also result in the lack of interaction between farmers. More shared spaces for the community are created together with local hubs of process, retail and innovation.

Figure 69. Aerial map of the proposed New Farming location.

Figure 70. Scheme of the Green Heart.

5.5.4 New farming

Current situation and phasing

The new farming proposal is about exploring alternatives to livestock farming in the area of South Holland that is mostly occupied by this activity. The areas in the upper part as well as rivers' banks have soil more suitable for growing plant-based protein food. Therefore, the livestock farmers there would be encouraged to change the type of farming by various instruments from the Manual (Fig. 39). What is more, as the Green Heart is important for the biodiversity in the Netherlands, the green corridors would be implemented by allowing farmers to sell the land and 'give it back to nature. The same principle would apply to creating green buffer zones around the cities. The remaining livestock farming in the area should aim to be as sustainable and local.

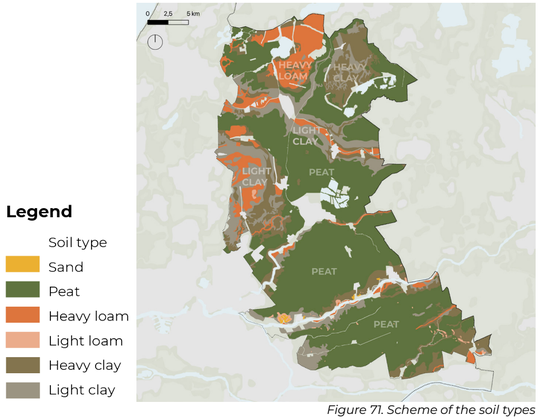


Figure 71. Scheme of the soil types in the future New Farming area.

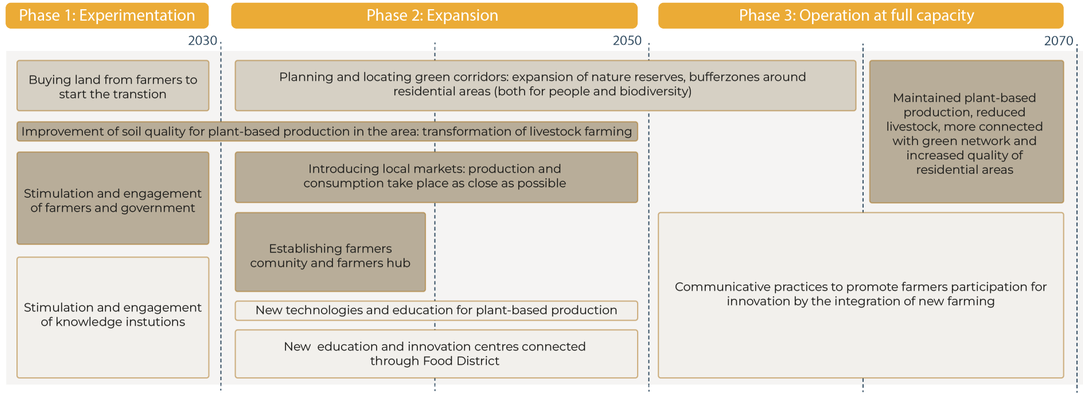


Figure 72. Timeline of the New Farming implementation.

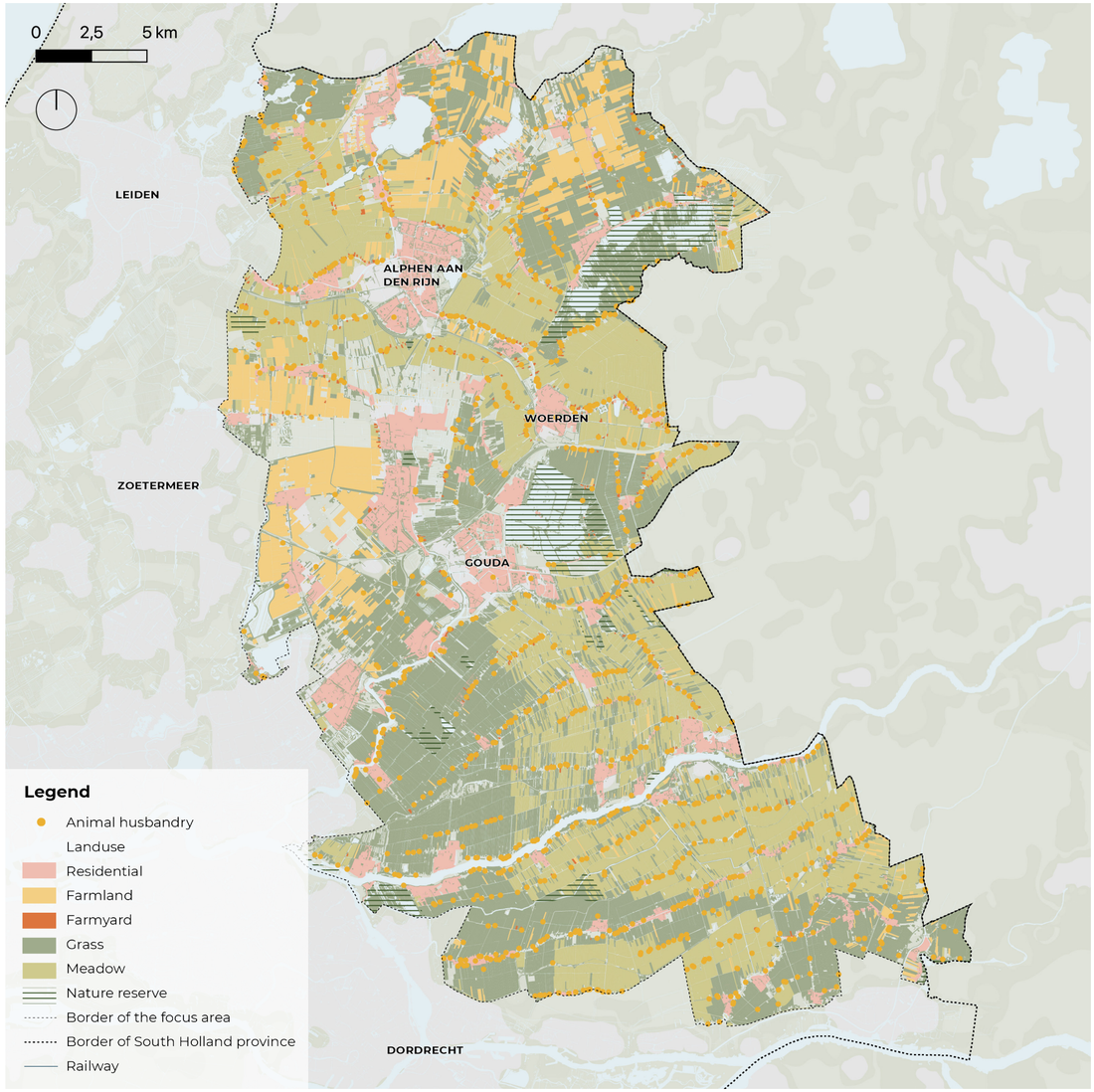
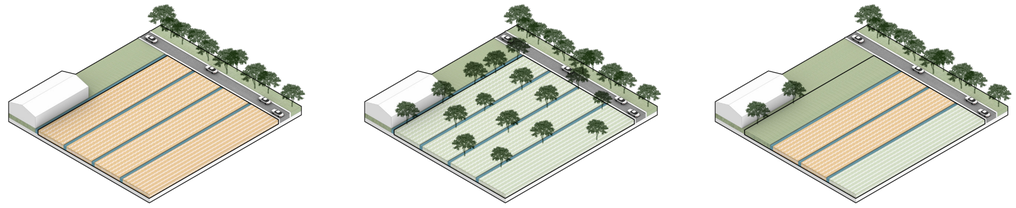


Figure 73. Map of the current situation in the future New Farming area (page 103).

5.5.4 New farming

Proposal



Pland-based production

Back to nature

Transition phase

Figure 74. Proposed typologies of the New farming area

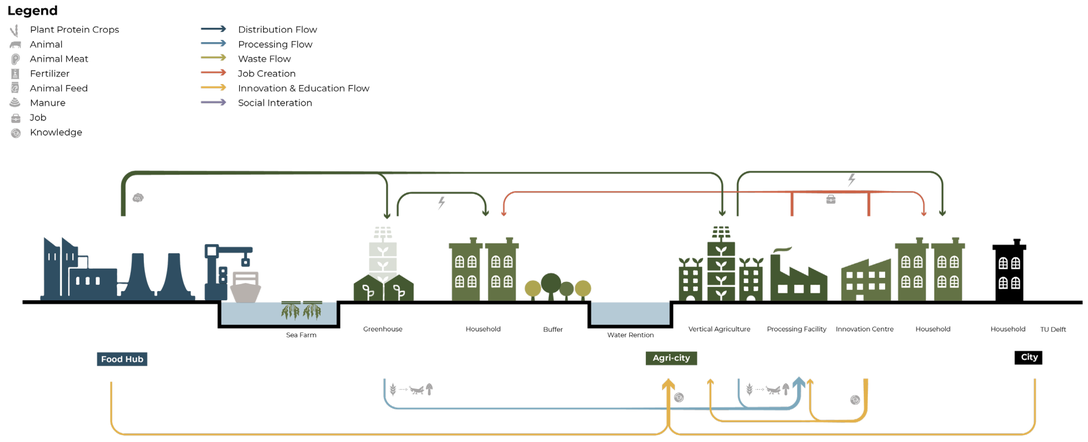


Figure 75. The systematic section of the proposed New Farming area and main flows.

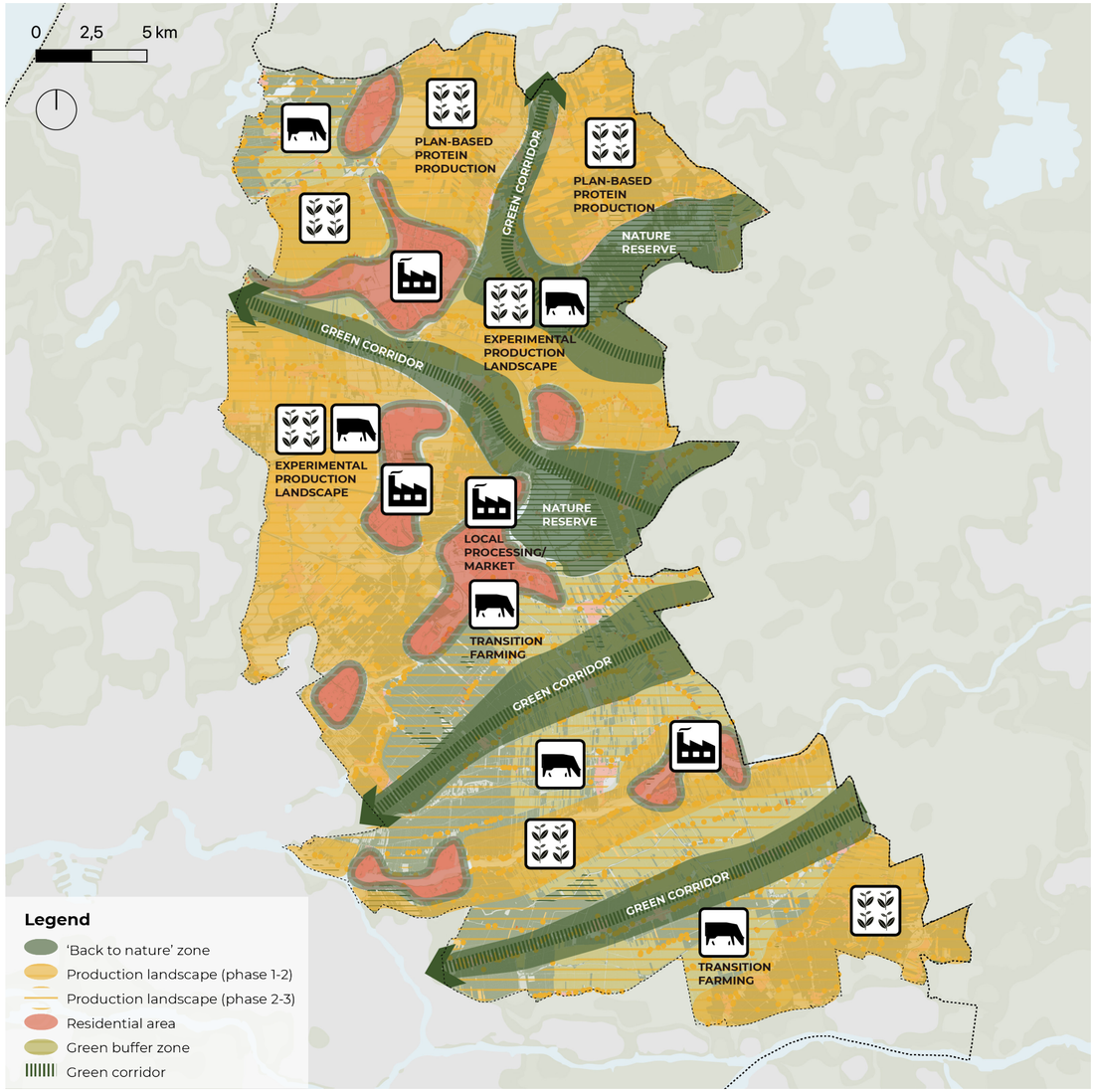


Figure 76. Proposed zoning map of the New Farming area (page 105.

5.5.4 New farming

Stakeholders analysis

Collisions

The main collision between the Dutch national government and farmers happened a few years ago when the government aimed to solve the nitrogen crisis by drastically reducing farming activities. This caused protests all over the country. As the actions have to be taken, it is crucial to make the transition as gentle and smooth as possible and combine it with social awareness, education, and compensation policies (Fig. 77).

Synergies

The area is already located between TU Delft, Rotterdam Erasmus, and Wageningen universities, therefore, the knowledge should be used for sharing knowledge about innovative farming and transition towards agricultural activities even though the peat landscape comes with certain challenges for agriculture (Fig. 78).

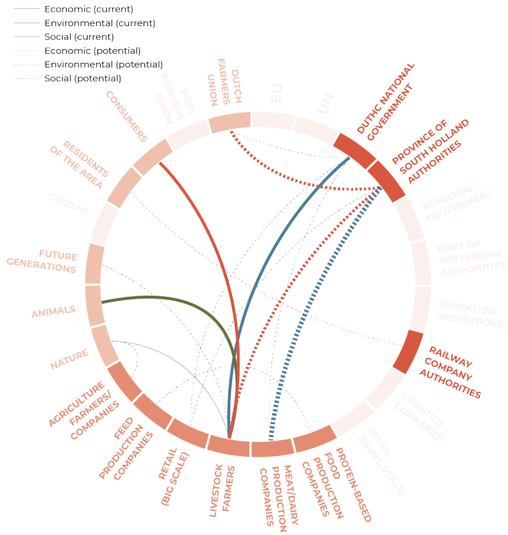


Figure 77. Current and potential collisions between stakeholders for the New Farming area implementation.

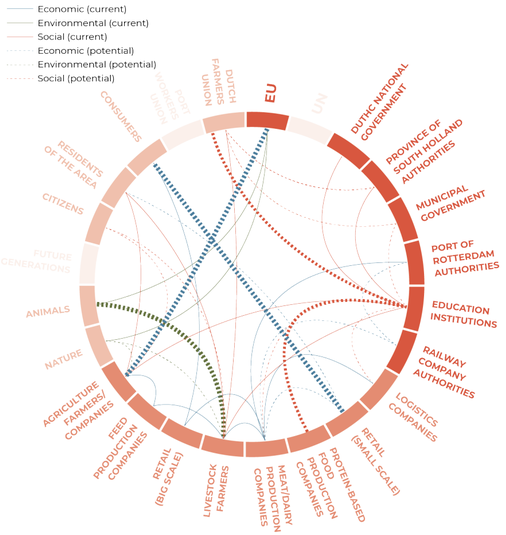


Figure 78. Current and potential synergies between stakeholders for the New Farming area implementation.

Figure 79. Collage of the Farm-lab (page 108). The same landscape is shown in a dual image: the current situation (on the left) and our proposal (on the right).

5.5.5 Farm-lab

Introduction

For the Farm-lab location, the Southern part of the Province of South Holland was chosen. The area is near the Port of Rotterdam, however, it is quite isolated from the Rotterdam - the Hague metropolitan area by the rivers delta. It results in social separation as young people tend to leave the area to move to the bigger cities. It also has a negative effect on the economy of the area. What is more, pollution, decreasing biodiversity, and soil salinization need to be taken into consideration.

Figure 80. Aerial map of the proposed Farm-lab location.

5.5.5 Farm-lab

Current situation and phasing

Farm-lab project is a showcase, aimed to experiment with protein-based food production types as well as focusing on education, research, and innovation. It highly contributes to Sustainable Development Goal number 12: ‘responsible consumption and production’. Despite the lack of connectivity, the balance between the closiness to the urbanised area (together with the Food Hub and Food District) and the intact rural character allows us to propose area where protein-based production is combined with education about nature, agriculture and responsible consumption. New, innovative or currently still experimental sustainable alternatives such as mushroom, insect or floating farms are presented in combination of hospitality sector and education.

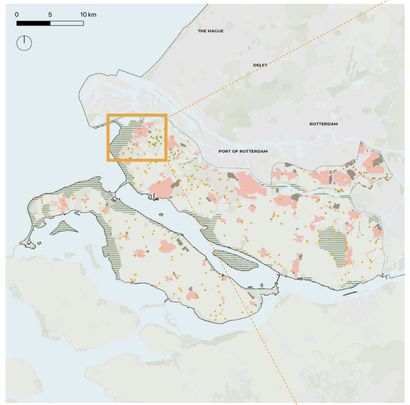


Figure 81. Scheme of the larger area of the Farm-lab project.

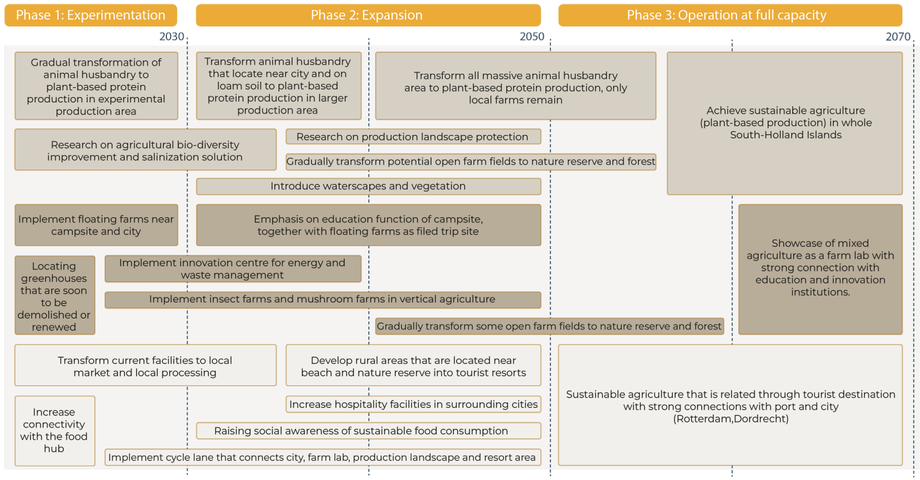


Figure 82. Timeline of the Farm-lab implementation.

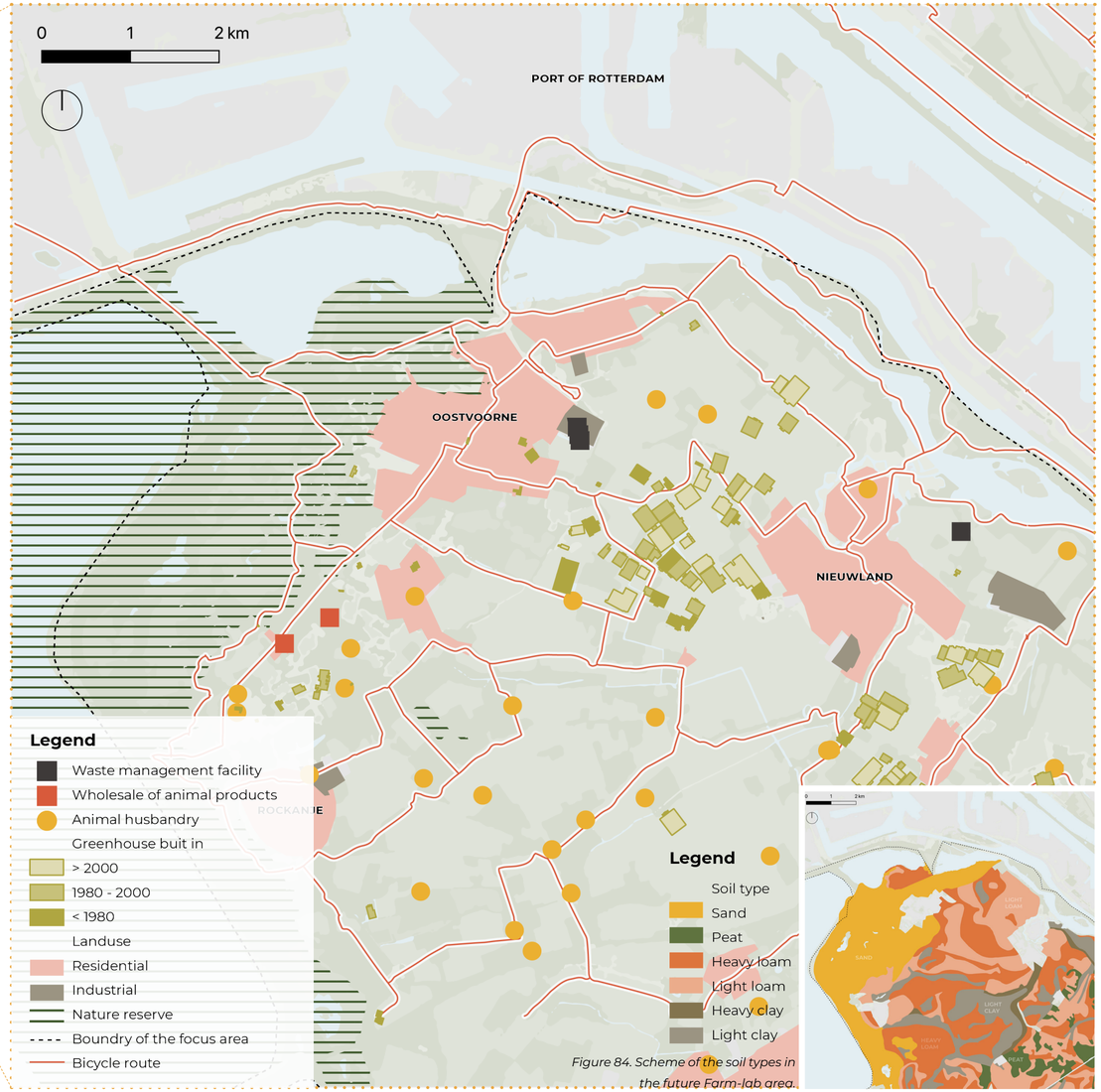
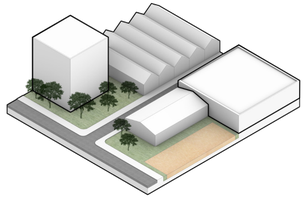


Figure 83. Map of the current situation in the future Farm-lab area (page 111).

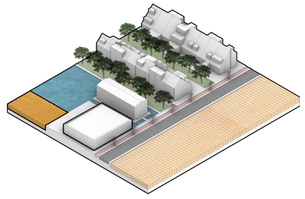
Figure 84. Scheme of the soil types in the future Farm-lab area.

5.5.5 Farm-lab

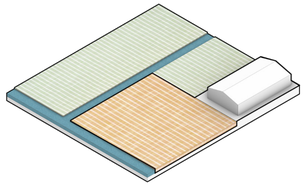
Proposal



Greenhouse areas (alternative protein production)



Urban-rural transition



Production landscape

Figure 85. Proposed typologies of the Farm-lab area.

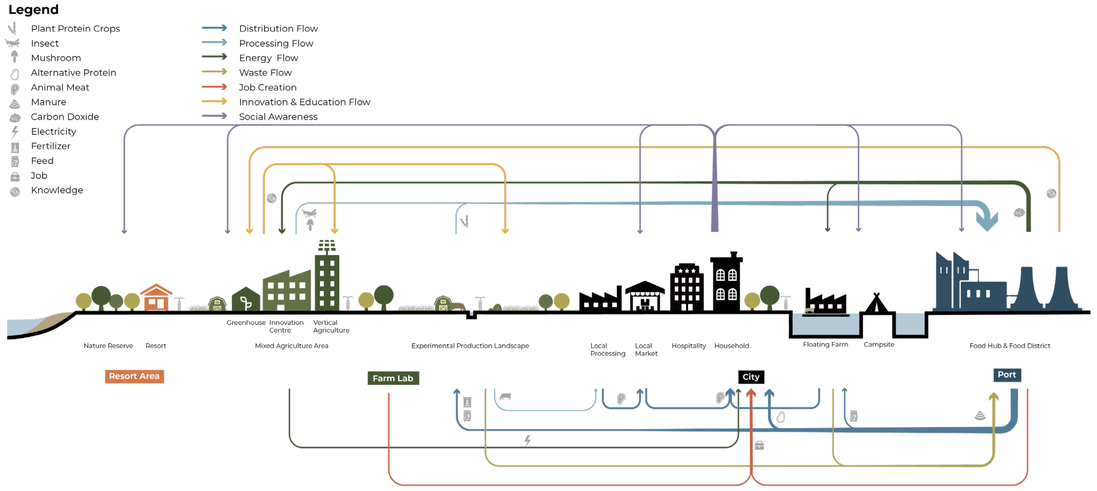
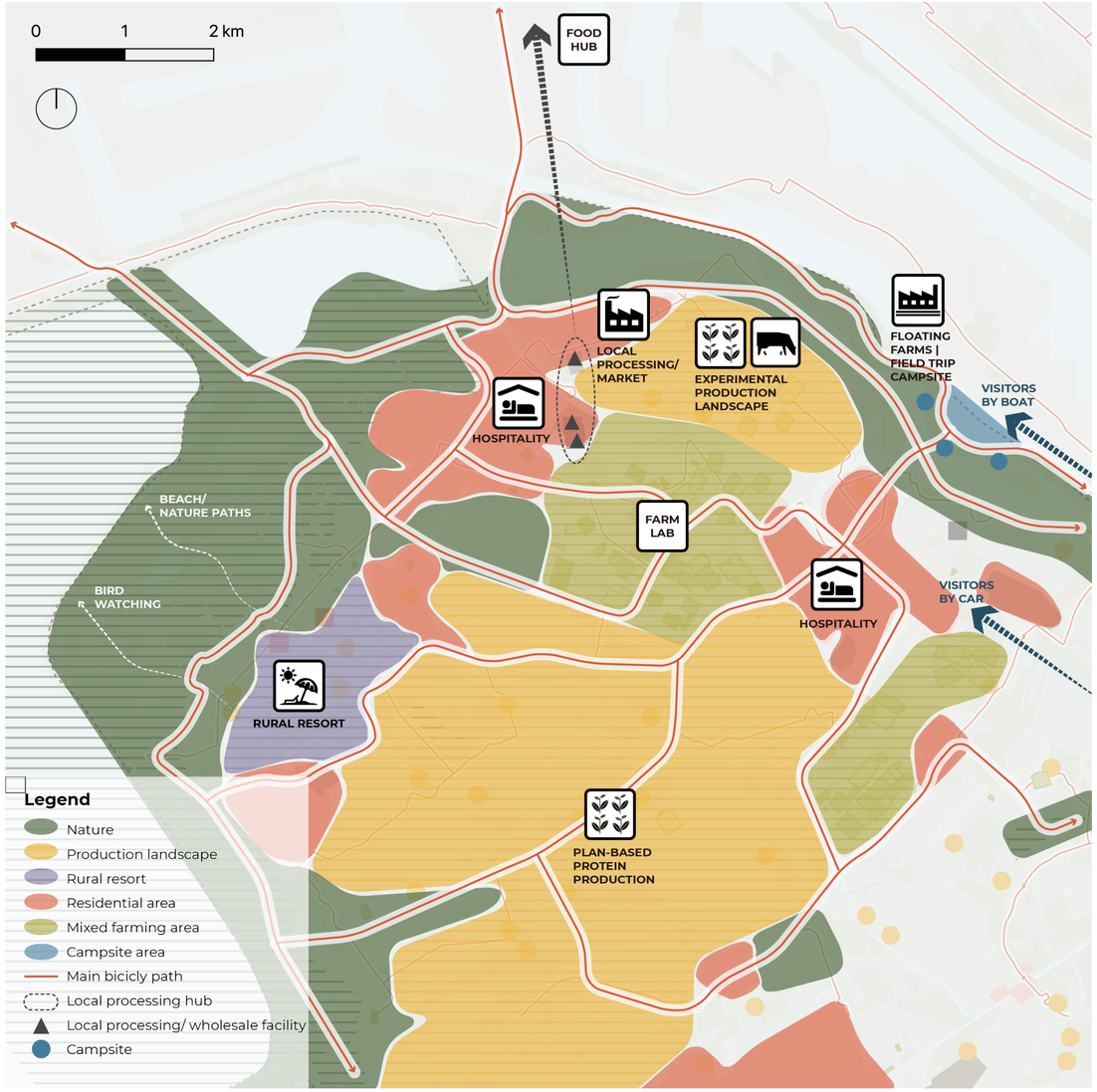


Figure 86. The systematic section of the proposed Farm-lab area and main flows.

Figure 87. Proposed zoning map of the Farm-lab area (page 113).



5.5.5 Farm-lab

Stakeholders analysis

Collisions

There is already a collision happening between municipal government and farmers in terms of emission reduction, especially the measures that were taken in 2019 to fight the nitrogen crisis. On the economic side, as more farmers will turn to growing plant-based protein food, cannibalization will happen and pose a threat to protein-based food companies. With increased urbanization and high levels of automation in agriculture, young people from farmers' families will be more attracted to cities, leaving farms empty (Fig. 87).

Synergies

To achieve sustainable farming through a smooth transition, the synergy between municipal government and agriculture/ livestock farmers is very important both in environmental and economic aspects. Towards the trend of reasonable consumption, the social awareness of the public is crucial for the development of agriculture farmers and portion food companies, which should contribute to raising social awareness (Fig. 88).

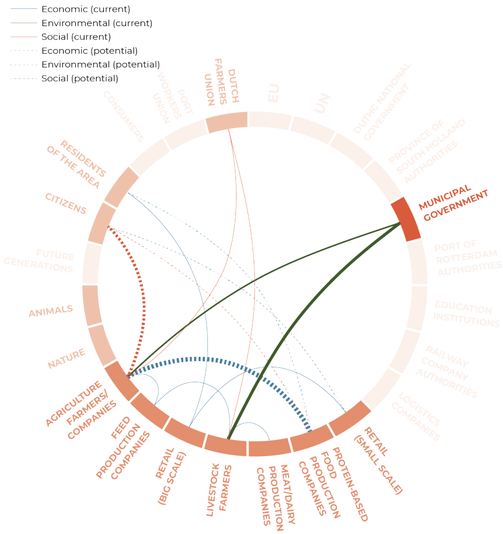


Figure 88. Current and potential collisions between stakeholders for the Farm-lab area implementation.

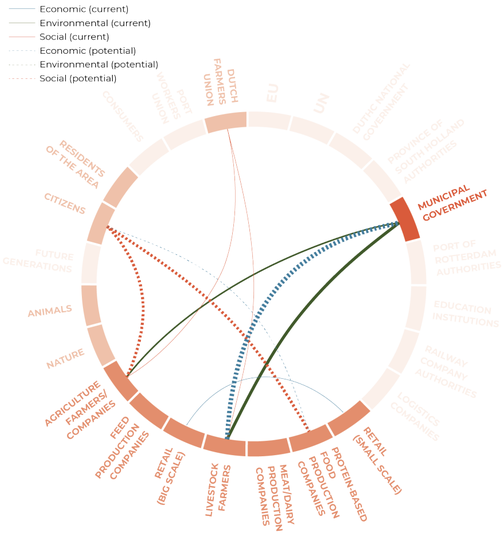


Figure 89. Current and potential synergies between stakeholders for the Farm-lab area implementation.

6. Discussion and conclusions

6.1 Discussion

This report draws a strategical proposal for a transition towards a protein-based food industry, addressing the current problems regarding the climate crisis and behavioural change.

The results support the idea that it is possible to carry out a transition of this magnitude with the subsequent research and location-bonded design and analysis. It showcases how the concept of the 'protein transition', which has been proposed by universities such as Wageningen University. It marks the first steps for change and opens up possibilities for a national and even global transition. Moreover, it proposes a set of goals and conceptual framework that is aligned with the UN, EU, province and Port vision, which can have implications in other future regional or smaller-scale projects.

The implementation of the Protein Factory is a big step towards a more sustainable and resilient food industry through the reuse of existing infrastructure and the implementation of alternative ways of production. However, there are limitations to this project.
The Protein Factory requires the collaboration of numerous stakeholders and authorities from the private, public and civil sectors. As shown in the stakeholder analysis of chapter 5, there is going to be collisions of interests of different actors which can make conflict arise. Moreover, although there is a clear trend of behavioural change in diets, the social dimension of this transition might be the most delicate.
Currently, livestock farmers are a vulnerable guild that is losing faith in government actions, causing the farmers' strikes in 2019 (RTL, 2021). Implementing a long transition that offers alternatives for all professionals in the livestock industry. With this project, we acknowledge the importance of farmers and the historical and traditional value of the farming landscape and farming activities. This is why it is necessary to implement change carefully, with a focus on education and a strong policy and tools plan to avoid social conflict.
Moreover, the economic aspects of this transition have only been addressed with a qualitative approach. It would be pertinent to also review the transition with a quantitative approach and see the concrete economic consequences of global trades with protein-based foods and the decrease in meat and livestock export and import. This is also applicable to the spatial configurational design of vertical greenhouse areas and crops in the farmlands. This project proposes general guidelines with typologies and zoning plans, but further steps on quantitative methods of research would be a further step on the strategy and key projects.

Furthermore, the project is very dependable on actual future changes related to climate change, social behaviour and global economic flows. This suggests the need for a review or checkup of the problem statement, trends and forecast analysis and landscape conditions analysis throughout the transition timeline. This might lead to changes in the strategy.

Further research in the frame of the protein-based food transition would be into concrete ways of production and processing in an energy-neutral way. Also, innovations such as the production of cultured meat can be a big step into the transition.
Moreover, this project represents a regional plan that needs further analysis and design on smaller scales and could also be extrapolated to other provinces in The Netherlands.

Figure 90. Key projects on the map

6.2 Conclusions

The focus of the Studio Spatial Strategies for the Global Metropolis was on the theme 'Towards a biobased economy'. Within this theme, the Protein Factory looks into the animal-based food industry and presents the possibility of a more sustainable protein-based food chain.
This report aims to answer the question: How to implement a sustainable protein-based food transition in the current animal-based food industry in the frame of South Holland through the Port of Rotterdam?'.

South Holland has the biggest agriculture and horticulture production in the Netherlands (CBS, 2021). In combination with the import and export activities of the Port of Rotterdam, this makes the Netherlands one of the biggest global exporters of animal-based foods (CBS, 2021).
The Port and the Province (also the UN and the EU) have designed a vision for sustainable transitions and circularity in their economic activities. With this project, we present a proposal for a transition of the animal-based food chain that supports these visions to create a sustainable, resilient, inclusive, local and circular protein-based food chain in its social, environmental and economic aspects. Consequently, climate action and responsible consumption and production are key concepts or goals for this project.

The proposal for the Protein Factory starts with a vision. Following societal trends and authority goals, animal husbandry and the animal-based food industry is going to decline in the coming decades.
Because of this, the transition is focused on the production, processing and distribution of alternative protein foods in different areas of South Holland. The vision presents three transition zones (with their consequent strategical key projects) with the Port as the core of activities: Westland, Eastern Farmland and southern farmland.

The Port of Rotterdam has a central role in this transition as it is directly related to the food production sector through import and export activities together with processing and education. We propose the ongoing Food Hub project and the Food District as the machinery of the Protein Factory, implementing education and research facilities that will promote the transition within the Dutch population and will fuel it with new technologies. The seaweed production from the new sea farms will happen in the Food Hub. Moreover, these Port areas will be connected to the other transition areas in South Holland through railway connections to optimize the logistics of the process.

The area of Westland, currently destined for agriculture and horticulture will be potentiated. Current greenhouses will gradually be replaced by vertical greenhouses, which allows a bigger capacity for new crops of soybeans, legumes, mushrooms and other protein foods, without hindering the current production. Moreover, it allows the creation of green buffers or space typologies for healthier living environments in this area. Moreover, waste management and sustainable energy production in combination with Port infrastructure and facilities allow a circular process.

The Eastern Farmland area has a large number of farms for animal husbandry. This proposal entails implementing different space typologies that will allow alternative protein-based food production, implementing other types of agriculture and bringing the land back to nature. The cooperation of actors, governance tools such as policies and communication and education of stakeholders on the transition is crucial for this strategic area.

Finally, the southern farmland area is planned to be mixed-used, with mushroom and insect farms together with soybean crops. As this area is mostly used for agriculture and has already been an experimental area for soybean plantation, it presents opportunities as a crucial protein-based food production area. Moreover, the key project of the Farmlab presents a social project in which education, nature and stimulation come together to divulge the importance and urgency of the transition.

The strategy for these areas presents six principles that are the 'components' or strategic concepts that make the Protein Factory work. These are (1) social awareness, (2) Innovation, technology and education, (3) Port as activity centre, (4) global to local, (5) alternative protein food production ad (6) connections.
All these components entail strategic actions that will be carried out in the transition areas through five key projects: 'Agricity, in Westland; 'New Farming' in eastern farmland, 'Farmlab' in southern farmland and the mentioned Food Hub and Food District by the Port.

These strategic key projects present timelines, stakeholder analysis, tools and spatial designs that make the vision and strategy more concrete and present practical ways to introduce them.

Figure 91. Strategy components

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7.2 Figures

Figure 14: Current challenges

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Figure 15: Cypher eating steak, The Matrix

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Figure 45: Collage of the Food Hub
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Figure 52: Collage of the Food District
For TU Delft building 3D model
https://3dwarehouse.sketchup.com/

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Figure 59: Collage of the Agri-city

For the image of vertical greenhouses in the background
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Figure 68: Collage of the New Farming

For the indicated building typology, spatial
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Figure 79: Collage of the Farm-lab

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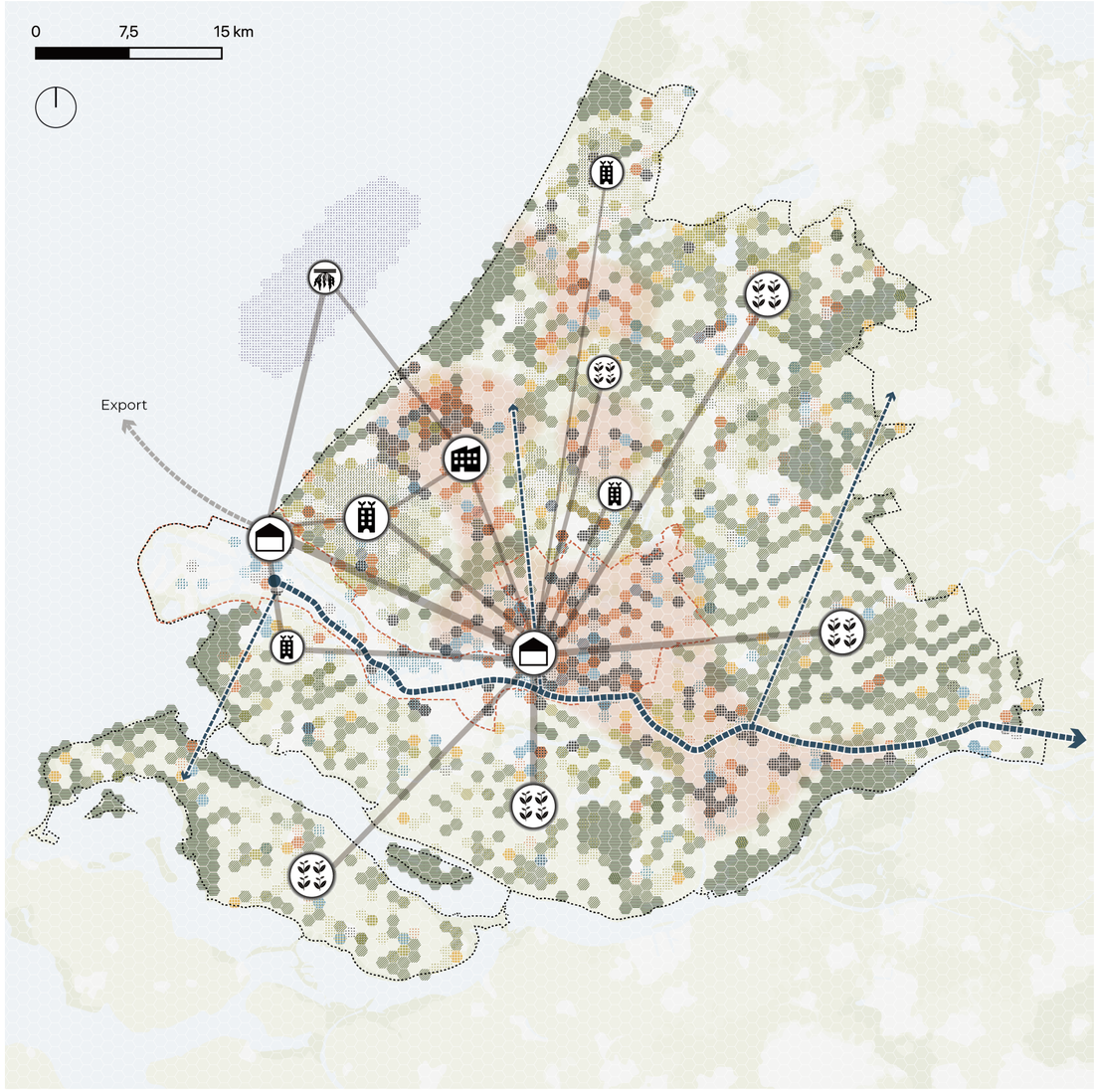

Figure 92. Vision map (page 127)

8. Appendix

8.1 Individual reflections

Arnta Kalentzi (5362180)

This quarter had a rough start I must say. I have never worked on a regional scale project or in a port city before. The introduction of circular economies and material flows was also something new that made the situation even more intimidating. But I started to comprehend the subject as we resolved and determined our project's topic over time. Everything was straightforward after the midterm presentation through the design of the strategy, where I finally felt like we are producing concrete interventions. I would say that I am satisfied with our spatial vision and the way we execute it spatially through a distinct narrative at the end.

It was essential to identify the networks of animal husbandry in the province of South Holland, and what is the role of the Port of Rotterdam. Dutch animal husbandry maintains a critical global position in the production and export of animal-based food, and the port has a significant role as the sector depends on global networks. Further understanding the current situation of animal-based food production took a lot of research. And I was not aware of the problems caused by the whole process before, including the import of animal feed, manure surplus and nitrogen emissions. Recognizing the problem and why we need a transformation was a necessary step, laying a solid foundation for the whole narrative.

I think we built up a strong argument through the detailed study of the current systems, network of connections and spatial typologies in the region. South Holland is a working factory, and through our vision, we implemented the transformation of this factory by maintaining sustainable and resilient protein-based food supply chains. I admire this approach that allowed us to analyze distinctly and identify the parts of the factory in the whole region. Thus, I believe we have a strong transition between our spatial vision and the execution of the strategy. This led me to embrace our project even more and I am happy with the process and result of the project.

Development of the strategy and converting our vision into a design was the most intense part. Personally, I think we over-pushed ourselves by indicating five key projects and it took a lot of time and effort to manage them all. But in the end, we accomplished a great layout and structure for all the key projects that give a good insight for our spatial interventions and that we made an elaborate study for the whole region. Further research and analysis to enhance the design decisions for the key project were required, but I guess we did not have the time and energy to proceed more.

Overall, I have learned so much this quarter. To emphasize on the whole process as a preview for the final thesis year was informative. As I hoped for, I learned more about QGIS and made a habit of using it more. In general, the whole process contributed to my knowledge and skills as an urban designer. However, I feel like I have aged ten years in these two and a half months.

Ruta Vitkute (5624010)

The concepts of circularity and sustainability are nowadays visible almost everywhere: in the literature, media, various plans and strategies for the future. Moreover, as the concerns about the climate crisis are rising, green parties all over the world gain more political power. However, before starting my Master's in TU Delft, I would get a feeling that I, often as well as those who would use those terms, actually lack an understanding of how to achieve them. Sustainability would be often simplified to having some solar panels, planting more trees or driving an electric car and circularity to recycling used materials. Therefore, the Q3 broadened my knowledge of those concepts as well as provided some critical approaches. First of all, learning about the R-ladder in one of the first lectures was very useful to understand that recycling materials is not the main solution to achieving circularity and, actually, it stands very low on the ladder. What is more, during the lecture 'Towards a circular port of Rotterdam' Els Boesveld answered the question of whether not using plastic at all would be a solution, saying that no, actually the research says that disregarding plastic altogether would result in increased CO^2 emissions. That made me think that the current issues do not need drastic changes but well-calculated transitions. Also, data visualization and methodology lectures gave a strong base for scientific research that was very helpful this quarter as well as will be for the thesis.

Learning in the class is important, however, learning from the environment itself is even better. I am happy to see how the TU Delft goes together with the values we are taught in classes and takes small steps towards sustainability. One of them, no meat and dairy products in the cafeteria, was not an easy one as I have never been a fan of meat-alike alternatives. Nevertheless, during this year, I actually tried some plant-based meat alternatives I did like. From my perspective, it was one of the reasons, why the livestock farming topic aroused my interest and I am glad that we as a team decided to explore this topic further.

It was not an easy journey, as the current meat and dairy industry in the Netherlands is a very important economic flow and any changes in the capacity of livestock farming would result in a financial loss for the interested parties. However, one of the main reasons why we are dealing with the climate crisis, is that 'we cannot imagine a future that is not market-based' (Rocco & Dabrowski, 2021). What is more, the transition of the livestock farming sector also covers questions of ethics and animal welfare, meat and dairy production-consumption trends, social justice, job accessibility and other social issues. Taking into consideration the farmers' protests against the Dutch government in 2019, remarks of the interested parties who participated in the midterm presentation as well as my previous work experience with stakeholders, I am sure, it would be a very difficult task to make our proposal a reality. Despite that, I believe that it is crucial to work towards that direction, maybe today more than ever.

I am glad that this quarter we worked in a team that allowed all of us to grow in a professional way, discuss a lot and freely share our opinions. I believe, that despite different backgrounds and often different initial ideas we managed to achieve the consensus and provide a result we are all happy with.

Rocco, R., Newton, C., d'Alençon, L. M. V., Watt, A. v. d., Babu, G., Cara- donna, G., Di Gioia, L. Subendran, J., Tellez, N., Pessoa, I. T. (2021). A Manifesto for the Just City. Delft: Delft University of Technology.

Miriam Schoemakers (4859014)

The course Spatial Strategies for the Global Metropolis was the first grasp I have ever had on regional design. At the beginning, of the course, I was a bit intimidated by this because of my lack of experience, but because of that, I could take full advantage of the course.

Sustainability and circularity are concepts that are always on the top of the list of goals to achieve in any spatial project. However, diving into the Biobased universe and looking at it from the scope of food production was completely new for me. Although it was confusing at the beginning of the course, and after changing a few times our main goals and problem statement (there are so many things that need to be solved) we managed to find an interesting and strong goal to make our project about: a sustainable and resilient food industry through a transition into alternative protein-based food production.

The fact that the assignment is centred in the Port of Rotterdam with such a global reach and within the scope of the Metropol region of South Holland made this project very interesting and complicated, as it entails global economy problematics together with local social and environmental aspects.

I found the social aspect of the protein-based food transition very interesting and would like to do further research about it. In the process, there were discussions about the social movement that it would take to be able to increase a behavioural change this big, and how it would be possible to encourage it through spatial design. The use of planning instruments (see 'The Manual' on pages 68 and 69) to pull the strings between actors and find where the interest of each stakeholder is is a type of analysis I had not carried out frequently in the past. It showed me how it is possible to encourage public, civil and private sectors to commit to change. However, this is a very complicated process. As Fred Hobma said in the SDS lecture 'Planning tools': 'Any spatial vision has to (...) engage with difficult political choices' (Hobma, 2022). To implement spatial and social justice (for example food accessibility and affordability for all, in the context of the transition), all resources need to be carefully distributed within space and actors. Finding the balance and the border between public and private domains and opening a social agenda for both of them is something I would have found very interesting to investigate for this project. Unfortunately, we have as always the big limitation of time in the courses of this Master track that don't allow us to dive into all the topics we would like to. I was happy that in the course of Research and Design Methodology for Urbanism we could learn and debate more about social issues in the frame of Urbanism and governance and I hope this will be given more importance in the education of planners.

Overall, the process and group work was a pleasant journey in which I was also able to know myself better when it comes to group dynamics. It took long discussions and sketching sessions to merge our ideas and come up with a product we were all satisfied with. I am happy I was able to work with a group of people that challenges me and that help me grow in the field of strategic design.

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Shiming Xu (5567866)

Facing the threat of climate change, the concept of ESG (Environmental, Social, and Governance) becomes more and more important in economic investment. Q3 studio focused on spatial strategies for the global metropolis, which will contribute to a circular and socially innovative port economy in the South Holland province. Therefore, as urban planners, we need to reflect on these aspects in regional planning.

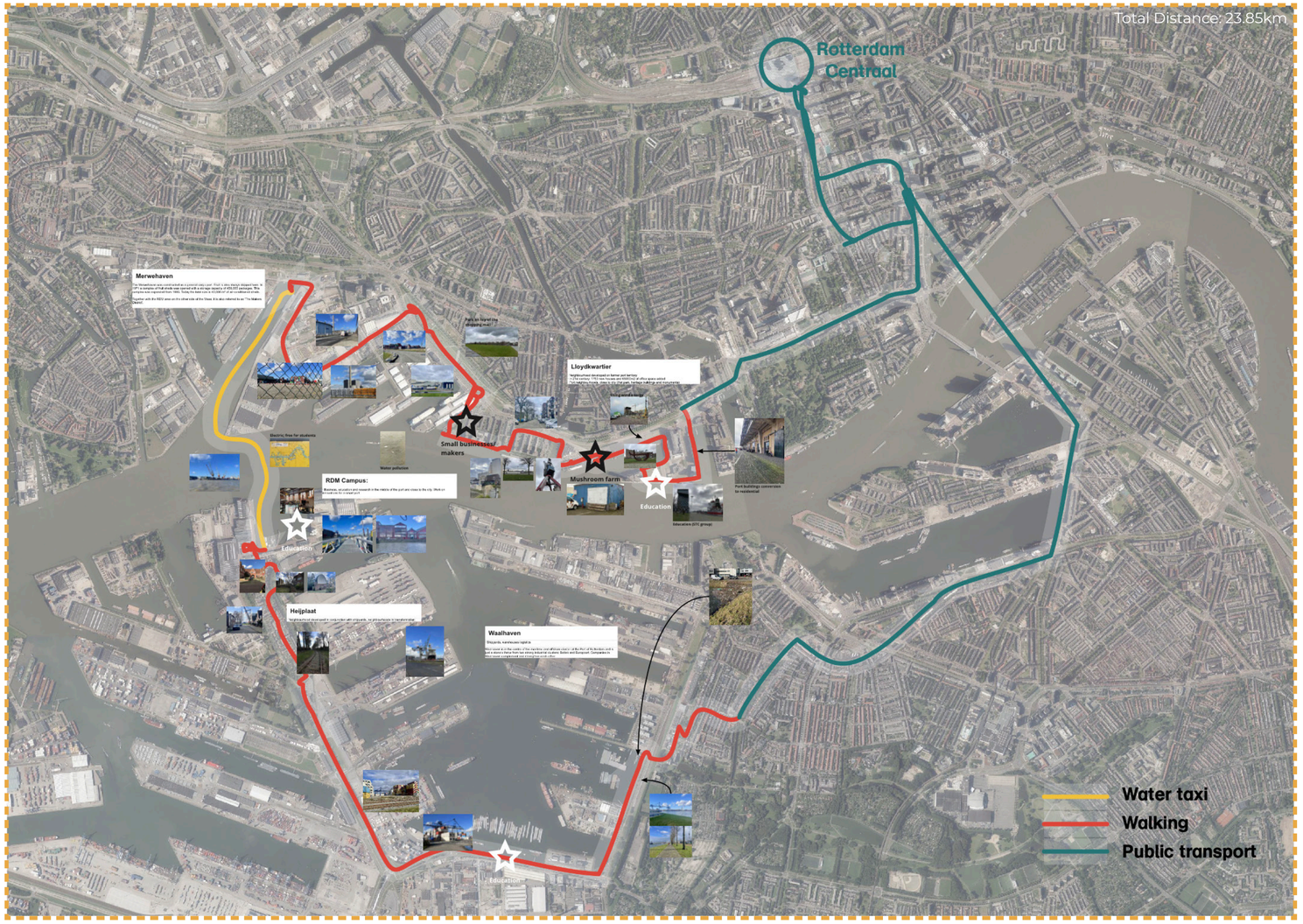
From lectures on port introduction, we learned that the port of Rotterdam has made a CSR statement, which guides the port to build a more sustainable future, aiming at being a carbon neutral port by 2050 (Rotmans, 2022). However, as the largest port in Europe, current economic figures also come with large amounts of emissions. To achieve the port's goal, we need to look at not only the port but also on a regional, national and global scale. Through SWOT analysis and mapping, we formed some insights into the area and decided to work on the topic of protein-based food. The material analysis is very helpful to understand the material flows among all main components and pointed out the direction for our vision. When defining our spatial vision, we faced some obstacles in reaching common agreements. We experimented with different scales and several scenarios such as no-meat consumption, reasonable consumption, and local consumption. We worked on economic, environmental, and social domains as well as networks simultaneously and finally formed our spatial vision.

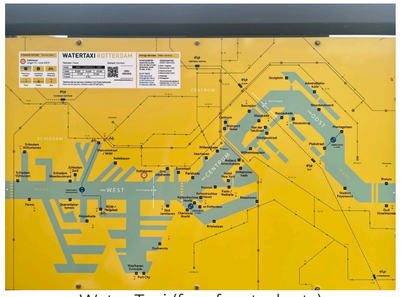
Defining spatial strategies is more than drawing. From the methodology course, we learned the example that Dutch farmers has a strong reaction when the government tried to address the nitrogen emission crisis. As stated in the methodology booklet of 'I have a dream', 'the socio-technical systems connected to dairy and meat production and consumption require a much more holistic approach, in which the system must be re-assessed, including entrepreneurs, technologies, spaces, regulations, and consumers' attitudes and preferences.' (Rocco, 2022) Therefore, we introduced a step-by-step transition toward a sustainable protein-based food future. New projects will be implemented in experimental areas first, then gradually applied to the whole South-holland province and other Dutch provinces. Through stakeholder analysis, we recognize current and potential collisions and synergies between relevant stakeholders. We use a manual of planning instruments to create preconditions for a smooth transition. However, due to the time limit, the manual is very general and we should put more thought into the detailed policies of each key project.

I think Q3 was a very rewarding quarter and I am very happy with both the courses and group work. The studio gave me a general idea of the procedures of regional design and methodology courses trained my ability to write an academic report. Most importantly, I get to know more about climate change & sustainability which I found very interesting. I also had a nice experience in group work. Although I think we need to improve our group efficiency a little bit, I did learn a lot from my group members, not only software skills but also different perspectives on the design approach. We took a detour of switching topics in the beginning and had some difficulties in proceeding with the vision but in general, it was a pleasant and smooth process, everyone plays to our strengths and worked collaboratively.

Renée, R. (2022). On the Port of Rotterdam. https://brightspace.tudelft.nl/d2l/le/content/398764/viewContent/2598728/View
Roberto, R. (2022). I HAVE A DREAM https://brightspace.tudelft.nl/d2l/le/content/398766/viewContent/2603176/View

8.2 Field trip





Water Taxi (free for students)


Railway


RDM Campus


Water Pollution

Innovated Mushroom Farms

8.3 Social media: Methodology assignment

Frank The Cow @FrankTheCow · Mar 8

Productive conversation with the authorities of Port of Rotterdam and province of South Holland today.

We will continue to work hard to ensure animal wellfare during the transition towards the plant-based meat production.
Together we can achieve #nomoremeat2050 !

@PortOfRotterdam
@ZuidHollandAuthorities

Frank The Cow

59 62 376

Port of Rotterdam
4 hrs ·

One more step towards the local production of meat alternatives. Read more:

PORTOFROTTERDAM.COM
Port of Rotterdam approves first sea farms as the part of 'No-meat meat 2050' project

669 353 Comments 6 Shares

Like Comment Share

Most relevant

Write a comment...

Frank The Cow
Finally we will get the retirement we deserve... Proud of #Port of Rotterdam for making this step!
Like Reply 2h 134

5 Replies

View more comments 1 of 171

Instagram

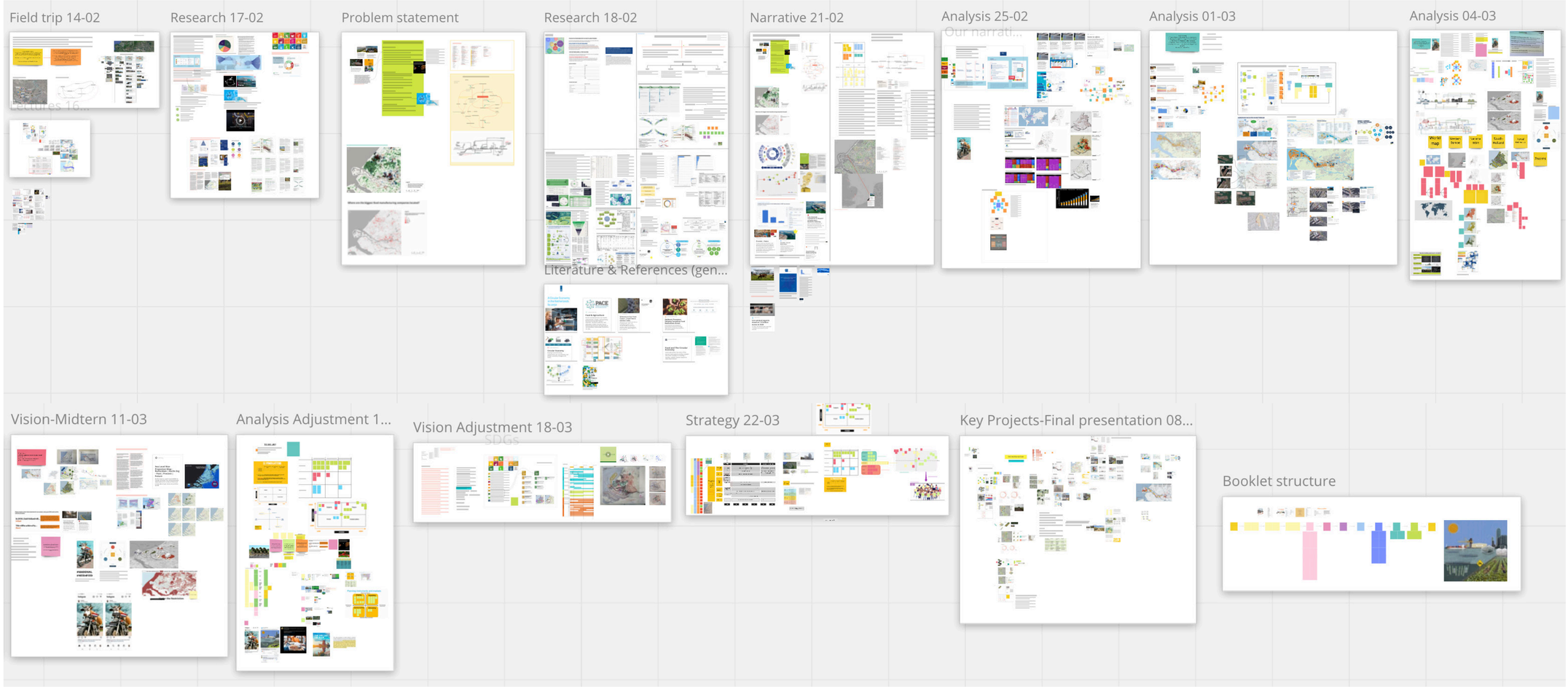
frank_the_cow
Port of Rotterdam

frank_the_cow Is the meat industry going away? #retiringcows #whatsnext?🌱

7 seconds ago

8.4 Our process

If you are curious about our research process or want to see more information about the topik check the link to our Miro board!
https://miro.com/app/board/uXjVOR_Jld8=/?invite_link_id=798443171342




FOOD HUB