Down Scale-Up!

'Downscaling global agri-food flows with an upscaled regional system'

Msc Urbanism Q3 I TU Delft Faculty of Architecture and the Built Environment
4563050 Amber Luesink I 4549759 Henriette Hugenholtz I 4694562 Rosa de Kruif I 5203899 Yuru Chou

AR2U086 Spatial Strategies for the Global Metropolis
Tutored by Alexander Wandl, Caroline Newton and Lei Qu

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01.
Abstract

Abstract

The Netherlands exported in 2017 for 91,7 billion euros and exported for even more: 62,6 billion euros (CBS, 2018). This shows the big agri-food flows in which the Netherlands is involved. Sadly, these global flows have a big impact on economic, social and environmental sustainability worldwide. For example, transport causes many emissions, there is an unfair economic system that keeps farmers trapped and there is a lot of environmental damage. This is a situation that needs to change, but the Netherlands is also very dependent on the economy that the worldwide trade brings. This shows the problem that South Holland is dealing with: The Netherlands is too much economic dependent on its agri-food import and export flows and is thereby causing economic, social and environmental sustainability challenges.

This report proposes to DownScale international agri-food flows and Scale-Up a regional food system. The import and export flows are limited to only the European Union while food hubs and knowledge networks contribute to a system in which local food consumption and participation are important values. Waste, water and CO_2 systems contribute to a circular approach of these DownScaled flows and the production of seaweed helps to change the diet which is necessary to make a DownScaled system possible. The report is supported by a sustainability triangle resulting from the nested sustainability model, the R-ladder of sustainability and the X-curve for a sustainable transition. A toolkit of interventions is designed as a strategy to achieve the vision goals. With DownScale-Up a new circular economy with DownScaled international flows and a Scaled-Up regional food system, is created by 2050.

Keywords: **agri-food, circular economy, global flows, regional food system, participation**

02.
Introduction

Introduction

The huge growth of the population of the world will lead to the expected amount of more than 9 billion people by 2050. This population growth leads to an increased demand for resources, climate change, but also social inequality. This shows that the current economic model, which is linear, isn't sustainable (Metabolic, 2018). The developments of the increasing demand for raw materials, climate change and the dependence on other countries and also the connection of raw material consumption lead to the need to create a transition to a circular economy (Rijksoverheid, 2016).

'A circular economy is an economic system of closed loops in which raw materials, components and products lose their value as little as possible, renewable energy sources are used and system thinking is at the core. In this article, we will explain this definition in more detail.' (Ellen MacArthur Foundation, 2017).

Including all those villages and cities which are economically very powerful, the Port of Rotterdam and the innovation climate, South Holland is currently one of the most competitive regions in the world. Because of all the material flows that converge in this region, there are a lot of opportunities to strengthen our economy and improve the quality of life. In this way, South Holland will maintain its competitive position and remain future-proof (Provincie Zuid-Holland, 2019). The circular economy will be provided, by creating a transition in the following material flows: the construction and demolition sector, the agri-food sector and the mechanical sector.

With the project: 'DownScale-Up!', the focus is on the agri-food sector and its material flows. How is it possible that all these flows are going worldwide when this is not sustainable? Zooming in on South Holland, it becomes clear that 48% of the total land area is designated for the agri-food sector, of which a lot is exported (Metabolic, 2018). Besides that, we are also importing a lot of materials. All these global material flows are causing a lot of challenges, related to economic, social and environmental unsustainability. In the project, first, an analysis will be made of all these challenges of the current system of the agri-food import and export sector. The challenges, such as the current material flows, will be located to make them spatial visible on the map of South Holland.

The goal of this project is to redesign the region of South Holland circularly, wherein the focus is on the agri-food flows.

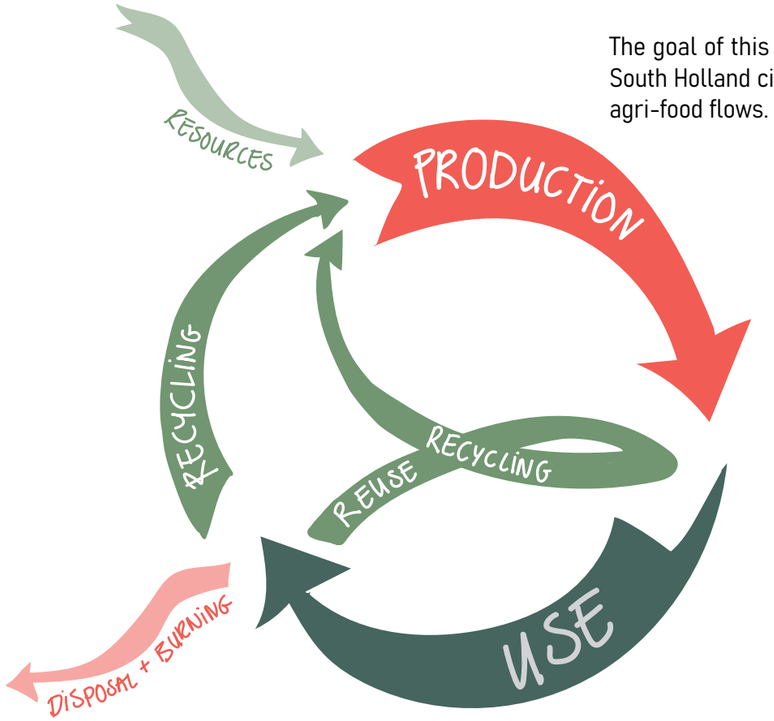


Fig. 1: Elements Circular Economy

Problem Statement

Because countries all over the world are economic dependent on each other, all these flows are going worldwide in a very inefficient way. For instance, a lot of products which are exported in South Holland, are imported as well.

These current agri-food flows involve a lot of sustainability challenges. Because of these huge distances, for instance, they are causing a lot of emissions. But because of the opportunity to import and export all these materials, people will adjust their preferences to these products. This leads in many cases to unsustainable diets. Besides that, all these import and export flows go along with unfair regulations. When we in South Holland are importing soy from Brazil, we are not aware of the (bad) working conditions in other parts of the world. The current power of supermarkets leads to the underpayment of those farmers in Brazil, because of the current unfair economic system.

So, if more sustainable agri-food flows would be created, these global flows, causing a lot of sustainability problems, should not be part of the system. 'Just going local' isn't that easy. Currently, there are many jobs in this agri-food import and export sector and import and export have a very high added value in BBP. All these challenges lead us to the following problem statement:

Dutch economic dependency

Global import & export flows are causing economic, social and environmental sustainability problems

"The Netherlands is too much economic dependent on its agri-food import and export flows and is thereby causing economic, social and environmental sustainability challenges."

Fig. 2: Problem Statement Framework

Research Questions

How is a circular (agri-food) system defined?

What does the current agri-food system look like and what are the strengths, weaknesses, opportunities and threats?

What could a regional agri-food system spatially look like?

What spatial interventions are necessary to create a regional agri-food system?

Which policies are necessary to create a regional agri-food system?

What does the current agri-food economy look like?

How does the economy change when switching from a global system to a regional system?

How can a feasible regional agri-food system be created?

"How can a regional circular agri-food system be created that is economic, environmentally and socially sustainable?"

What does the environment look like in the current global agri-food system?

What should the environment look like in the future regional agri-food system?

How can spatial justice be achieved?

How is sustainability defined?

What changes are needed to become sustainable?

What social change is needed to make it possible to switch from a global food system to a regional system?

What is the role of the current societal paradigms in the agri-food system?

What are the current relationships between different stakeholders in the agri-food sector?

What is the future relationship be between the different stakeholders in a regional system?

Theoretical Framework

As the problem statement and research questions indicate, this project is organized around the three pillars of sustainability: social, environmental and economic. Insights on the topics and sustainability pillars are needed for the development of the regional vision and strategy for a circular economy in the province of South Holland. The vision and strategy are realized through research and research by design, where theory forms the basis of the strategy and yields new insights.

Model 1: The Sustainability Model

The most well-known definition of sustainable development comes from the Brundtland Commission. They define it as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p. 41). With this definition, they introduce the three pillars of sustainability: economic growth, social equity and environmental protection (World Commission on Environment and Development, 1987). These pillars can be understood in three different models of sustainable development, the 3-legged stool, the 3-ring view and the nested sustainability model.

For this report, the nested sustainability model is used as an example model for sustainability (Figure 3). In the model economic growth falls into social equity, which falls then again in the environmental protection pillar. This model is understood as a more correct presentation of the relationship between the sustainability pillars, than the other models (Samaie et al., 2020). This is the case because the 3-ring view implicates that the economy pillar can exist without the environment. In the nested sustainability model, the pillars do not only stand next to each other, but they also interact with each other. It implicates that without the environment, the society and economy cannot exist. The model recognizes the value of the environment and gives the health of our planet the priority. The model explains with this that an integral approach is wishful for a sustainable future. This is also the main principle for this report.

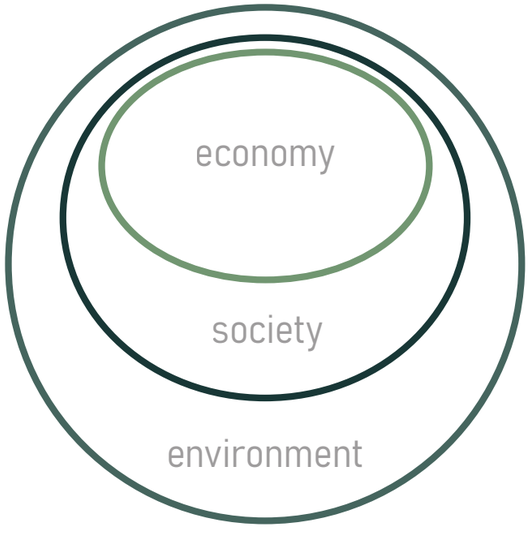


Fig. 3: Model of Sustainability (Source: Samaie et al., 2020)

The three pillars

To organize the steps that have to be taken for reaching sustainability, it can be helpful to define each pillar of sustainability separately.

There are several definitions for environmental sustainability. John Morelli from Rochester Institute of Technology, for instance, wrote a paper about this definition. His conclusion is to define environmental sustainability "as meeting the resource and services needs of current and future generations without compromising the health of the ecosystem that provide them" (Morello, 2011, p. 6). The Swiss Sustainability report defines environmental sustainability as the development where environments for plants, animals and humans are protected and attention is given to the use of natural resources for future generations (Swiss Federal Council, 2002). Components of this development include that there needs to be a reduction in the impact of environmental disasters, but also in the impact of toxic substances and emissions. The consumption of (non-)renewable resources needs to be as low as possible. And the areas which are naturally important need to be preserved, as well as biodiversity.

For economic sustainability, several definitions can be found. "Economic sustainability refers to practices that support long-term economic growth without negatively impacting social, environmental, and cultural aspects of the community" (University of Mary Washington, z.d.). Besides environmental sustainability, the Swiss Sustainable report also defined economic sustainability. In their explanation, they define it as a sustainable development if the capacity for economic development and prosperity will be preserved (Swiss Federal Council, 2002). It is explained by several components, such as that the employment and the level of income need to be maintained and increased where it is needed. Besides that, should it be possible to maintain and show some improvement in the productive capital, which is based on social and human capital. There should be economic competitiveness and capacity to improve innovation, so that market mechanisms are going to be the primary economic determinants. The last goal to receive economic sustainability according to the Swiss Sustainability report is that the public sector is not to be managed at the expense of future generations.

The last sustainability pillar is social sustainability. Also, this type of sustainability has several definitions. Again the Swiss Sustainability report gives us the explanation of sustainable development in the social solidarity if the development is promoting solidarity and well-being in human life and development as well (Swiss Federal Council, 2002). This again is explained by a few components to gain social sustainability. At first, the health and safety of humans need to be promoted and protected comprehensively and equal rights and legal security need to be guaranteed. Solidarity needs to be promoted, within and between generations and education which ensures individual development and identity should be provided. Lastly, culture should be promoted, while preserving and developing the resources and social values that form social capital.

Assessment Triangle

For this booklet, an adjusted version of the previously explained sustainability model is used to assess certain situations (Figure 4). In this adjusted model the three sustainability pillars are shown around a triangle to indicate the relationship between different challenges and between the challenges and the three pillars. The more an aspect is situated in the middle of the triangle, the more integral the aspect is for sustainability. The framework can in this way show if the totality of a plan is covering the whole surface and is thereby considered sustainable.

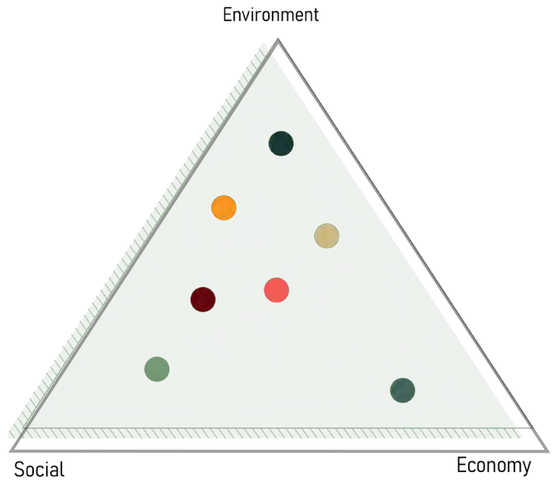


Fig. 4: Sustainability Triangle

Theoretical Framework

Model 2: The R-ladder of Sustainability
The R-ladder of sustainability (Figure 5) is another methodology framework that will be used in this report as a measure of circularity. The ladder is a conceptualized form of the circular economy and in general, the higher the strategy is on the ladder, the more circular the strategy is.

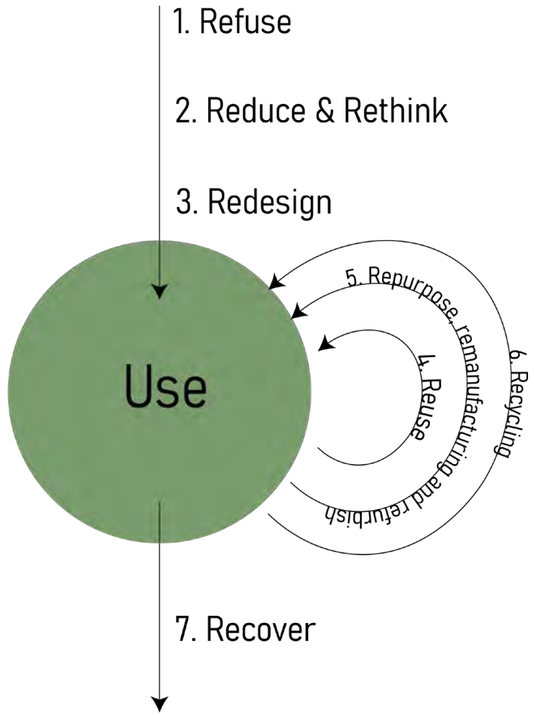


Fig. 5: The R-Ladder (Source: Metabolic, 2018)

Step one is Refuse. This can be done by regulations and rules that force people to use less material. Secondly on the ladder is Reduce and Rethink. In the agri-food sector, this is mainly about reducing emissions and the use of natural raw materials and raising awareness of the current diet. In the ladder, step three, Redesign, is mainly about the redesign of products (de Boer & van Ittersum, 2018). In this report step three is about the redesign of the system, the system of import and export flows, and regional and local flows. If it is not possible to Refuse or Reduce the loss of materials and substances, they must be used for Reuse, Remanufacture and Recycling. In this way, the highest possible value can be added back to the food system (Jurgilevich et al., 2016). The last step in the ladder is Recover, the least desired one. In the agri-food sector, for example, it concerns the recovery of phosphorus from manure and nutrients from wastewater (de Boer & van Ittersum, 2018). The model will frequently return during this report. It will be used as an assessment for circularity and opportunities for South Holland are considered with the help of this model.

Model 3: The X-curve
To consider the efficiency of the process during a design project, the X-curve can be used (Figure 6). This model shows the phasing of a transition and illustrates which steps of DownScaling and which steps of Scaling-Up should happen simultaneously. Besides this, the model shows how several steps could strengthen each other and could slow each other down. This gives insight into the process of transition. The model is based on different trends in society as demography, technology, economy and politics (P+, 2017). The model will return in the report when explaining the strategy. Together with the sustainability model and the R-ladder for sustainability, it forms the starting point and the methodologic support for the research.

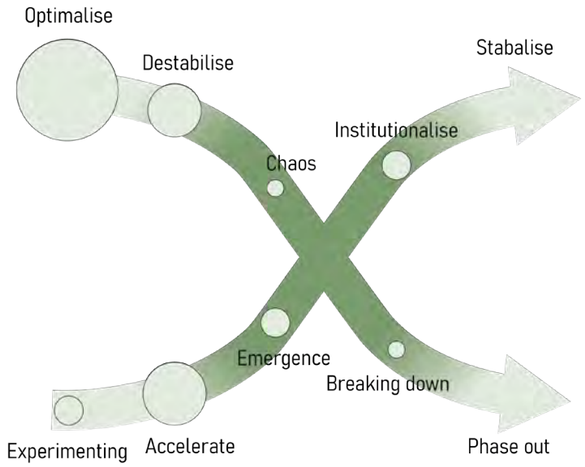


Fig. 6: The X-curve (Source: P+, 2017)

Methodology

Methodology used in this report
The model below (Figure 7) shows the tools used during the research in this report. It shows what methods and technical tools are used in the different chapters and elements of the research. The tools are alternately used during the report.

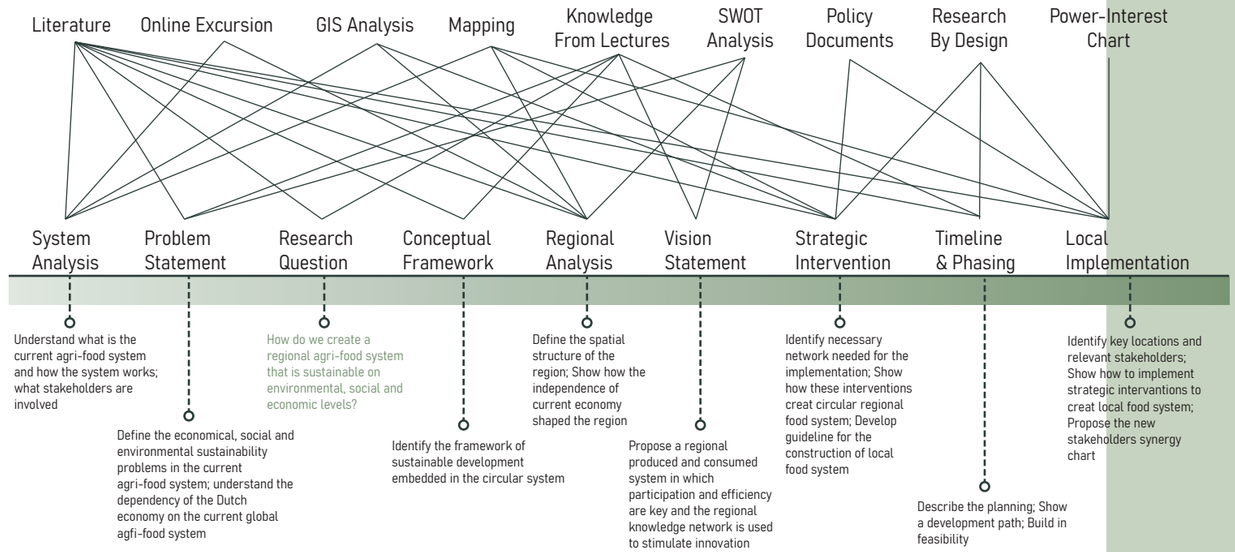


Fig. 7: Methodology Framework

Conceptual Framework

As explained in the theoretical framework, the sustainability model, the R-ladder of sustainability and the X-curve are the starting point for the research in this report. That is why the conceptual framework is built on these models.

DownScale-Up!
In the proposed vision and strategy of this report, DownScaling and Scaling-Up are the main principles. By 2050 global agri-food flows are limited to reduce the big transport flows and a new regional food system is Scaled-Up to create a new system in which participation and fair prices for farmers are important values. The down- and upscaling in this process have a strong relationship with the earlier explained X-curve, which shows the relation of phases during this process. In the conceptual framework, it can be seen that the DowScaling part of the concept mainly has associations with the first steps in the R-ladder and the Scaling-Up mostly with the last steps. The sustainability model returns in the middle of the framework where the different aspect of the vision and strategy are measured on the different pillars of sustainability.

DownScale
DownScaling is a big part of the conceptual framework. That is why in this chapter the concept of this downscaling will be explained.

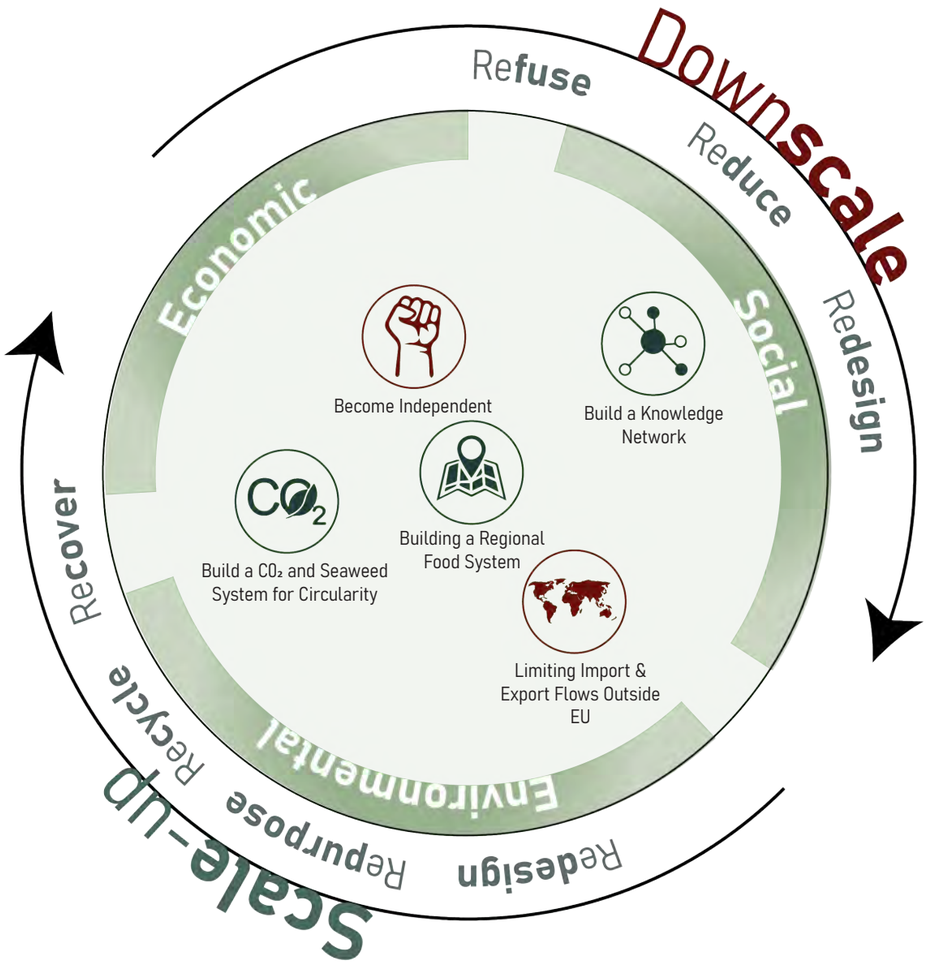


Fig. 8: Conceptual Framework

Limiting import & export from outside EU
The need to DownScale global agri-food flows come from sustainability problems that arise from the current situation of big amounts of international trade. These problems consider environmental damage, unfair trading agreements and emissions due to transport. But at the same time, there is also an advantage for trade since different climate conditions bring efficient growth of certain goods. That is why in this report global agri-food flows are DownScaled to only the European Union. In this way, the advantage of different climate conditions are optimised but big global problems are limited as well. The trading within the EU is optimised and controlled well.

Becoming independent
Another important concept in DownScaling is the independence of the Netherlands in the agri-food sector. Right now, the Netherlands is very dependent on the global agri-food flows since the Port of Rotterdam plays a big role in trade and many jobs arise from this function. By creating a new DownScaled economy, the independence of the Netherlands can grow.

Scale-Up
The other part of the conceptual framework is filled with Scaling-Up. This is focused on creating a regional food system with food hubs, living labs, a knowledge network and new water, waste and CO_2 networks. These concepts are explained below.

Regional food system
By 2050 a regional food system is created. This food system is defined as a system in which consumers eat local food and participate in the agri-food system. An important role in this is played by food hubs. These food hubs will have both a logistic function and a social function. For logistics, it will be a place where producers can leave their food or sell it directly and where consumers can come to buy the food. Also, the food hubs will bring the food further into cities. The social functions are for citizens, focusing on social interaction and education. The food hubs will be a place where people come together and learn about circular food consumption based on the R-ladder of sustainability. For farmers it will be a place where they can get technical assistance, can learn and can get in contact with consumers. To build this regional food system, living labs play an important role. These labs are places where food hubs can be tried out in small populations.

Knowledge network
Another important concept of Scaling-Up is creating a knowledge network. By building this network it becomes easy to share knowledge and learn from each other. This stimulates innovation which again contributes to a circular economy.

Water, waste & CO_2 networks
The last concept which has to do with Scaling-Up is creating new water, waste and CO_2 networks. Here, upscaling is not meant as making the system bigger, but as upscaling the efficiency and the knowledge sharing. The food hubs also play an important role, to in the end contribute to a circular economy.

Conceptual Framework

This framework shows the process of the report and the order in which decisions are made. It shows the role of the theoretical and conceptual framework and how these contribute to the vision statement.

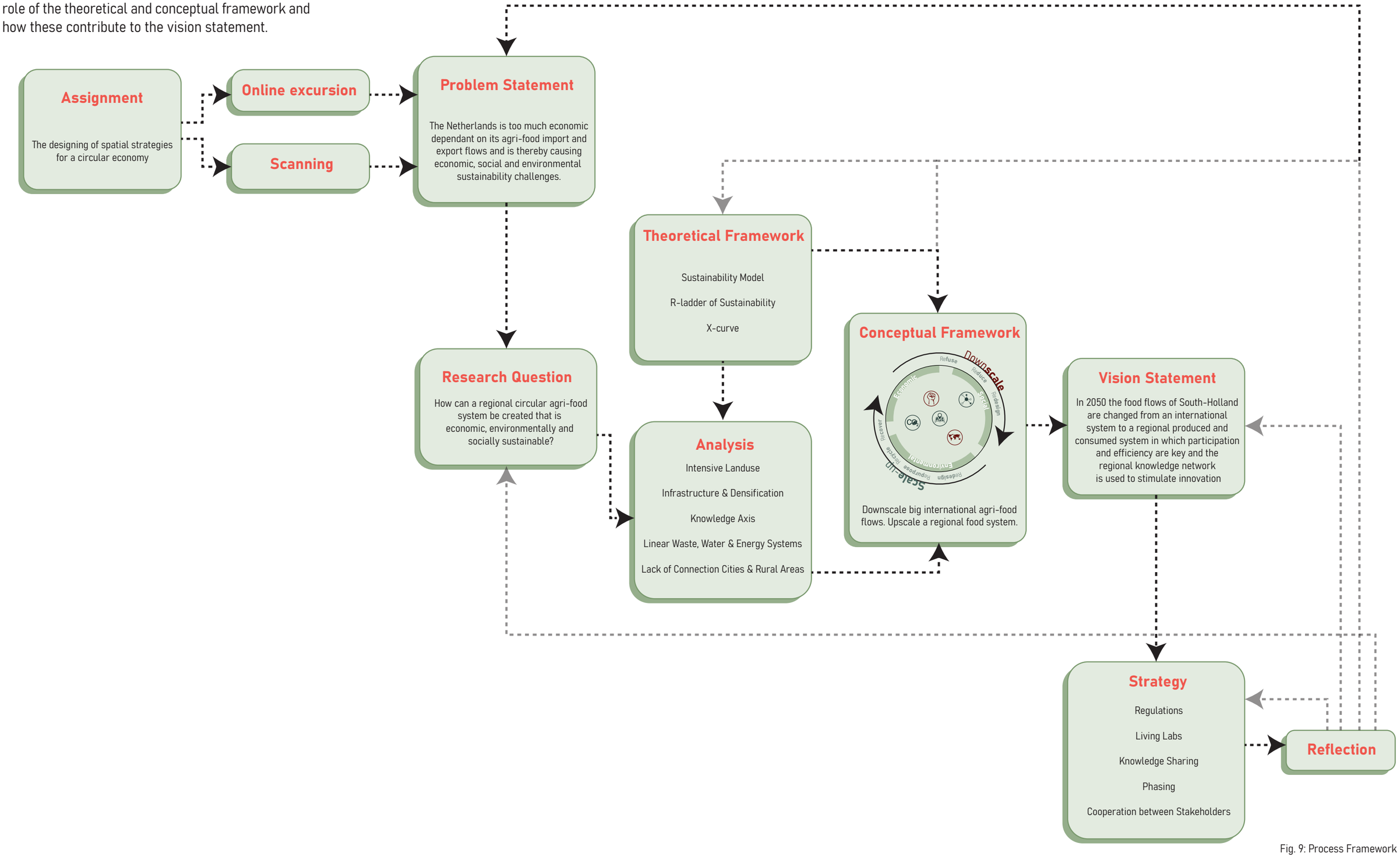
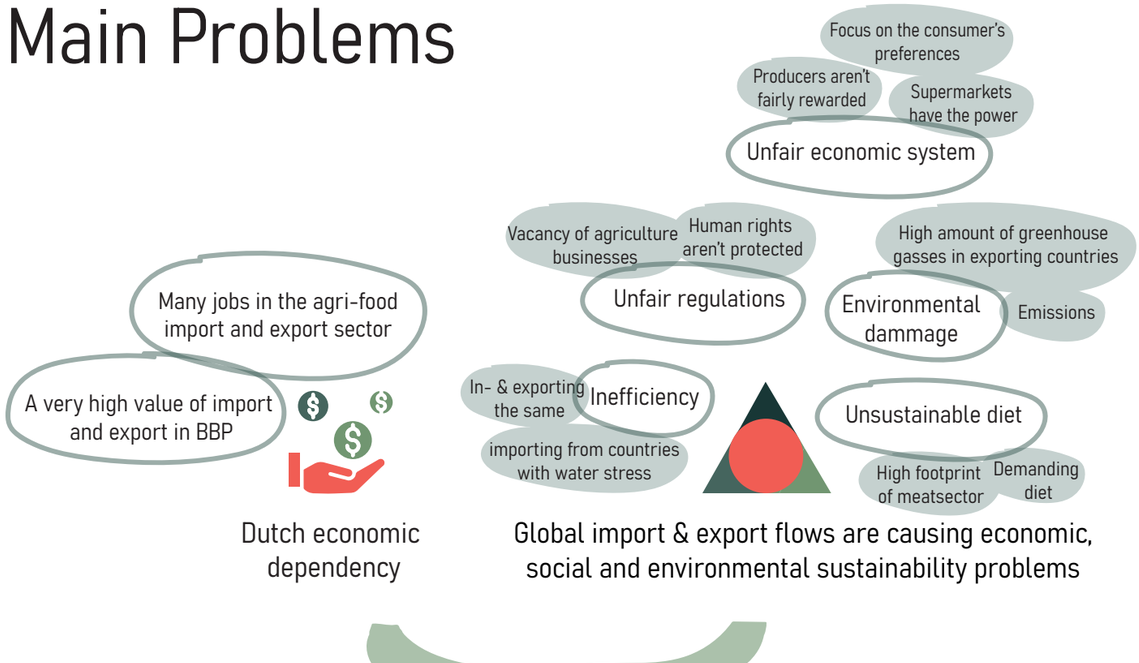


Fig. 9: Process Framework

03.
Problem Statement

Main Problems



"The Netherlands is too much economic dependent on its agri-food import and export flows and is thereby causing economic, social and environmental sustainability challenges."

Fig. 10: Problem Statement Framework

Because of our international trade position, South Holland is dependent on its agri-food import and export sector. Because of this dependency, we as a country are 'stuck' in the global agri-food system, because of all these jobs that are gained from this import and export system for instance. This dependency leads to the fact that a lot of economic, social and environmental sustainability problems are caused.

This leads to a problem statement that can be separated into two subproblems: the Dutch economic dependency of its agri-food import and export flows and the economic, social and environmental sustainability problems that are caused by these import and export flows (Figure 10).

In this chapter, we will dive into the evidence that is the proof of the problems of the current agri-food import and export system. Therefore, a distinction between several subjects has been made including the following: the jobs which are related to the Dutch agri-food import and export flows, the value in BBP of the import and export, the inefficiency of the current system, the unsustainable diet that is caused by the global flows, the economic system we are in right now, the unfair regulations where mostly the producers need to deal with the consequences and last but not least, the environmental damage that is caused by all these global flows.

To get a better grip on the agri-food flows, the current flows will first be explained.

Current Agri-Food Flows

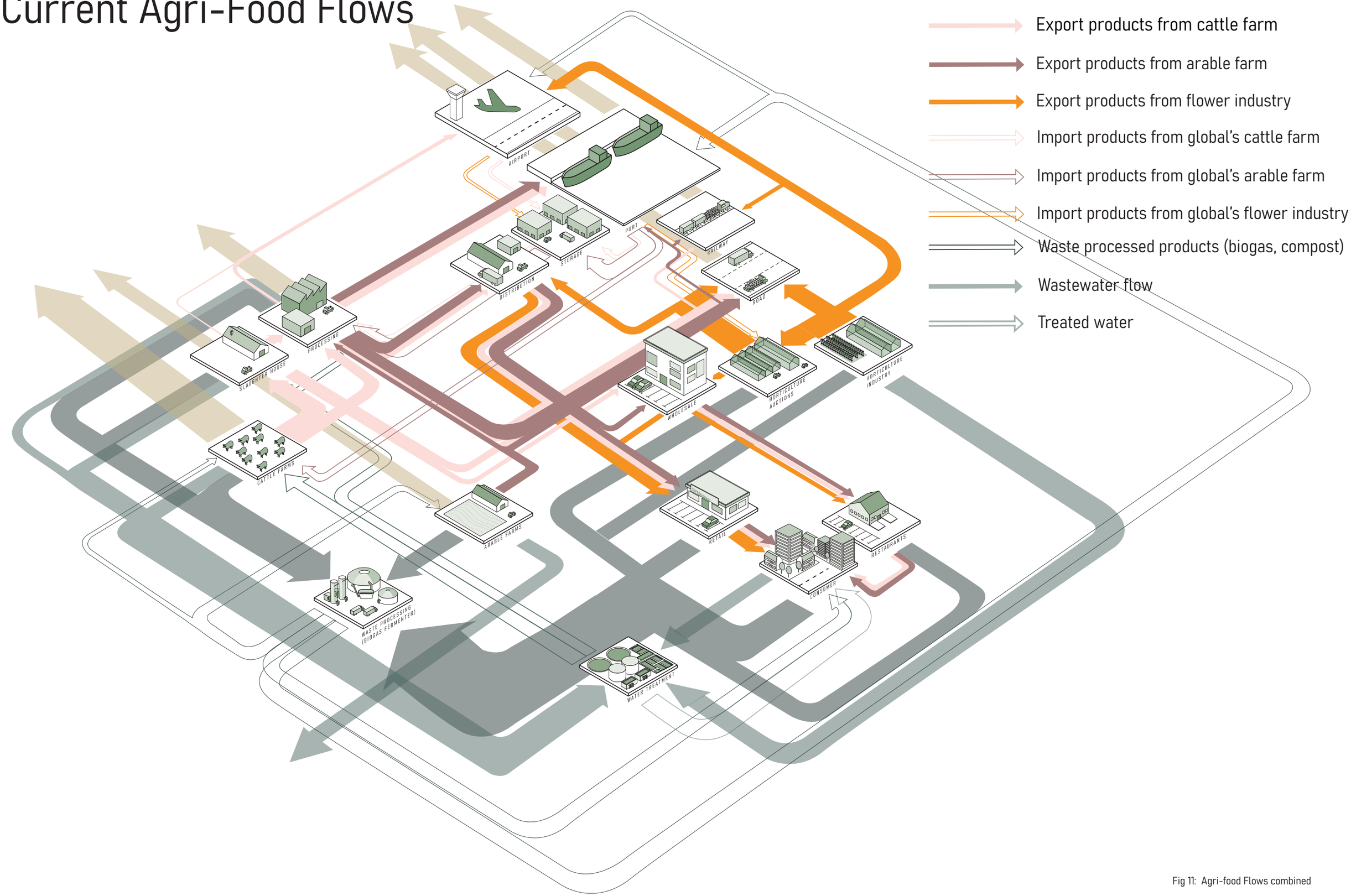


Fig 11: Agri-food Flows combined

Current Agri-Food Flows Explained

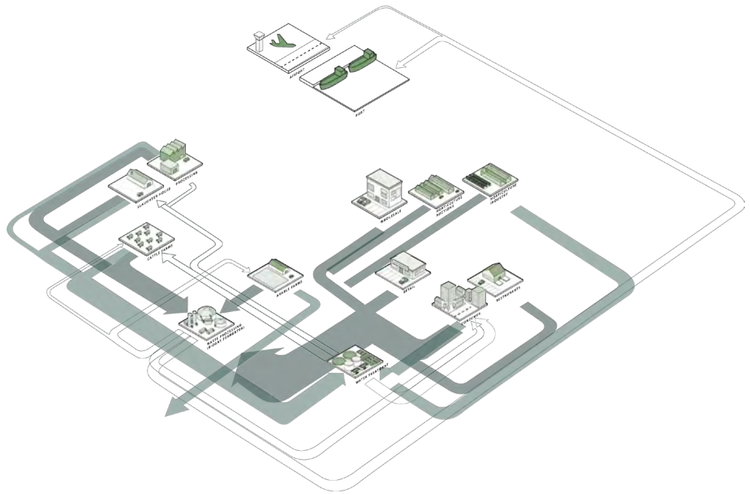


Fig. 12: Waste Flows

Waste flows
The waste flows are going through several processes. In the current situation, the agri-food waste is picked up by the garbage truck, after which it will go to the waste processing. At this location, biogas will be extracted from the waste. After this step, there will be made compost out of the waste. The waste that is not valuable will be burnt. The compost will be sold all over the country and even be exported to other countries. The question is if this re-use is that efficient in the current situation.

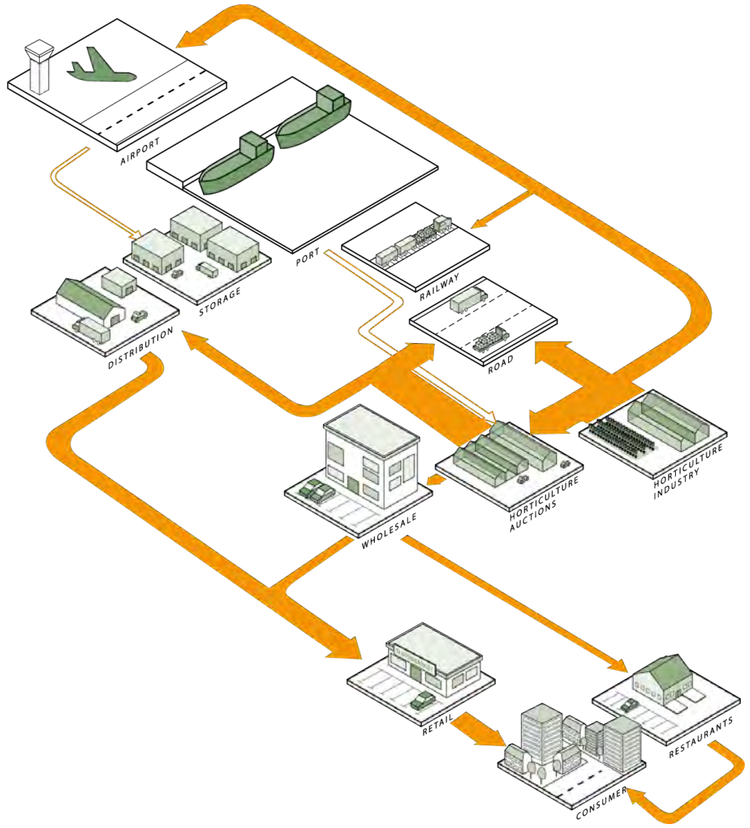


Fig. 13: Horticulture Flows

Greenhouse industry
The greenhouse industry exists of the industry of vegetables, fruits and horticulture. Looking at the horticulture industry, you can see that a lot of steps are being made. The (imported) horticulture products will go to auctions of wholesales, or go through auctions to wholesales, after which it will go to the retailers, after which the consumers can buy these flowers at those retailers.

At the same time, we're exporting a lot of horticulture products, even while we're also importing them.

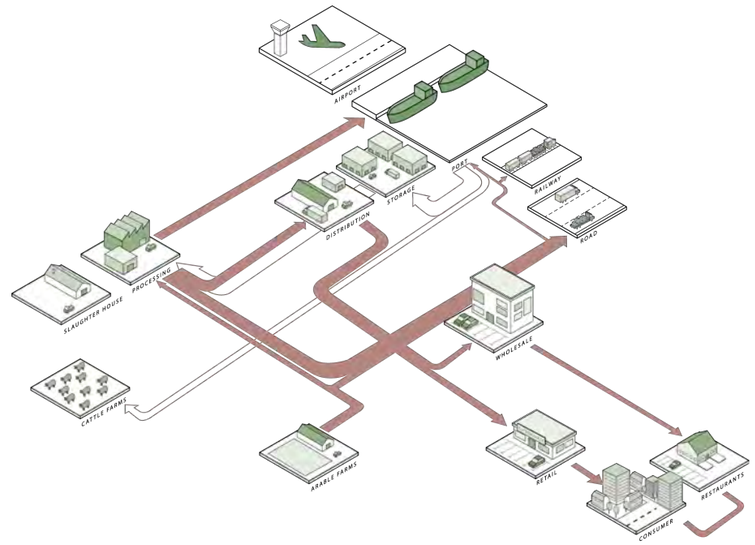


Fig. 14: Arable Farm Flows

Arable farm industry
Then there is the arable farm industry. Also in this sector, you can see that we're importing as well as exporting arable farm products. You can also see that there are a lot of steps being made at different locations. Such as storage, processing, wholesale, distribution, retail, et cetera.

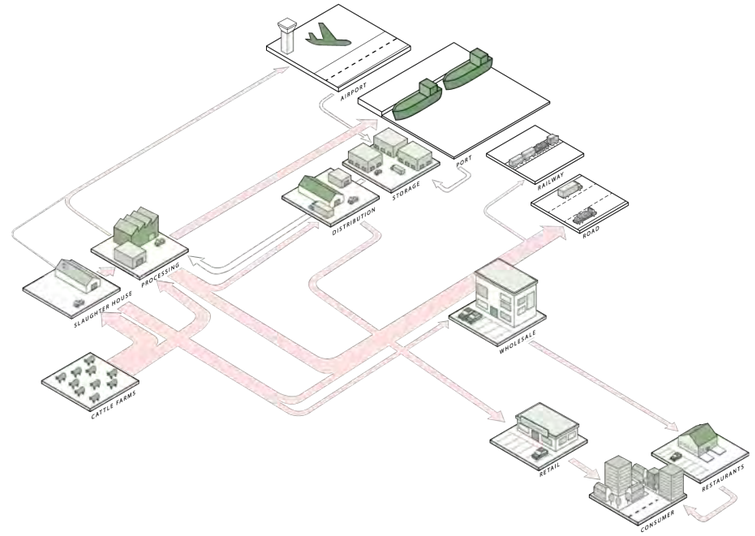
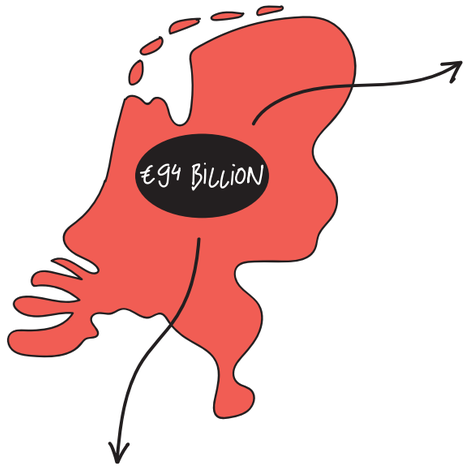


Fig 15: Cattle Farm Flows

Cattle farm industry
Also, the cattle industry has several steps which the materials have to make. For instance, it is striking that the cattle farms, slaughterhouses and processing are in three different locations. This leads to a lot of transportation.

Also in this industry, you can see that we're importing cattle as well as we're exporting them.

Dutch Economic Dependency



Top 3 exporting countries

1 Germany

2 Belgium

3 UK

1ST Largest exporter agri-food of the EU

2ND Largest exporter agri-food of the world

Top 5 exported products

9,4 % Materials & technology

9,3% Floriculture

8,3% Meat

7,7% Dairy & eggs

7% Vegetables

Fig. 16: Record export agri-food 2016 (Source: CBS (2016), edited)

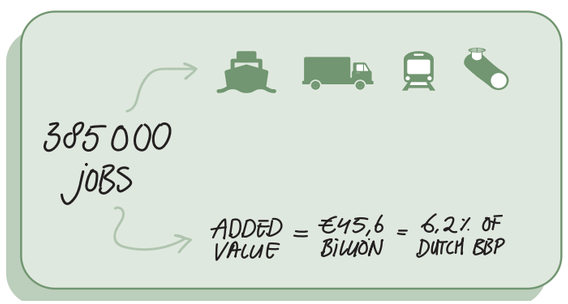


Fig. 17: Added value Port of Rotterdam (Source: Port of Rotterdam (n.d.), edited)

The Dutch economic dependency exists of the many jobs which are in the agri-food import and export sector, but also of the high value in BBP that is added, caused by all these international food flows.

As you can see (Figure 16), was the Netherlands in 2016 the 1st largest exporter of agri-food in the EU and de 2nd largest exporter of agri-food in the world. The materials we are exporting the most are materials and technology then the floriculture, meat, dairy and eggs and vegetables. The fact that the Netherlands is one of the largest exporters of agri-food materials might be a good thing when you think from an economic perspective. But this current trading system leads to gigantic agri-food flows with its (negative) side effects, which also does not help with the awareness of these flows at the consumers. Because of this economic dependency, it isn't that easy at all to 'escape' from this unsustainable global system.

As you can see (Figure 17) is the good trading position of the Netherlands leading to the fact that the direct and indirect added value of the Port of Rotterdam is 45.6 billion euros. This includes 6.2% of the Dutch BBP. These imports and exports not only provide a lot of added value to our BBP, but they also provide a lot of jobs. In the Port of Rotterdam, there is a total amount of 385.000 jobs in the import and export sector.

Inefficiency

The next problem which is caused by these import and export flows of the agri-food sector is a lot of inefficiencies. At first, a lot of products South Holland is producing and exporting, we are also importing. Think about the tomatoes which we are producing in the Westland, but at the same time importing from Spain. This leads to a lot of unnecessary emissions to transport these products to their country of destination.

There is an overall inefficiency of the current agri-food flows. A lot of steps are being made at different companies, such as producing, processing, storage, and retailing. The fact that all these processing steps take place at different locations, lead to a lot of transportations and work that could be saved when some or even all of these steps would be merged by producing and selling at the same location.

The Netherlands is a country where a lot of products are being processed, after which they will be exported again. It is striking that more than three-quarters of imported cocoa beans, soybeans and palm oil are processed or consumed in the Netherlands and less than a quarter go directly to other countries, particularly the European hinterland (CBS, 2019). This also leads to a lot of unnecessary emissions caused by these transportations, which would not be there if a product would be produced and processed in the same country, or even the same place.

The next argument for the import and exportation of agri-food products being inefficient is that many products are being produced in countries that have to deal with water stress (Figure 19) (H20 Waternetwerk, 2017). When cultivation products that need a lot of water, soy, for instance, this water can't be used for other purposes. Besides that, when the country cannot produce anymore because of this lack of water, the country is missing out on a large part of its income.

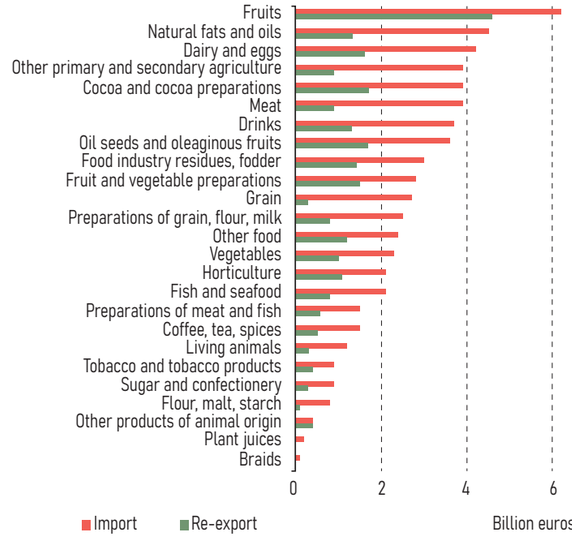


Fig. 18: Imported & re-exported products (Source: Bergevoet R., et. al. (2019), edited)

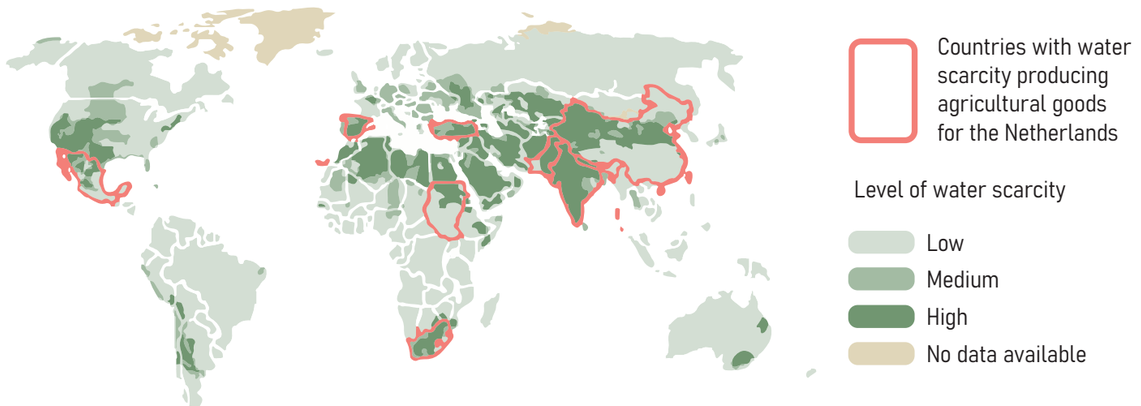


Fig. 19: Water scarcity combined with exporting countries (Source: Provincie Zuid-Holland (2019), edited)

Unfair Regulations

The next problem is the unfair regulations that are involved with all the global flows of the current agri-food system. In this current system, we are importing tomatoes from the countries Italy and Spain for instance. But because of this distance, we don't have any visibility on the working conditions over there. In 2016, there was an analysis published which gave some statements about those circumstances. The labourers would be exploited and underpaid (MO, 2016).

Besides this, Scaling-Up is also a common event of the current agriculture system. This phenomenon is among others caused by several trading agreements. These trading agreements can have a lot of advantages, such as reducing or even eliminating trade rates. But it also happens that certain certificates are no longer required for trade to take place (RVO, 2020). For instance, there is a trade agreement between Mercosur and the EU (Figure 20). This is an agreement between Argentina, Brazil, Paraguay and Uruguay and the EU, which leads to the result of an increase of the imported products from Mercosur countries to the EU. Farmers in several countries of the EU have been demonstrating because they need to deal with a new (unfair) competition model. The products that we are importing from South America have been produced among other circumstances than in the EU, because of the regulations being different in the different parts of the world. In this way, the imported products from South America can be sold for a lower price than the products that we are producing by ourselves in the EU (Carrico, C., et al, 2020). This leads to an unfair position for local circular farmers.

Then, there is also the CETA trading agreement (Figure 21), between Canada and the EU. On the one hand, CETA benefits workers and consumers: prices go down, companies gain new and better access to a market of 35 million people and consumers have more choice (Rijksoverheid, z.d.). Also, this trading agreement leads to more competition, which leads to a better trading position for the larger companies. Small businesses are left out in this way.

Because the producers need to produce more and more, caused by the growing global market, they need to scale-up their companies. In South Holland, this phenomenon already led to the fact that a lot of farmers went bankrupt (Gies et. al., 2016). They needed to scale-up, but the governance did not provide them with the money to actually realise this. The farmers also did not have the money for upscaling, so they needed to close their farms. Because of, among others this reason, there is already a lot of empty farmland in South Holland.

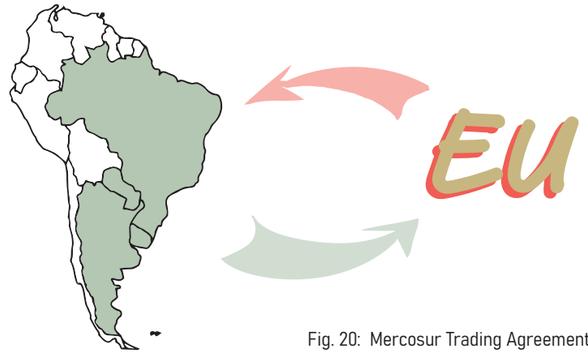


Fig. 20: Mercosur Trading Agreement

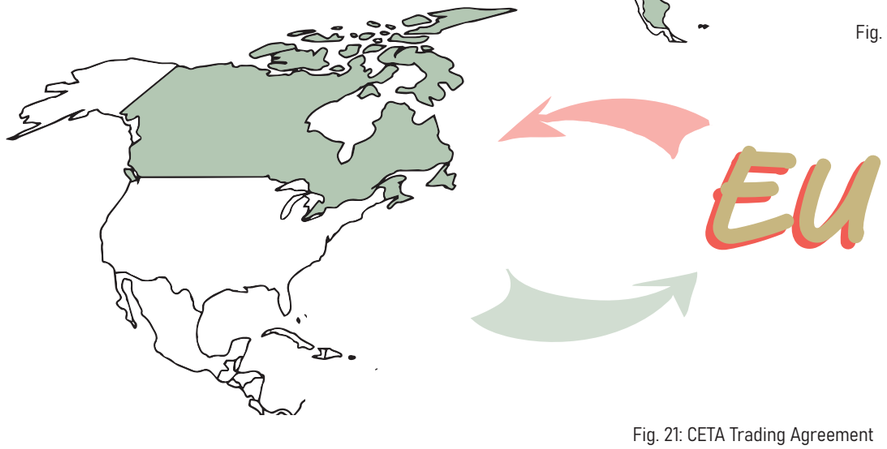


Fig. 21: CETA Trading Agreement

Unfair Economic System

The current economic system is concentrated at the retailers (Figures 22, 23 and 24). This concludes that the retailers do have the most power in this whole agri-food system. Farmers, on the other hand, have little power and are not fairly rewarded for their products. The farmers all over the world are producing for the supermarkets in among others South Holland, in working conditions we are not even aware of, just like mentioned before in the 'unfair regulations' part.

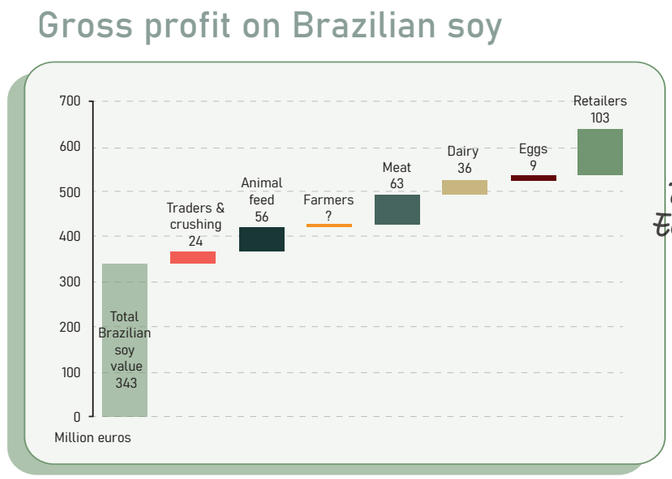


Fig. 22: Gross profit on Brazilian soy - top supply chain actors (Source: Kuepper & Rijk (2020), edited)

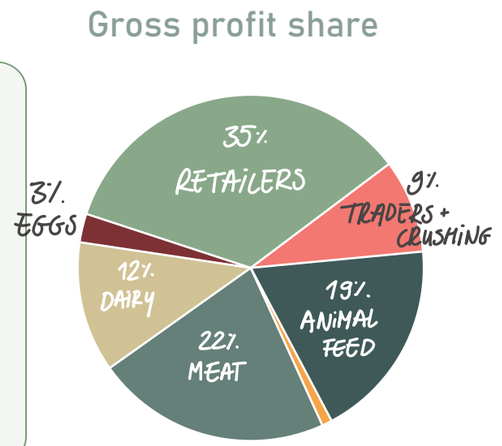


Fig. 23: Share in gross profit pool, edited (Source: Kuepper & Rijk (2018), edited)

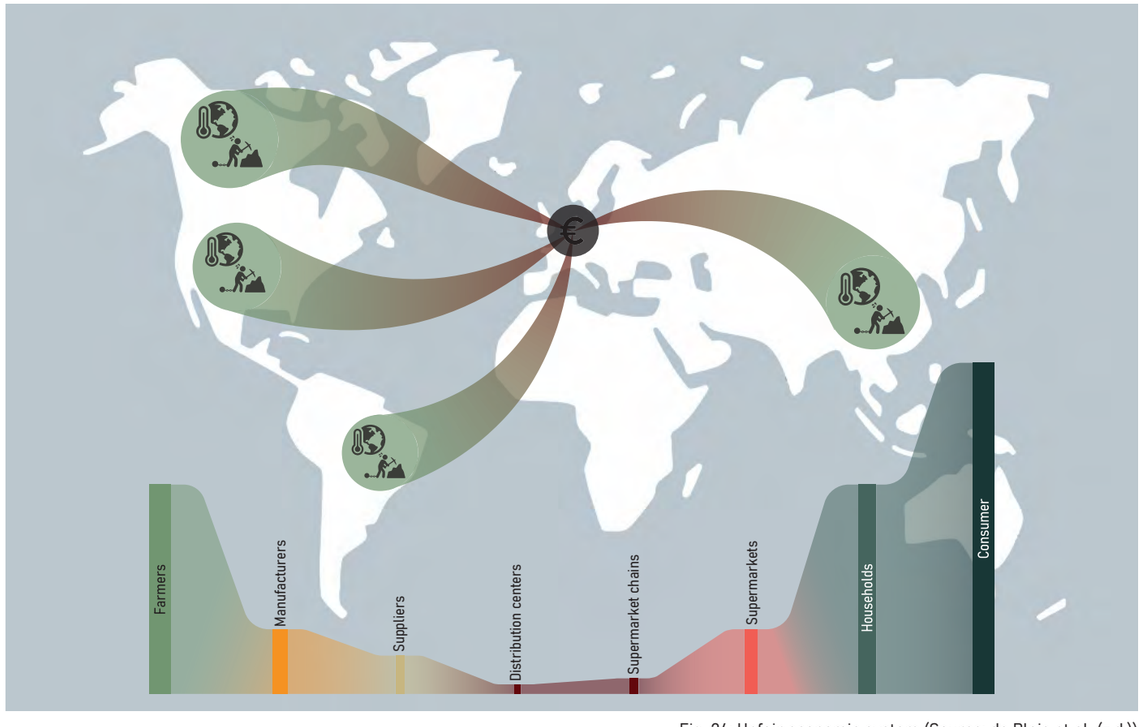


Fig. 24: Unfair economic system (Source: de Blois et al. (z.d.))

Environmental Damage

At first, all the import and export flows lead to a lot of emissions (Figure 26). The materials are being transported by trucks, train, containerships or even planes, which are quite bad for the environment. All those emissions could be reduced when we would make use of the products we are actually producing by ourselves. For example, the tomatoes. Right now there are many monocultures because of the need for this large production for the world market. This is also very bad for the environment (Schuurbiers, M., 2018).

Next to that, the Netherlands have several trading agreements with countries, such as Brazil for their soy production. The fact that all the people in Europe want soy, leads to the fact Brazil has to deal with environmental damage. Many forests and other natural vegetation will be converted to agricultural land. The huge amount of soy cultivation (Figure 25) leads to a lot of greenhouse gases that are emitted. This is due to two things. Forest contains much more biomass than agricultural land because trees are absorbing much more CO_2 than soy plants, and plant material in the soil comes into contact with the oxygen when the soil is churned up and then starts to rot: this releases CO_2. Globally, this process accounts for about 10% of all greenhouse gas emissions that we humans emit (Milieu Centraal, 2020).

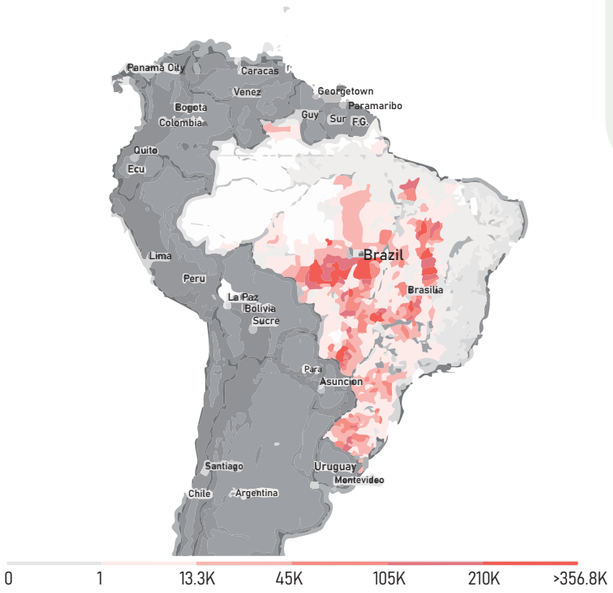


Fig. 25: Soy plantages in Brazil (Source: GRO (2021), edited)

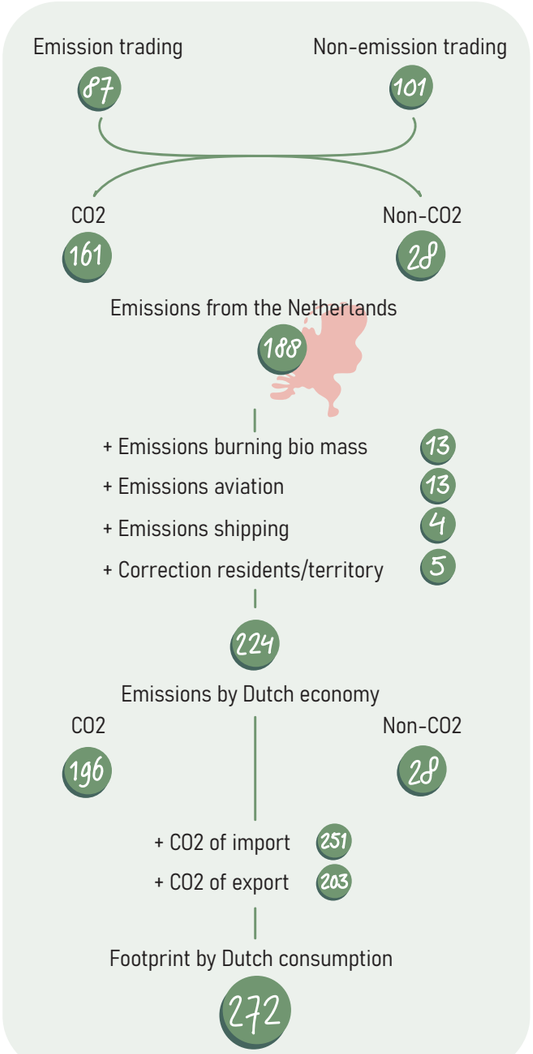


Fig. 26: Greenhouse gas emissions according to different definitions (Source: CBS (2018) , edited)

Paradigm Current Diet

The reason that the current food system needs to be scaled up all the time, is not that strange. We are importing products for ages now, so we got used to this luxury. A growing world population leads to an increasing demand, which will lead to increasing export and import flows. This increase will again lead to more sustainability problems on an economic, social and environmental level.

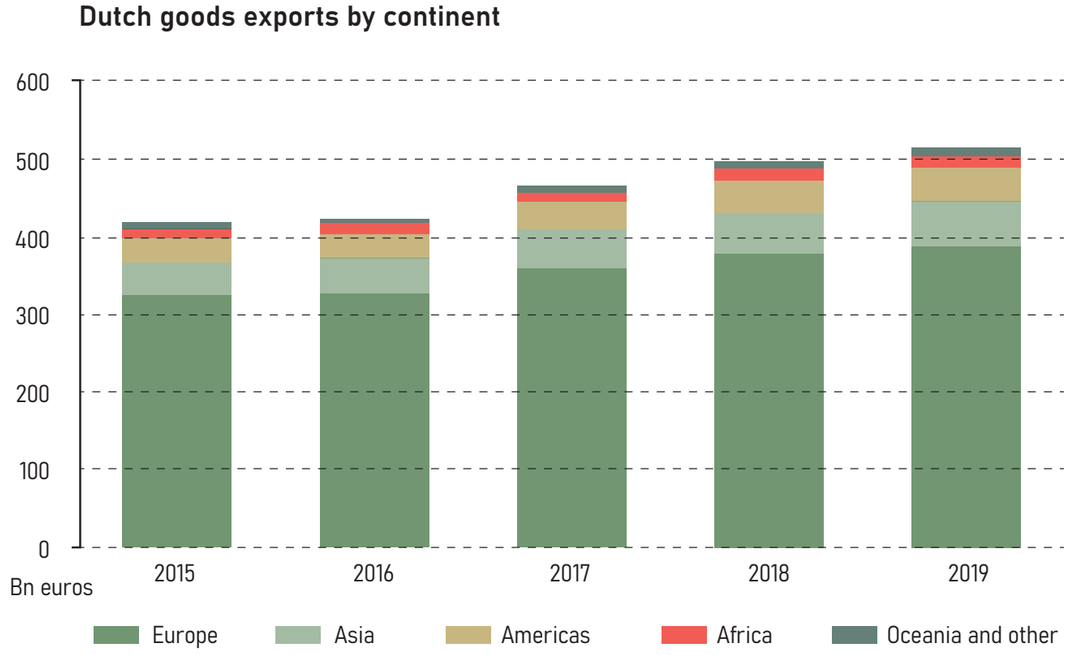


Fig. 27: Growing world market (Source: CBS (2019), edited)

Conclusion

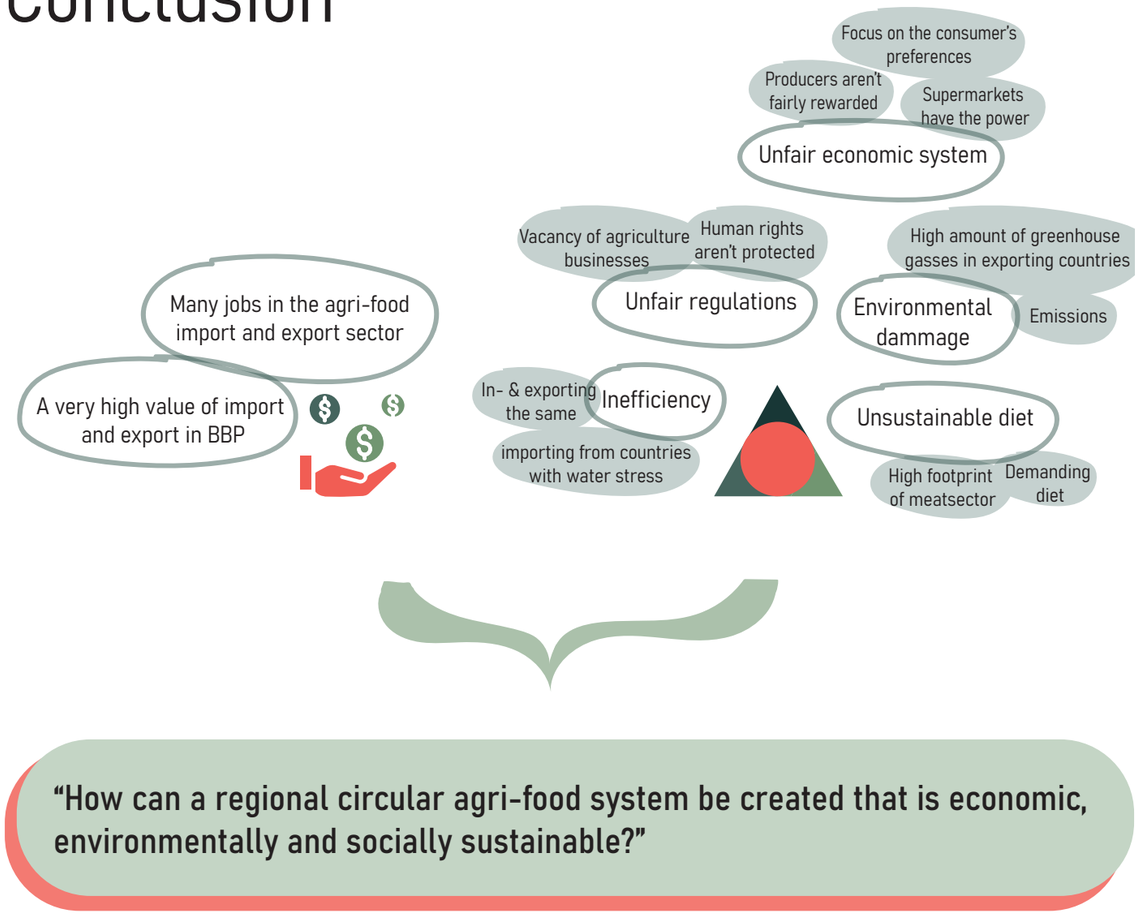


Fig. 28: Research Question Framework

It can be concluded that the current agri-food system, existing of all these global import and export flows, is not sustainable at all on environmental, social and economic level (Figure 28). Something needs to change drastically if a circular economy in 2050 is desired.

All these problems of the current system led to the research question: 'How do we create a regional and circular agri-food system that is economic, environmentally and socially sustainable?'.

In the next phase of the project, the current structures of South Holland will be analyzed, so a vision for the future situation can be made.

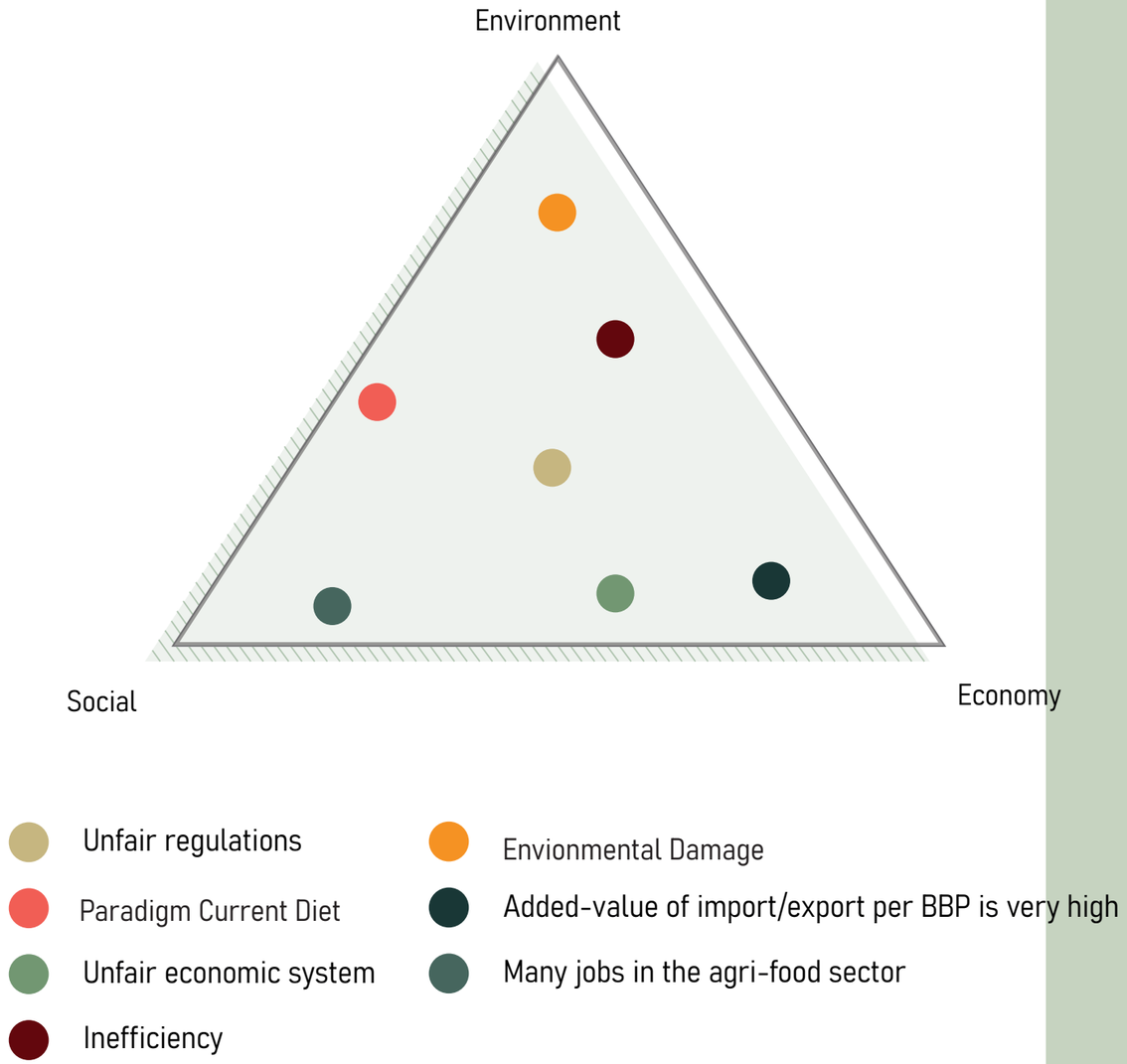


Fig. 29: Conceptual Framework including problem statement

04.
Analysis

Analysis South Holland

In this chapter, the current situation and structure of South Holland related to the agri-food sector is shown and explained. The chapter starts with an explanation of the land use in the province. This shows that a lot of land is used by either the agri-food sector or as population cores. This brings other nature like dunes, forests and open grassland in danger. Secondly, the infrastructure and its social trends are explained. This shows that South Holland contains an extensive infrastructure which makes the region very accessible. On the other hand, research also tells that the use of all transport possibilities is increasing, which brings challenges to the region. Other challenges are population growth and the need for more houses. This chapter shows the already existing plans for densification and their accessibility. It also shows the small scale initiatives aiming for a local food system which are already existing. These initiatives are facing financial and spatial challenges in which there is an opportunity for the province to help and invest. Also, the knowledge network and the plans for a knowledge axis shows these opportunities for innovation and new systems.

The chapter continues with an explanation of the current water and waste system in the province of South Holland. These systems are spatially very spread out which leads to big distances. Also, the system is very linear. This shows big challenges in moving towards a circular economy. When analysing the region it also appears that there is barely a connection between cities and the countryside. An analysis of the Rotterdam Port shows that agri-food takes a big part in the economy. A stakeholder analysis shows all the actors of the agri-food sector and their interests in a circular economy.

The chapter ends with a SWOT analysis and maps which show the problems and opportunities of the region of South Holland. These maps are a starting point for the vision in the next chapter.

Land Use

Fig. 30: Arable farming in South Holland (Source: P-dok, QGIS (n.d.)

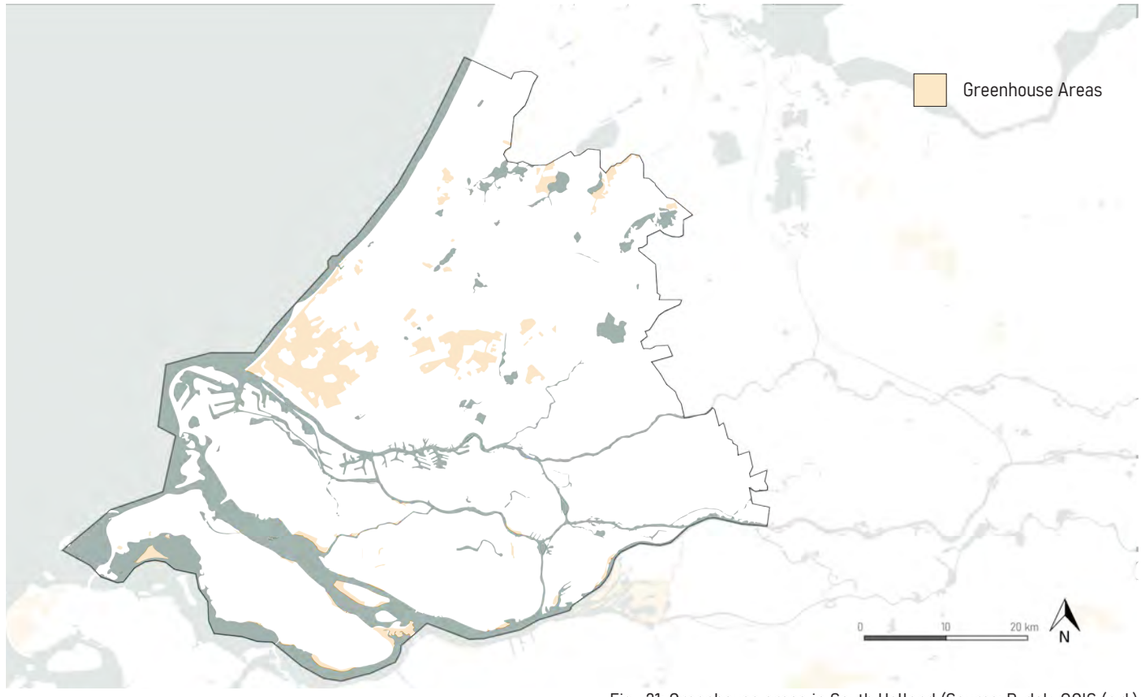


Fig. 31: Greenhouse areas in South Holland (Source: P-dok, QGIS (n.d.)

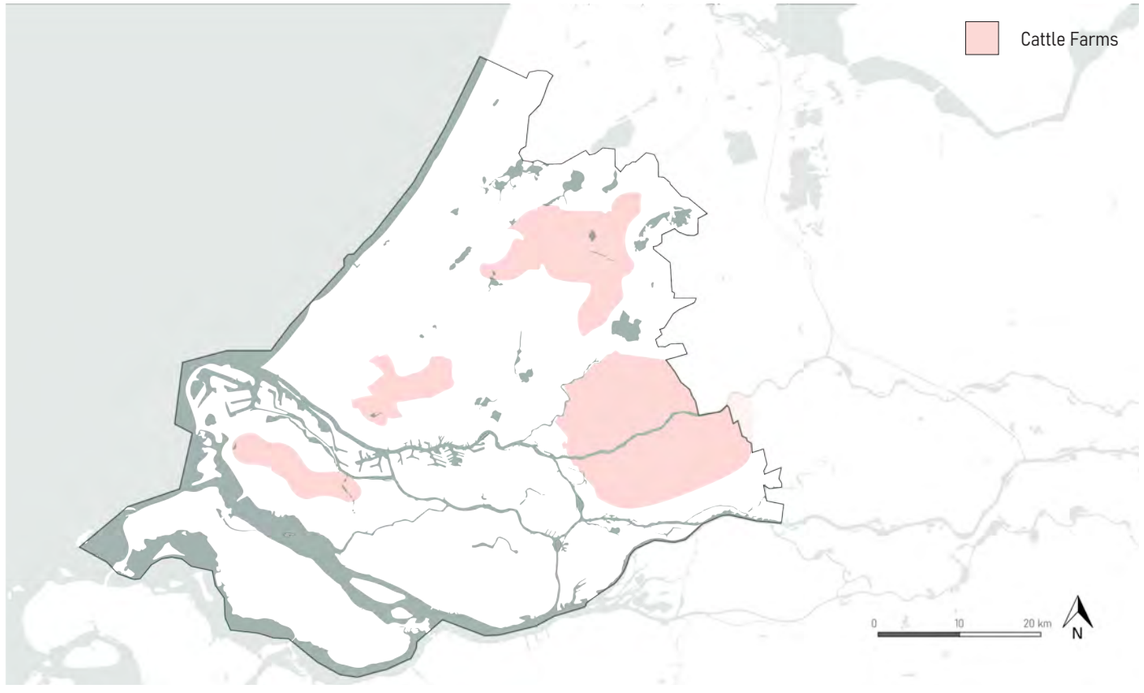
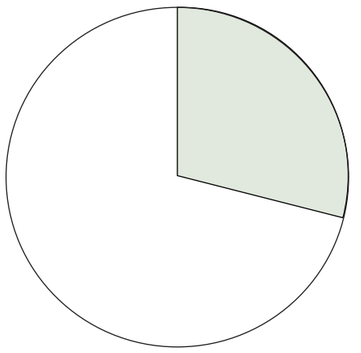
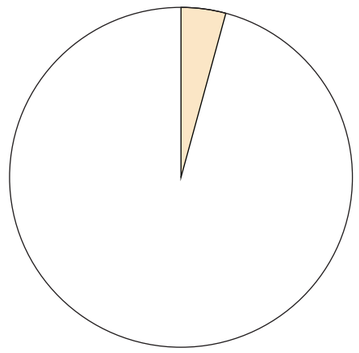


Fig. 32: Cattle farming in South Holland (Source: P-dok, QGIS (n.d.)

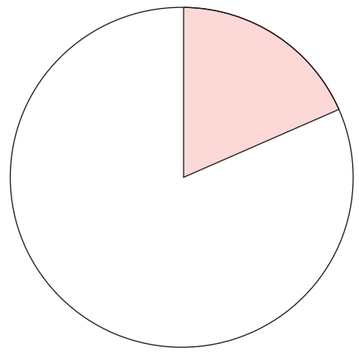
The land in South Holland is for a big part occupied by the agri-food sector. With 28,3%, the agricultural sector takes the most land of all. After that, the cattle farm sector also takes in a lot of space. The food produced in greenhouses takes only 4% of the land. The whole agri-food sector takes 50,3% of the land in South Holland.



28,3% of the land use



4% of the land use



18% of the land use

Population Cores & Infrastructure

Fig. 33: Popultation cores and infrastructure South Holland (Source: P-dok & LISA Data, QGIS (n.d.)

The map on the left shows the population cores in South Holland. These built surfaces have been growing rapidly over the last few decades and take nowadays 25% of the land use in the province. Together with the 50,3% land use of the agrifood sector, more than 75% of the land is in intensive use. The rest of the space, 25%, are for example beaches, forests and open landscapes. With the growing population and housing need, it is important to not danger the space occupied by nature because it can lead to scarcity of nature. This could be a threat to the region.

The map also shows the infrastructure of South Holland. The extensive car network makes it possible to get anywhere in the region within a suitable travel distance. This is important since far out the most travels happen by car. At the same time, there is a threat for the car network in the region since car use is still growing and the roads are already very busy. Encouraging public transport use could be a sustainable solution.

The big train network makes it possible to travel easily between cities and population cores. This together makes the region easily accessible. The good connection between cities brings great opportunities for the region in for example knowledge sharing. On the other hand, the public transport connections between the agricultural land and the population cores are not very good yet. This makes that there is barely a physical connection between the countryside and the city. This is a threat for the region since trends show that the use of public transport increases.

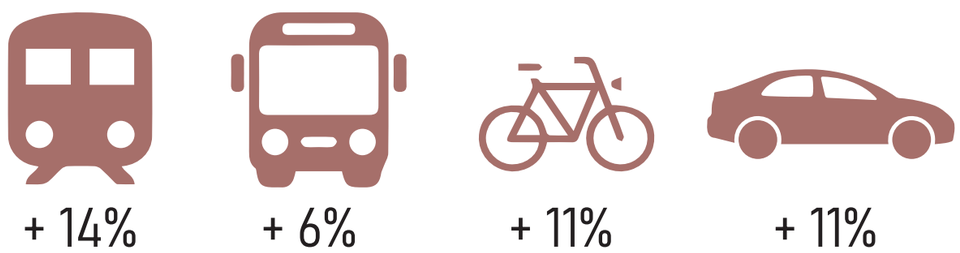


Fig. 34: Trend increase infrastructural use over the last 10 years (Source: COL (2020) & Fietsenbond (2016))

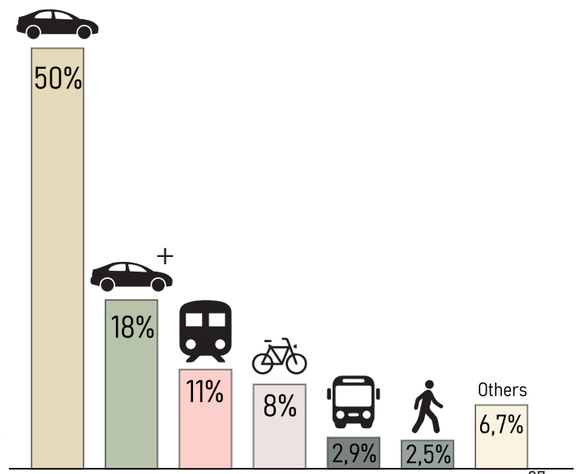
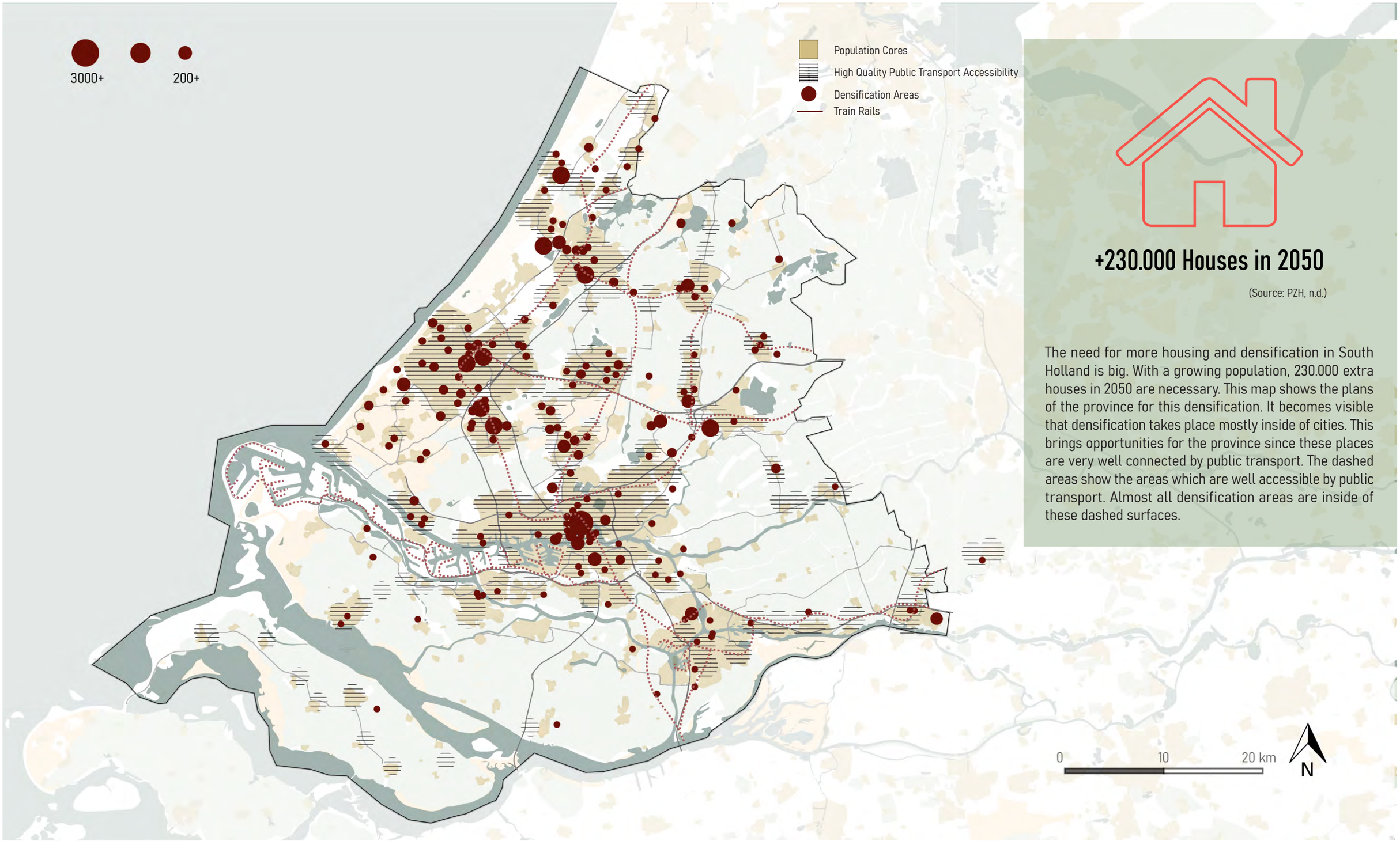


Fig. 35: Infrastructural use in the Netherlands (Source: CBS (n.d.))

Densification Areas



+230.000 Houses in 2050

(Source: PZH, n.d.)

The need for more housing and densification in South Holland is big. With a growing population, 230.000 extra houses in 2050 are necessary. This map shows the plans of the province for this densification. It becomes visible that densification takes place mostly inside of cities. This brings opportunities for the province since these places are very well connected by public transport. The dashed areas show the areas which are well accessible by public transport. Almost all densification areas are inside of these dashed surfaces.

Fig. 36: Densification in South Holland (Source: PZH (2020)

Small Scale Initiatives

Fig. 37: Typologies of small scale initiatives

Fig. 38: Small scale initiatives in South Holland (Source: Voedsel Anders (2021)

As the problem statement showed, the global import and export flows cause many sustainability problems. In South Holland, entrepreneurs are aware of this problem. These people started small-scale initiatives to contribute to a local food system. These can roughly be divided into 4 types. These types are initiatives that focus on education and research, that contribute to a connection between farmers and consumers, that focus on local own production and that make direct sell at farmers possible. These initiatives are the first step towards a local food system. On the map can be seen that the initiatives are well connected through the train network, which is an opportunity for further growth by learning.

Sadly, the initiatives still experience troubles in the feasibility and realization. The biggest problem they experience is financial but also a lack of space, participants, appreciation and knowledge are problems that often occur. Here is an opportunity for the government to support these initiatives more to move towards a local food system.

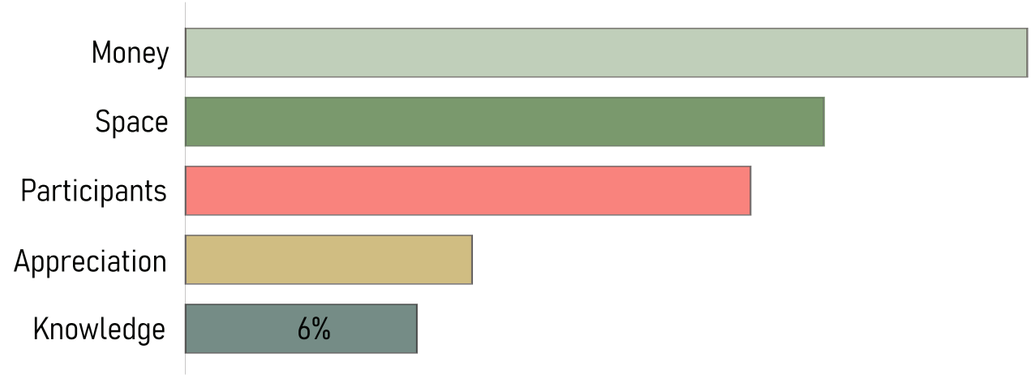


Fig. 39: Needs for small scale initiatives to exist (Source: Rutger Henneman (n.d.))

Knowledge Institutes

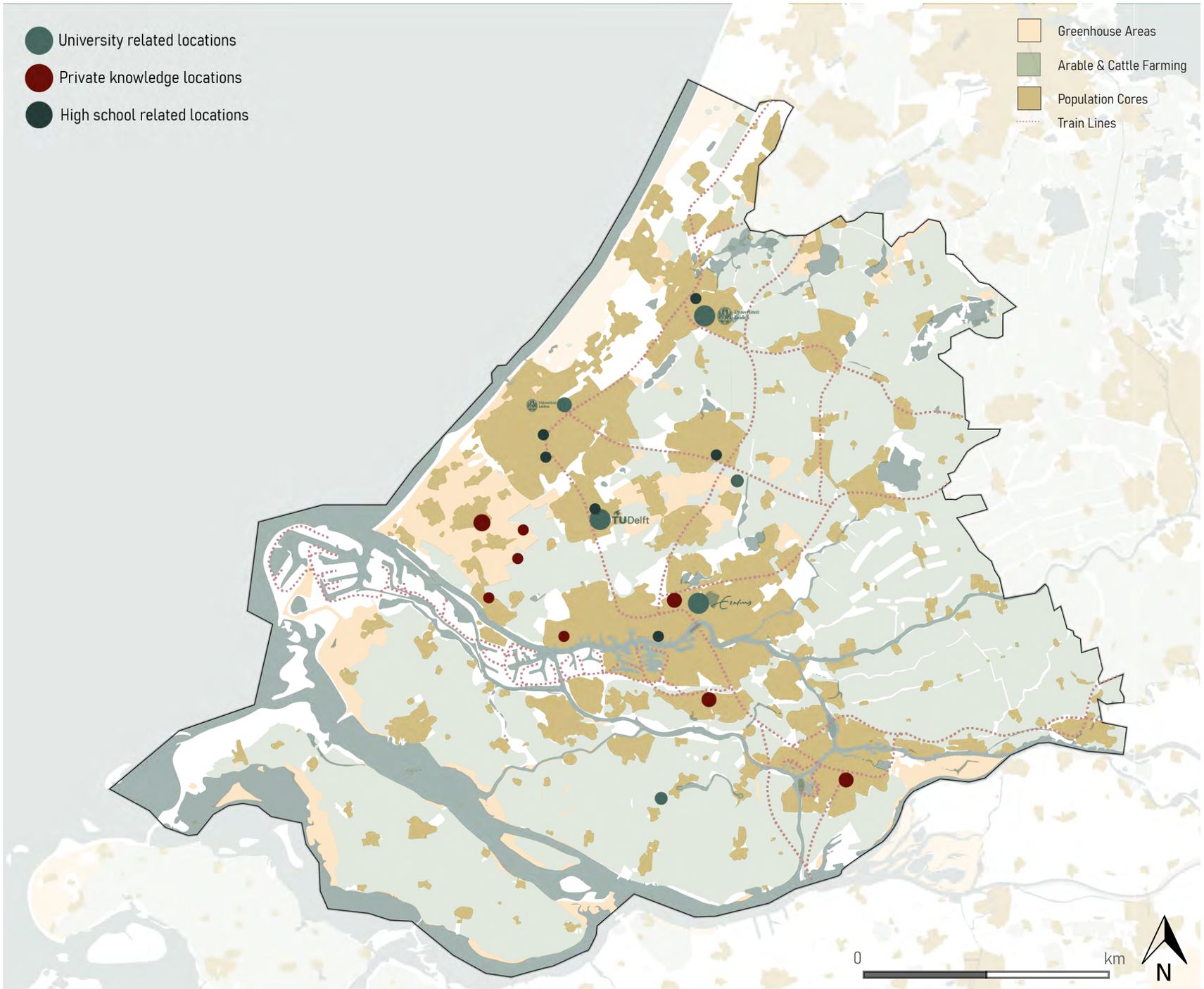


Fig. 40: Knowledge institutes in South Holland

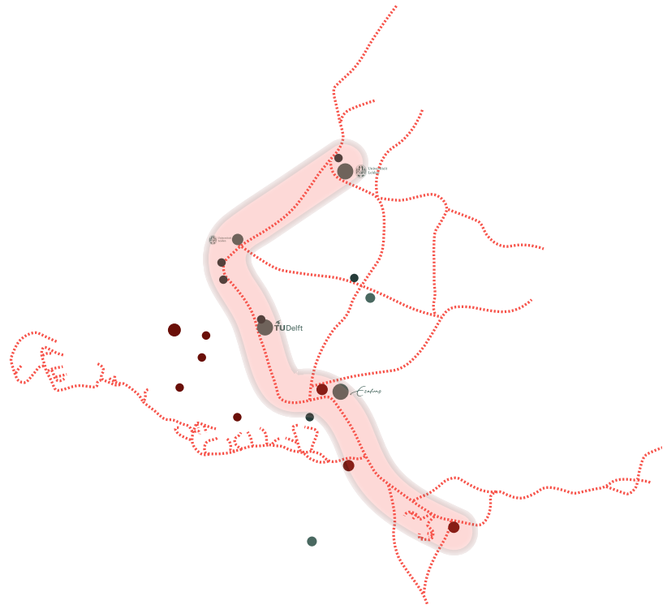


Fig. 41: The Knowledge Axis through South Holland

South Holland contains with three universities, the Haagsche Hogeschool, InHolland and several private knowledge institutes a richdom of knowledge. The locations of these knowledge institutes are close to the train connection from Dordrecht through Rotterdam, Delft, The Hague and to Leiden. This is also why the province speaks of a “knowledge axis” through these cities (RoyalHaskoningDHV, 2017). Strengthening this axis could bring big opportunities to the region in innovation and knowledge sharing. On the other hand, mainly focussing on the axis could be a threat to other parts of the region which also contain big amounts of knowledge. There is a big opportunity for the agrifood sector at enlarging this axis and connecting farming areas to it.

Waste, Water & Emission Flows

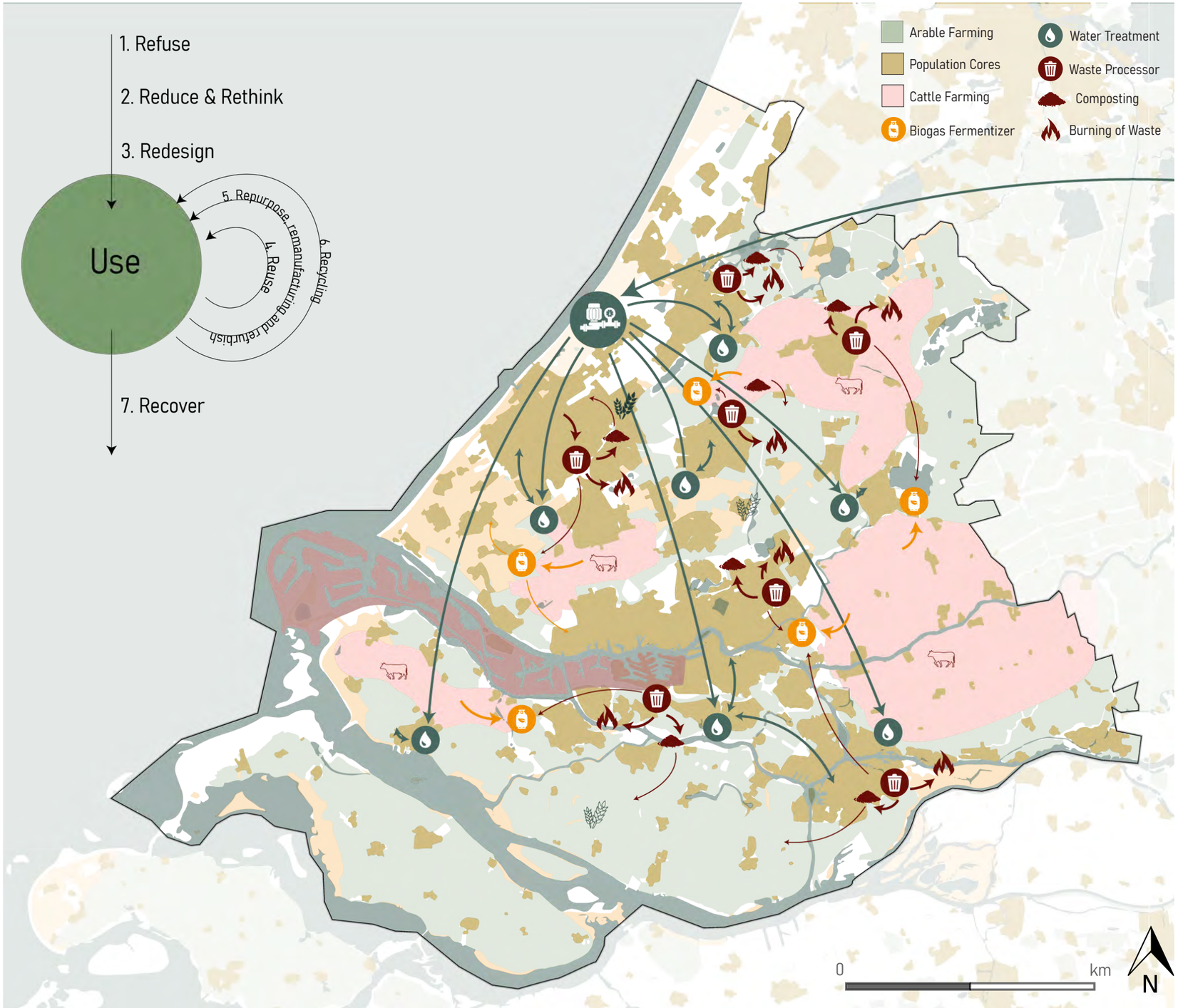


Fig. 42: Linear waste & water systems in South Holland

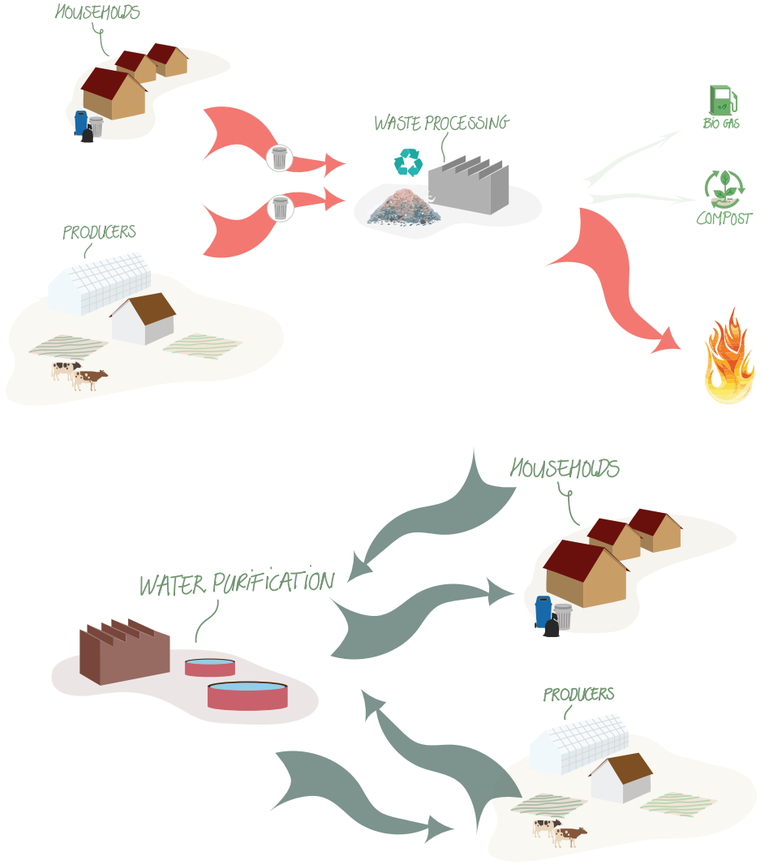


Fig. 43 & 44: waste & water systems in South Holland

The map on the left shows the flows of the water, waste and emissions in South Holland. It can be seen that these flows are very spread out over the region and that there are big logistic distances between the different parts of the chain. Also, the linearity of the system is very visible. Big waste amounts are ending by being burned and a lot of water is sent back to the water purification. There are big opportunities for the province in increasing the circularity of this system. With a focus on the R-ladder of circularity, and thereby mainly refuse, reduce and reuse, waste and water flows can remain in the city and the linearity of the agri-food flows can reduce greatly.

Relation Countryside & Cities

In South Holland, there are very strict separations between built areas and countrysides. This can be seen in the section on the bottom in which there is no hybrid area between the cities and the greenhouses and the picture on the left shows that a strict border can be noticed. This is a threat for the region since a good awareness of where your food comes from is very important. With awareness, a change to a more sustainable diet can be created. This awareness is hard to achieve when a general citizen barely sees and barely has contact with the agri-food sector. There is an opportunity for the region to bringing these actors closer together and letting general citizens participate more in the production of food.

Fig. 45: Relation cities and countrysides

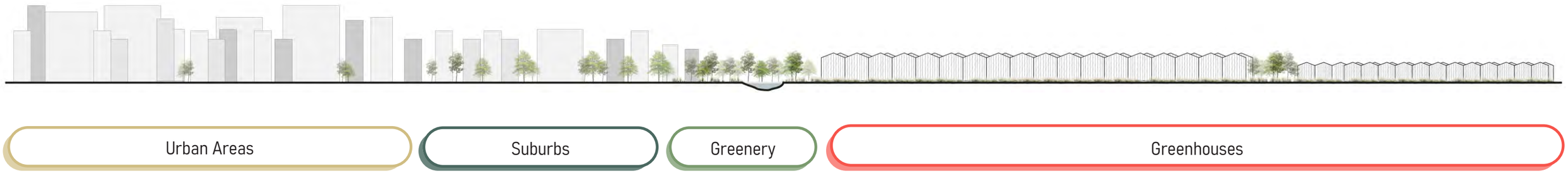


Fig. 46: Relation cities and countrysides

Port of Rotterdam

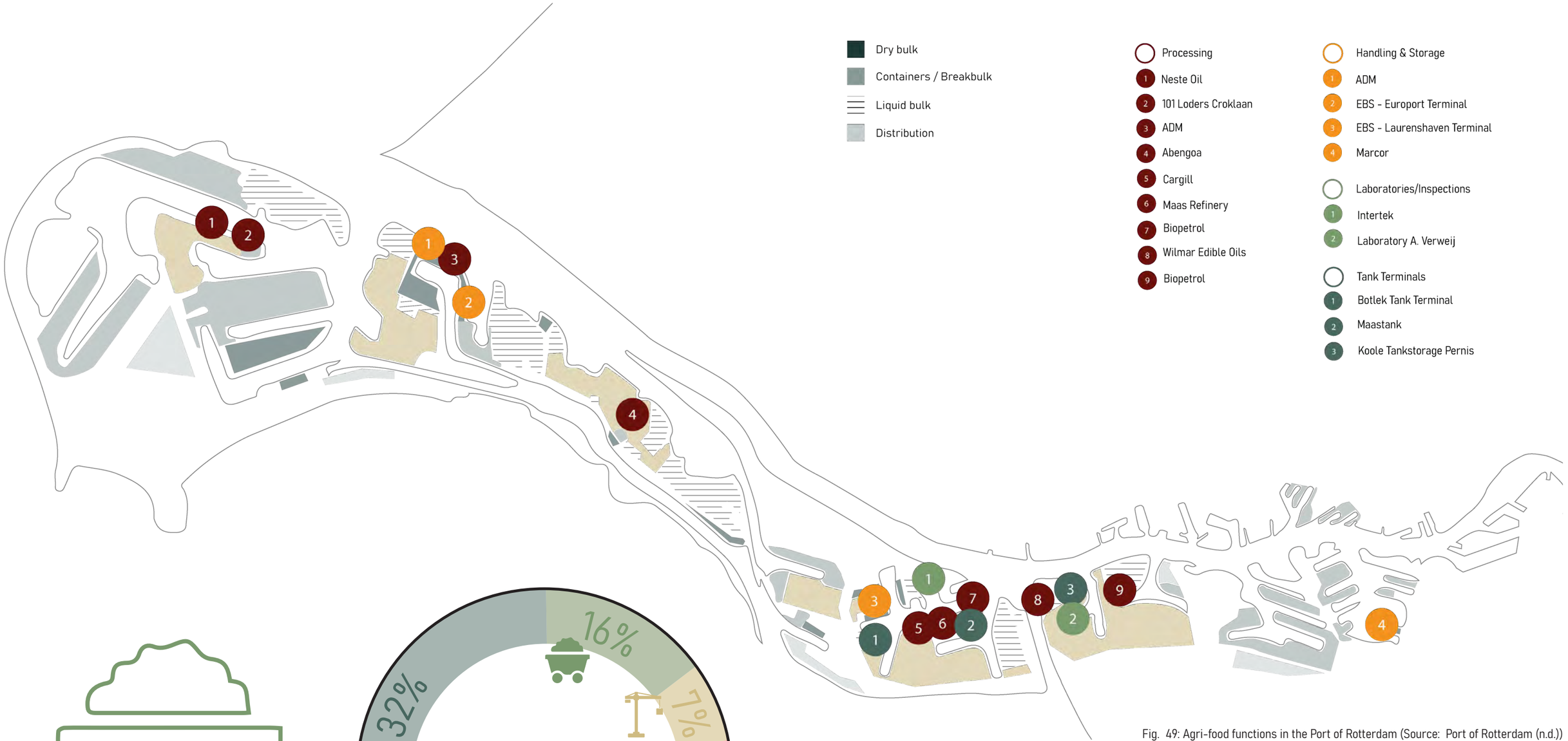


Fig. 49: Agri-food functions in the Port of Rotterdam (Source: Port of Rotterdam (n.d.))

Largest Dry Bulk Port in Europe

Fig. 47: Port of Rotterdam largest Dry Bulk Port in EU (Source: Port of Rotterdam (n.d.))

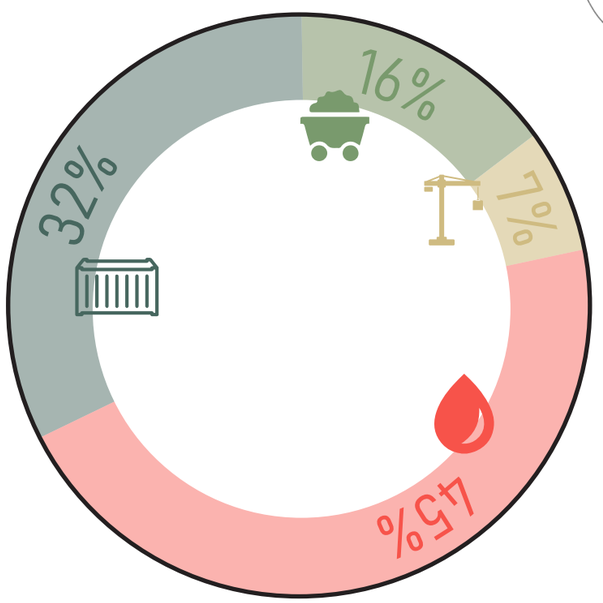


Fig. 48: Division functions Rotterdam Port in 2019 (Source: Port of Rotterdam (n.d.))

The Port of Rotterdam is a big im- and exporter of dry bulk goods, even the biggest in Europe (Port of Rotterdam, n.d.). 16% of all the activity in the port has to do with transporting dry bulk. Agri-food is mainly dry bulk and besides this, it sometimes has to do with wet bulk and container transport. In the map above the 42 km long Port of Rotterdam is shown. It shows the areas in the port occupied by dry and wet bulk and container transport. It can be seen that the agri-food sector takes quite some space in the Port of Rotterdam. It can also be seen the companies which have to do with agri-bulk are situated close to each other. This can be an opportunity for the region since this makes innovation and knowledge sharing easier. So in the Port of Rotterdam, there are many opportunities for change.

Pipes & Geothermal Energy

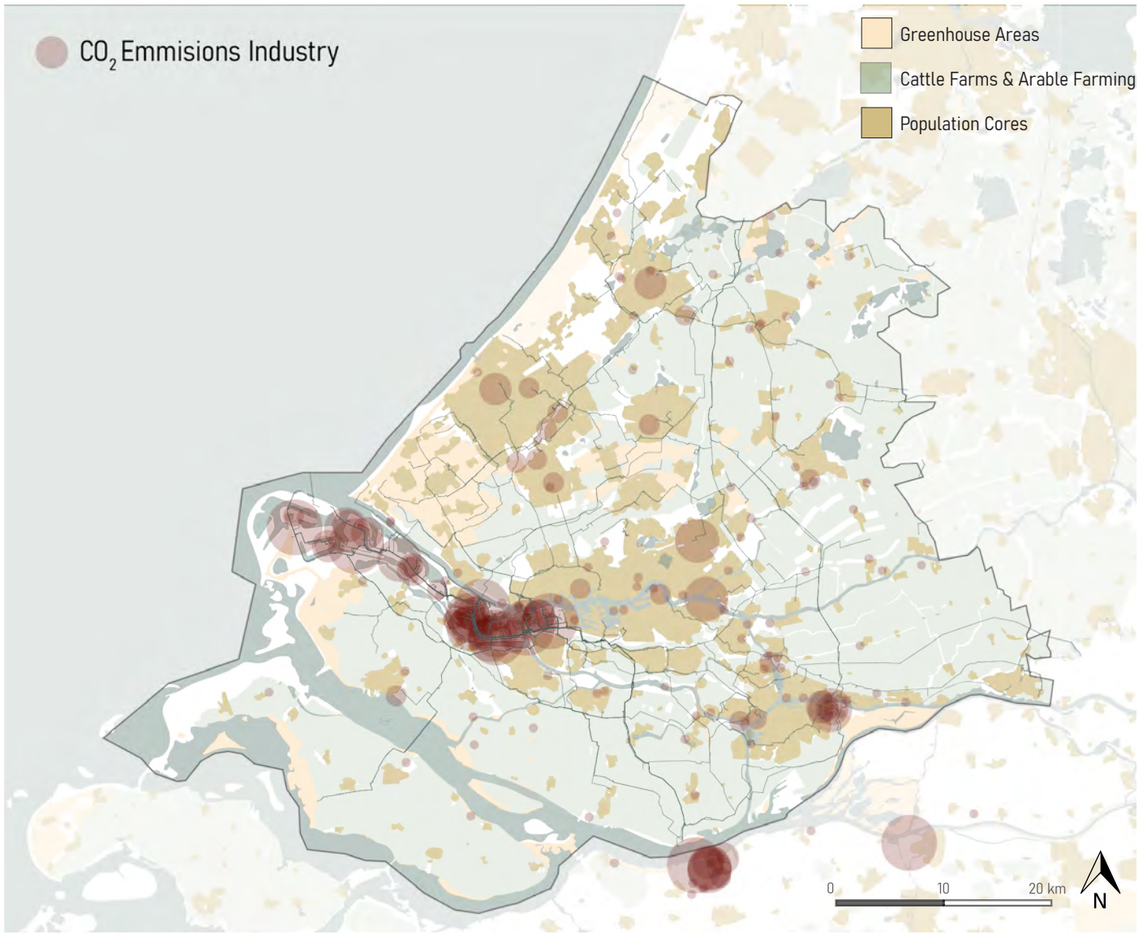


Fig. 50: CO_2 pipelines and potential (Source: Nationale Energie Atlas (n.d.)

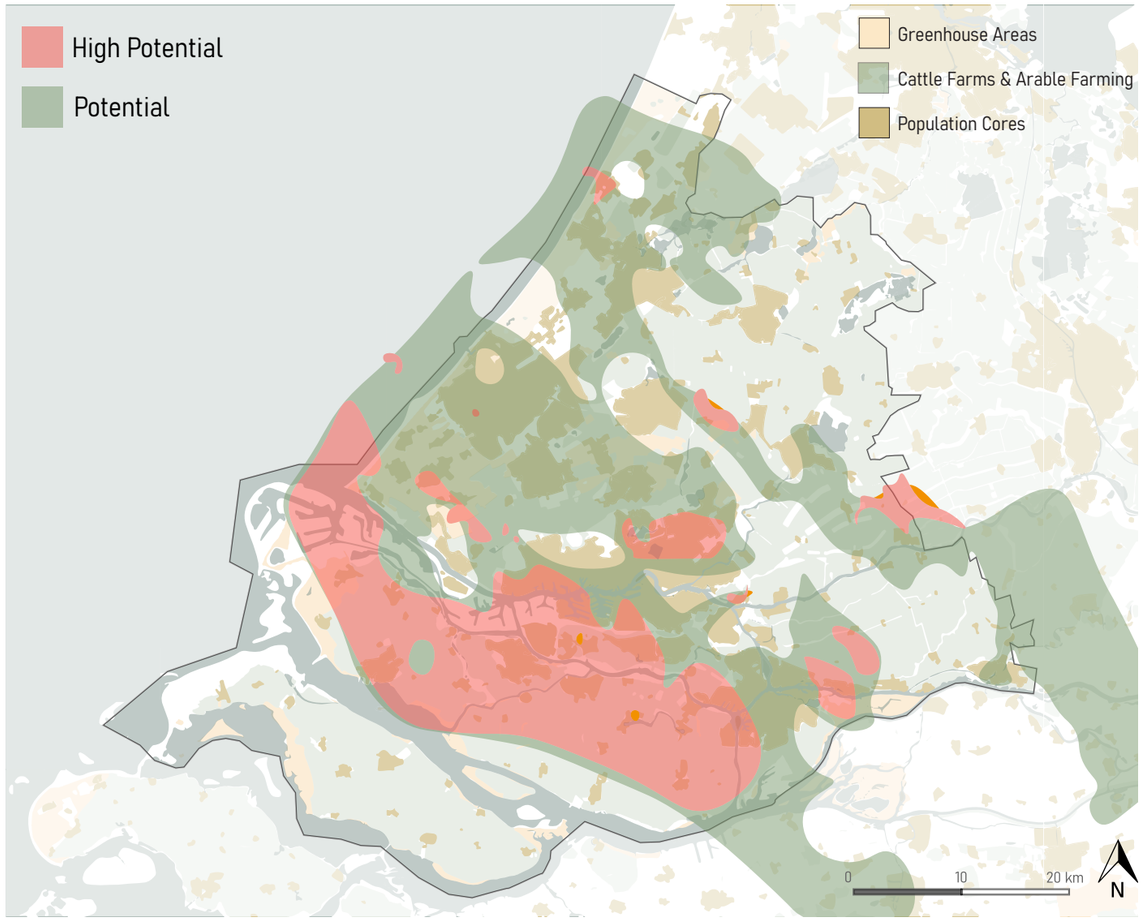


Fig. 51: Geothermal potential (Source: PZH (n.d.)

In the province of South Holland, there are a lot of emissions and potentials for geothermal energy. This can be a big opportunity for the region. When creating a connection between these potential areas and areas that need a lot of heat, like greenhouse areas and cities, a nice circular system can be achieved. Research shows that with the ongoing trend the heat needed in 2050 is 75 PetaJoule for the region and when the geothermal potential is used efficiently between 24 and 40 PetaJoule can be used. The map above shows which infrastructure can be used for this. When the province succeeds in using this heat well, a big opportunity can be achieved.

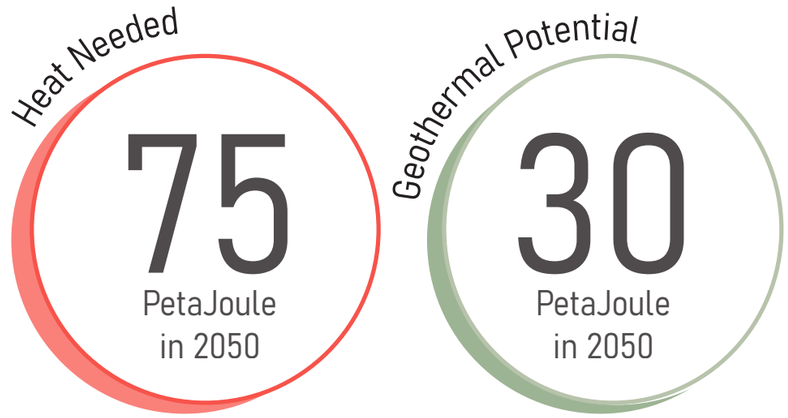


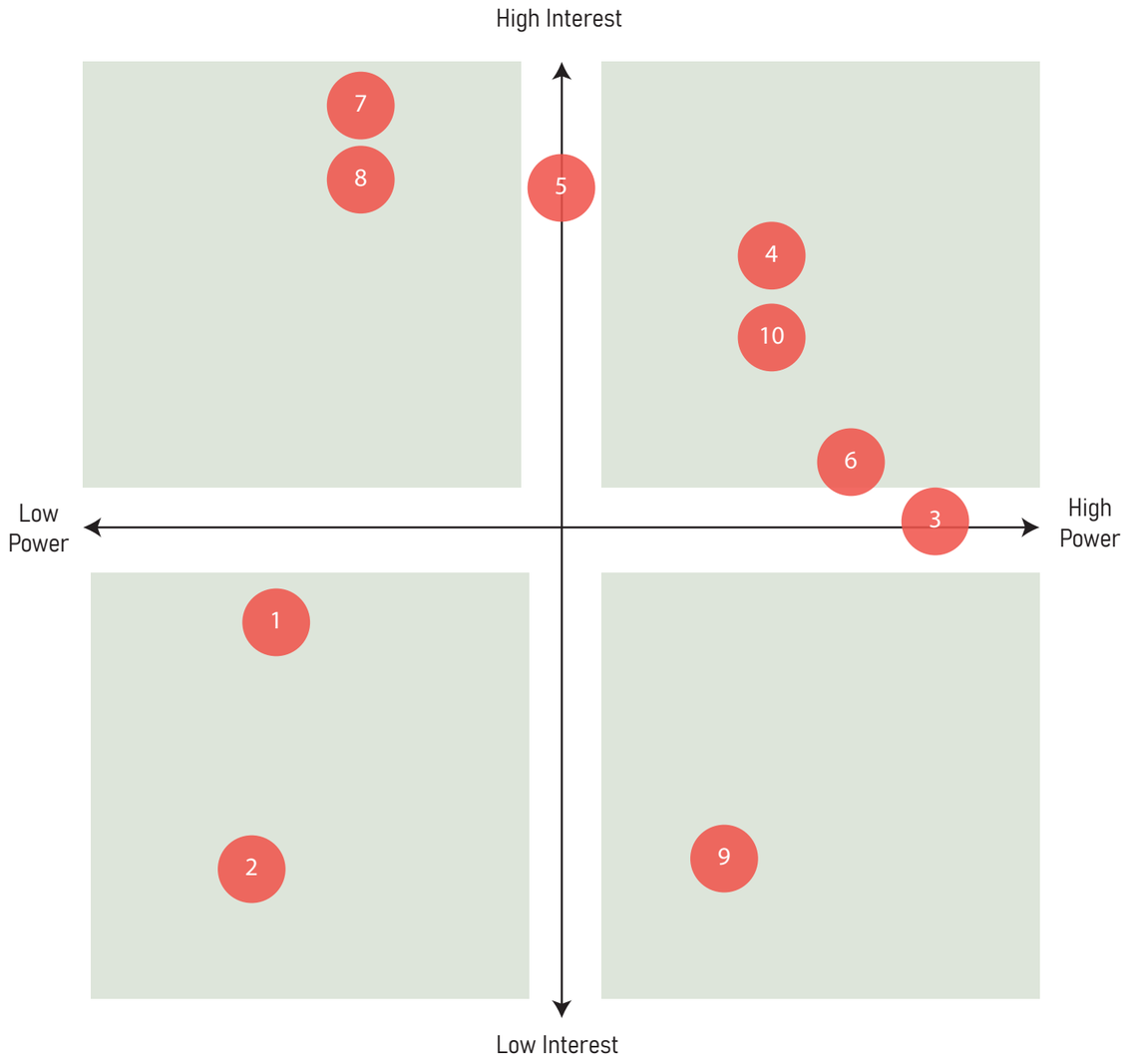
Fig. 52: Geothermal potential in 2050 (Source: H_2O (2019))

Stakeholders

	Stakeholder	Interest	Problem	Goal
	1. Producers	Getting paid fairly & directly sell to consumers	Supermarkets have all the power and don't pay fair prices	Get their power back and get paid fairly
	2. Distribution Workers	Having jobs in the import & export sector	When we go local, their would be a decrease in jobs for this stakeholder	New economy to offer new jobs
	3. Supermarket	Gain money and have a good name (branding)	The cheapest way isn't working in the future anymore with more awareness	Create a new system in which the consumer still wants to buy their food
	4. Consumers	Pay the least for the most sustainable products	Sustainability often is expensive	Make sustainable systems cheaper
	5. Governments	Social, economic and environmental sustainability	All the stakeholders have different interests (spatial justice)	Find an integral solution for everyone
	6. Waste & Water Treatment Companies	Become more circular, while being efficient and cheap	Expensive & extensive to change	New system in which people participate
	7. Small Scale Initiatives	Being more sustainable and circular and give fair prices to farmers	Lack of power and financial abilities	Cooperations with supermarkets and consumers
	8. Knowledge Institutes	Bring new sustainable innovations and knowledge	They can't reach the important stakeholders because it's not financial beneficial yet	Cooperations with important stakeholders to share knowledge with financial abilities
	9. Processing Sector	Gain profit	Sustainable processing isn't cheap	Create sustainable processing in a cheap way
	10. Rotterdam Port	Becoming more sustainable in an efficient way (all the processes can still take place)	Becoming more sustainable is in conflict with their usual bussiness	Transforming without losing money and jobs and cooperation with investors

Fig. 53: Overview of stakeholders with interests, problems & goals

In the agri-food sector, there are many different stakeholders with different interests and powers. To create a circular economy it is important to research these stakeholders and their motives. In the table on the left, the actors are shown with their interests, the problems they see and the goals they want to achieve. In Figure 54, a matrix is shown in which all the actors are placed. In the matrix, the power and the influence of every actor are shown. It can be seen that there are already quite some actors with more than average interest and power. These actors can help in creating a circular economy. But there are also actors with a lack of power or interest. There is an opportunity for the province to gain the power of these actors or gain the awareness and knowledge to move towards a circular economy.



Interest: Moving towards a circular economy

Fig. 54: Interest and power of stakeholders towards a circualar economy

Stakeholder Analysis

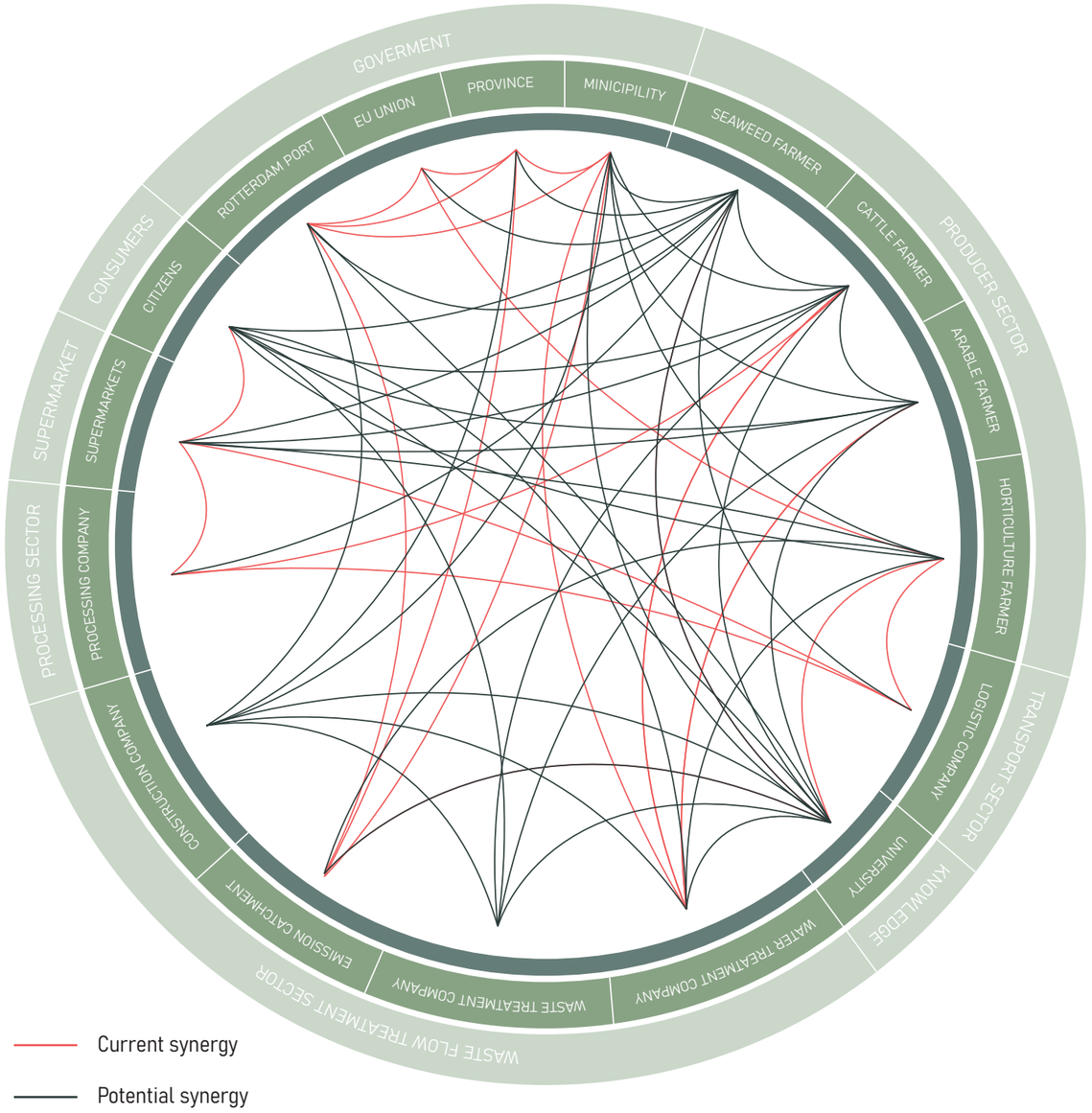


Fig. 56: Current & potential synergy between stakeholders in agri-food sector

In the stakeholder analyses above, the relation between the different stakeholders in the agri-food sector is shown. It can be seen that there are already synergies between stakeholders that can help to move towards a circular economy, but that many potential synergies are not used yet. This is a weakness of the current system in which the cooperations are not optimized yet. There is a big opportunity for the region to connect these stakeholders more and create cooperations that can achieve the feasibility of circular systems and knowledge sharing. Feasibility is important since the table on the previous page show that many stakeholders see financial problems and knowledge sharing is important for innovation.

The figure below shows the collision between different stakeholders in the agri-food sector. It can be seen that there is already some collision between different stakeholders but it can also be seen that when moving towards a circular economy, more collision can occur. This is a big threat for the region and should be researched carefully.

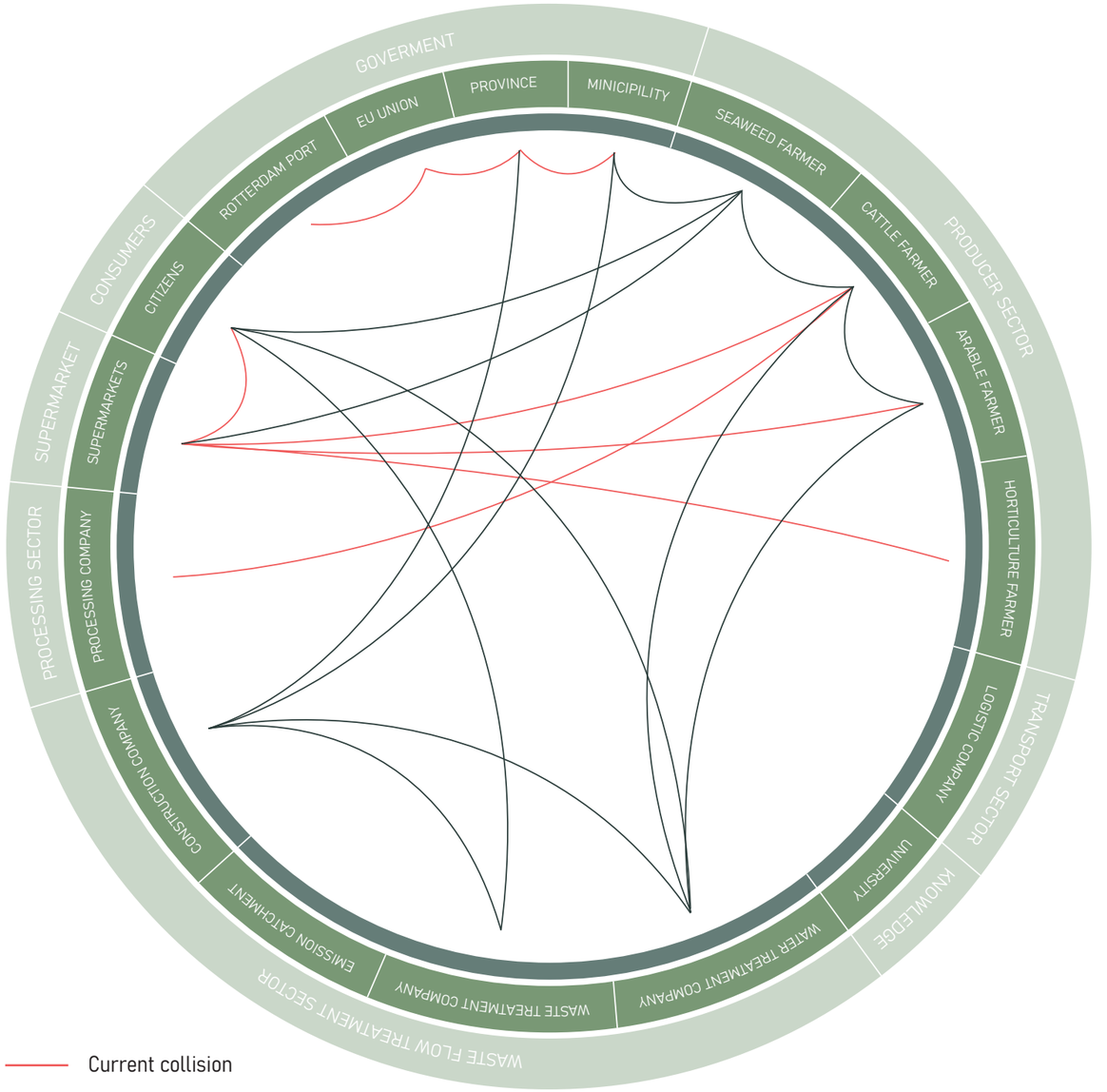


Fig. 57: Current & potential collision between stakeholders in agri-food sector

SWOT

Strengths

- The strong infrastructural network connects people easily and makes the province accessible.
- The position of densification areas are well connected with the infrastructural network which makes the province in the future even better accessible.
- The richness of knowledge institutes contribute to knowledge sharing and innovation.
- Small scale initiatives already create awareness in society and contribute to the short-chain.
- Current synergies between stakeholders are a good starting point for moving towards a circular economy.

Weaknesses

- Over the last years, the built area has increased rapidly, there is barely space left for free nature.
- The big distances and linearity in the waste, water and emission flows aren't suitable for a circular system.
- The countryside and city are not well connected which makes that there is little awareness about food consumption.
- There are already stakeholders who experience a collision. These stakeholders can not cooperate easily which resists a circular economy.

Opportunities

- Expanding the infrastructural network to rural areas could contribute to making a connection between producers and consumers.
- Already existing small scale initiatives are a good start to build a local food system.
- The already existing knowledge axis could contribute to knowledge sharing and stimulating innovation.
- Focussing on reducing, refusing and reusing in the waste and water system could make these linear chains way smaller and more circular.
- The clustering of companies in the Port of Rotterdam could contribute to research and knowledge sharing.
- Aligning the agri-food system with geothermal energy brings big opportunities for a circular system.
- Using the potential synergies between stakeholders can be a good opening for further cooperation towards a circular economy.

Threats

- Population growth and densification are a threat for the free nature since this already experiences a lack of space.
- Trends in infrastructure show that without extending the public transport network, there can be a threat of accessibility.
- Without further support of the government, small scale initiatives can experience a lack of space and financial abilities.
- When focussing mainly on the knowledge axis as it is defined now there is a threat of disconnecting valuable knowledge, from for example rural areas, to it.
- The stakeholder analysis shows that in the future situation there will be quite some collision.

Problem Map

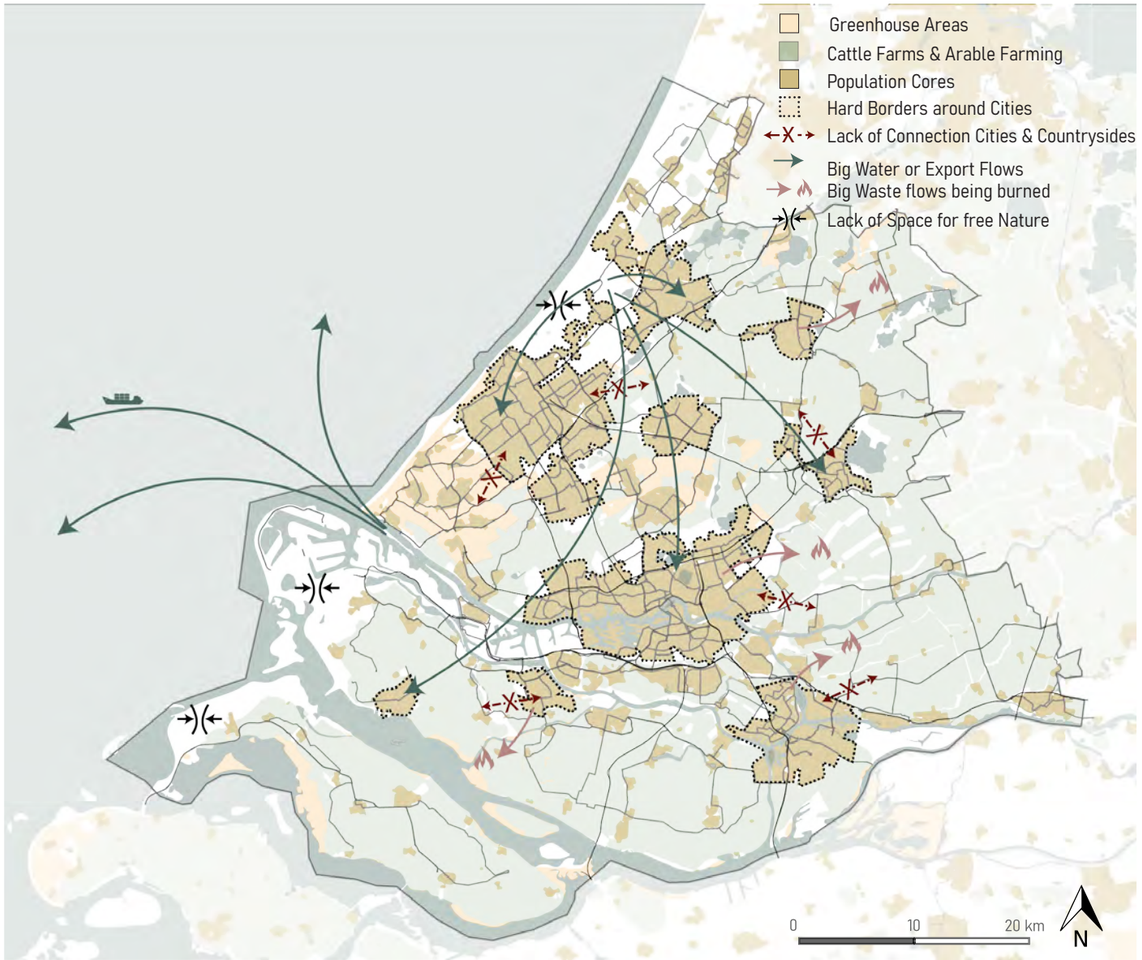


Fig. 58: Problem Map

The problem map shows the current problems in the region of South Holland. It shows how cities are very isolated and that there is a lack of physical connection between the countryside and cities.

The map also shows that areas of free nature are experiencing a lack of space. The big distances between the different parts of the waste and water chain and the linearity are made visible.

Opportunity Map

The map below shows the opportunities for the province of South Holland. It shows for example the potential of geothermal heat, the knowledge axis and the regional food system. It shows how new waste and water hubs could exist together with knowledge institutes and that these could be connected more. Also, it explains a focus on refusing, reducing and reusing inside of cities and how port function could move to the west while the companies situated in the east focus on innovation and knowledge sharing.

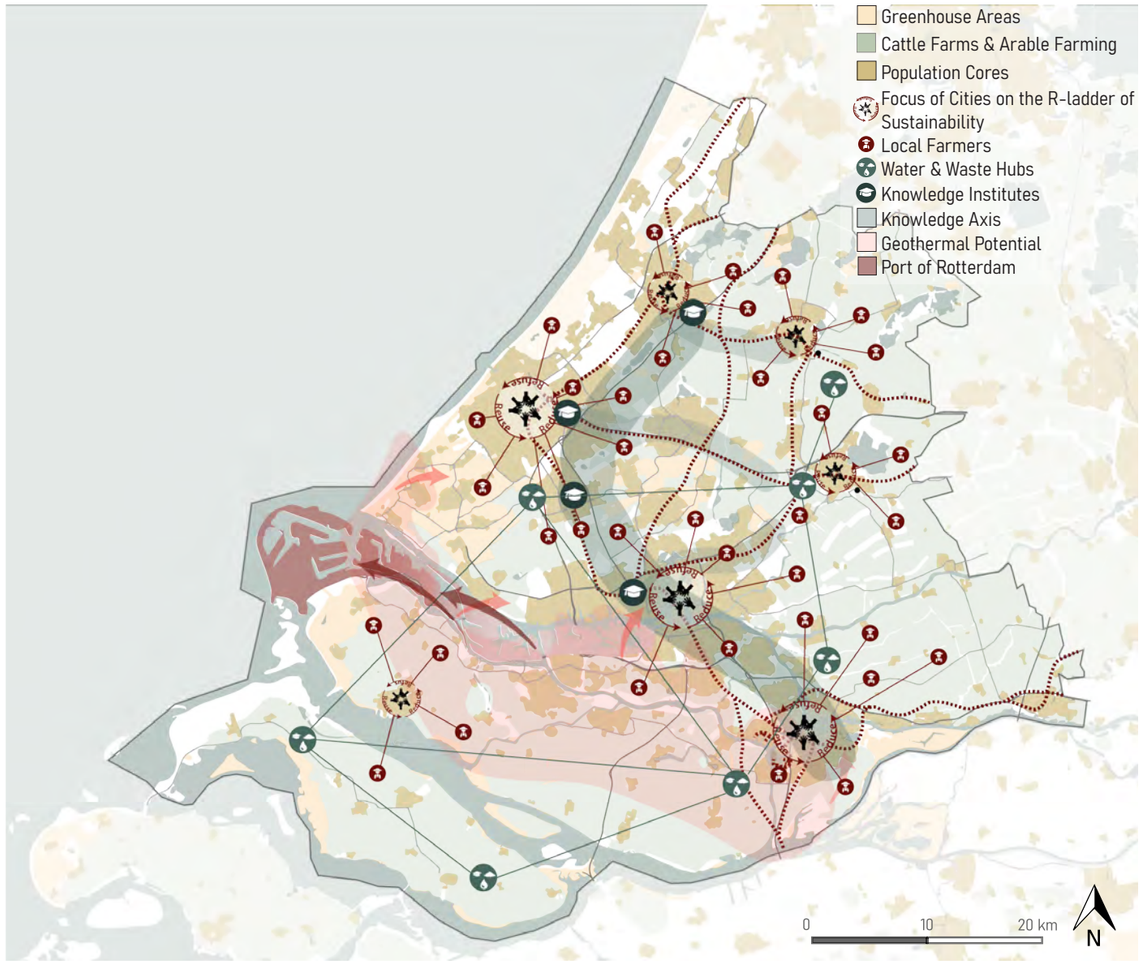


Fig. 59: Opportunity Map

05. Vision

Introduction

The problem statement makes it clear that the big amount of international agri-food flows cause a lot of sustainability problems on all three levels (economic, social and environmental). To reduce these flows a new vision for the year 2050 is created, which is mainly focussed on the DownScaling of the global flows and the Scaling-Up of a regional food system. To make this possible in a circular way, there is also a focus on innovation, knowledge sharing, sustainable water and waste system and a reuse of CO_2 emmissions. The vision for 2050 can be summarised in the following statement: In 2050 the food flows of South Holland are changed from an international system to a regional produced and consumed system in which participation and efficiency are key and the regional knowledge network is used to stimulate innovation.

This chapter explains the vision in depth and shows the circular South Holland of the future. There is a big focus on limiting the import and export flows of the region to only the European Union. For this, a change in land use is needed and a new infrastructure for the knowledge network is desirable. The chapter shows which network will be created in 2050 and how this could contribute to a regional food system with regional and local food hubs. This contributes as well to a better connection between the countryside and cities to create awareness and participation in the province. When realising a new system it is important to integrate sustainability from the beginning. That is why this chapter also focuses on creating water and waste systems in which the R-ladder of sustainability is used and create new systems in which CO_2 from mainly the Port of Rotterdam is used and innovations like seaweed production are developed. In this way, it is not only possible to limit the current intercontinental agri-food flows but also to build a new sustainable system.

The chapter ends with the sustainability framework introduced earlier.

“In 2050 the food flows of South Holland are changed from an international system to a regional produced and consumed system in which participation and efficiency are key and the regional knowledge network is used to stimulate innovation”

Fig. 60: Vision Statement

Vision Principles

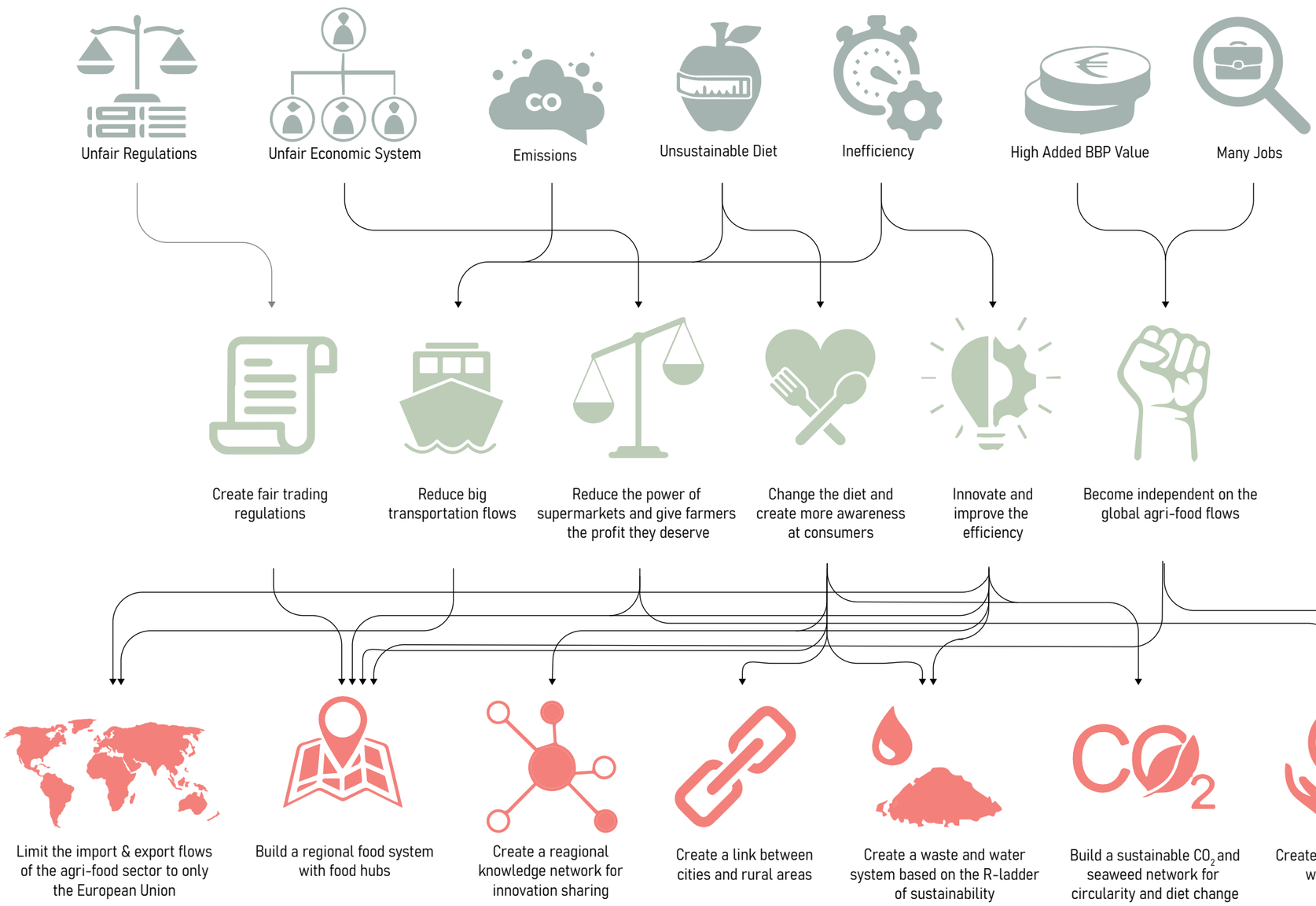


Fig. 61: Vision Diagram & Principles

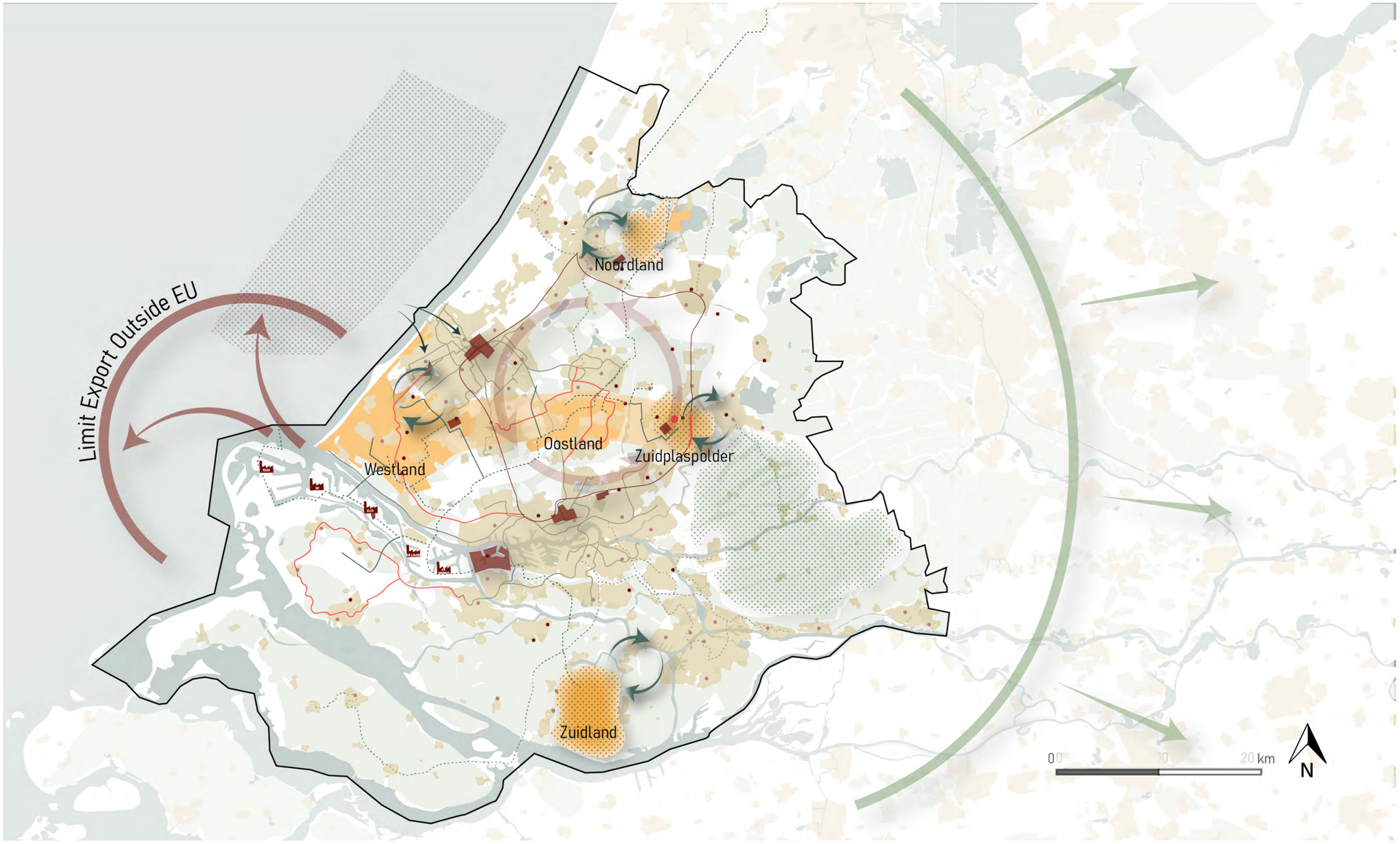
The problem statement showed the big Dutch dependency on the current global agri-food system which is not sustainable on the three different levels at all. This is a two-sided problem which on the one side shows the sustainability problems related to the current system and on the other side shows the Dutch dependency. From this problem statement, a few direct solutions appear. These solutions contain: the creation of fair trading regulations, reduction of big transportation flows and the power of supermarkets, giving farmers the profit they deserve, changing the diet and create more awareness at consumers, innovation and improving efficiency and becoming independent on the global agri-food flows.

These direct solutions are the starting point of the vision principles. These vision principles are the tangible and spatial interventions that will start the direct solutions named above. That is why the vision for 2050 is based on the following spatial interventions:

- Limit the import & export flows of the agri-food sector to only the European Union
- Build a regional food system with food hubs
- Create a regional knowledge network for innovation sharing
- create a link between cities and rural areas
- Create a waste and water system based on the R-ladder of sustainability
- Build a sustainable CO_2 and seaweed network for circularity and diet change
- Create a new economy with new jobs

How these interventions are applied on the map of South Holland will be explained further in the chapter.

Vision Map



The vision map shows the spatial interventions that will be applied by 2050 to create the vision statement. The map shows the transformation of certain areas. Big cattle farm areas will become free and will be given back to nature while other areas are being transformed into greenhouse areas to make it possible to limit the agri-food flows outside the EU. The map also shows how that a glass-axis is created between different greenhouse areas and that new public transport infrastructure contributes to a ring of knowledge, situated centrally in the province. This ring is well connected with different densification sites and the new greenhouse areas. These new areas are well connected with a new CO_2 pipeline system and the new seaweed production. A new extensive food hub system makes it possible to create a regional food economy.

Fig. 62: Vision Map

- Densification Areas
- New Connections
- Existing Connections
- New Greenhouse Areas
- Metro & Tram Connections
- Important Car Roads
- Train Connections to strengthen
- Greenhouse Areas
- Cattle Farms & Arable Farming
- Population Cores
- Land Given Back to Nature
- CO_2 Catchment Locations
- CO_2 Pipelines
- Local Food Hubs
- Regional Food Hubs
- Relation City and Countryside

Calculations Land Transformation

Fig. 63: Space needed in South Holland when limiting agri-food flows to EU (Source: See Appendix, Table 1)

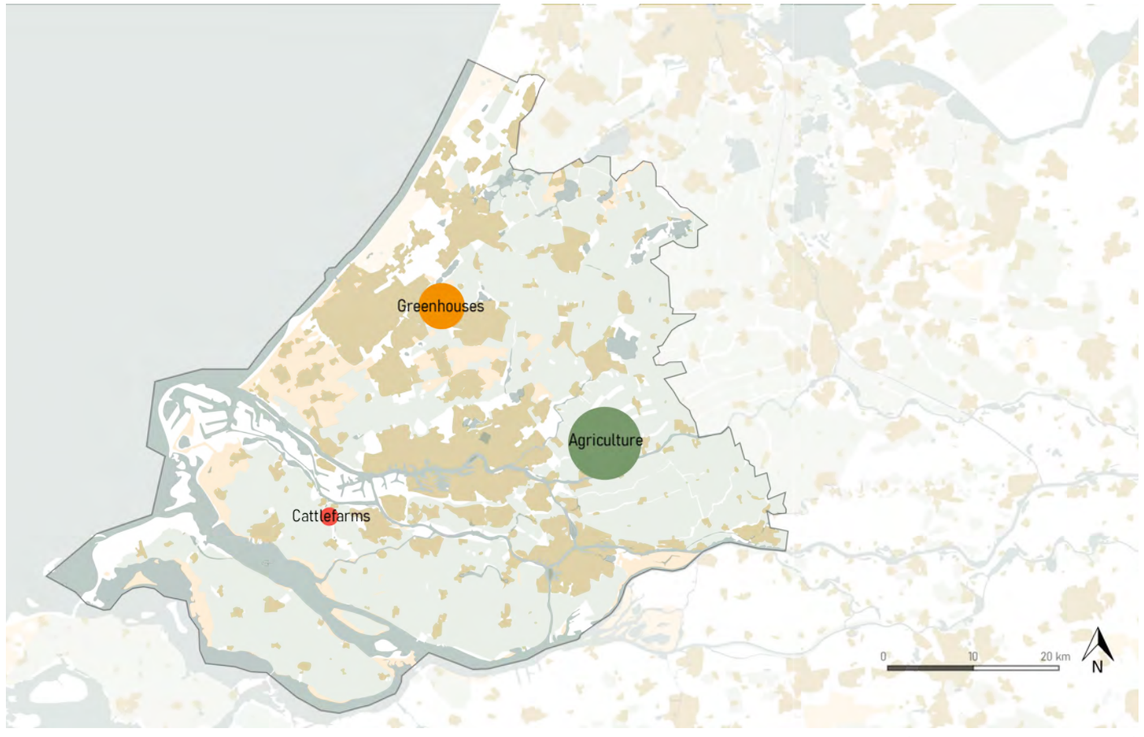


Fig. 64: Space coming free in South Holland when limiting agri-food flows to EU (Source: See Appendix, Table 1)

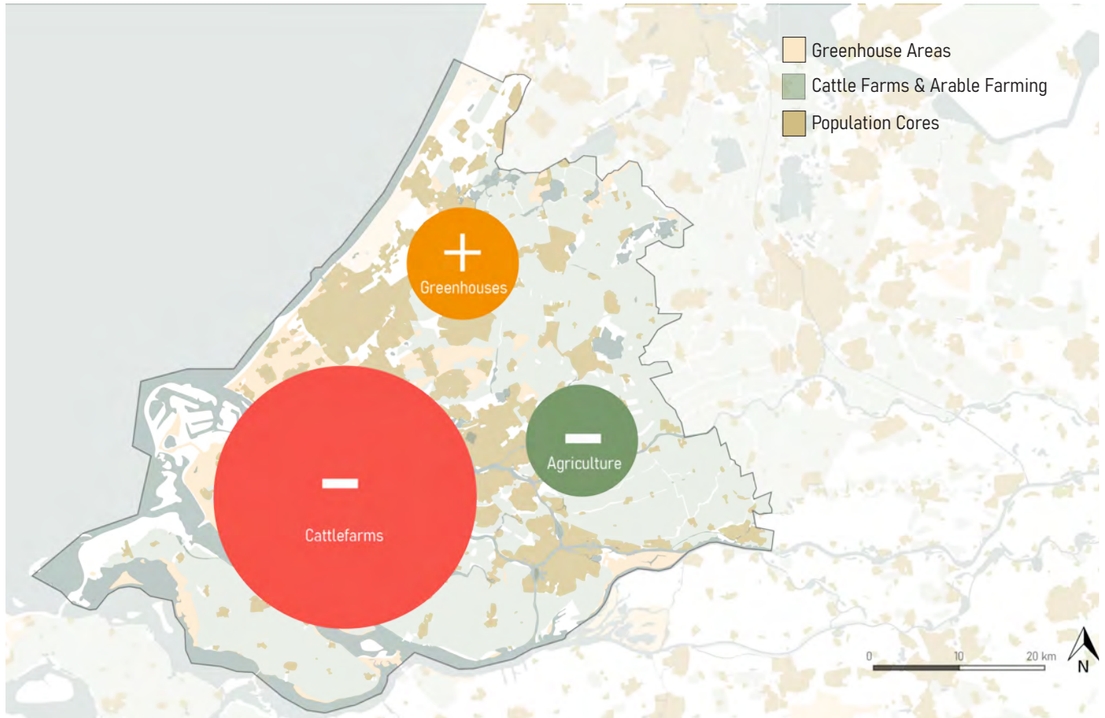


Fig. 65: Space needed and coming free in South Holland when changing diet (Source: See Appendix, Table 1)

Limiting the import and export flows to and from outside the European Union is a big part of the vision for 2050. This makes it possible to DownScale the big transportation flows and the big amounts of emissions coming free with that. Only products which cannot be produced in the European Union due to climate conditions can still be imported in very little amounts. To make optimal use of the climate conditions that the EU contains, these flows will remain and be optimized. Transportation inside the EU will mainly happen in sustainable ways, for example by train.

The reduction of the intercontinental import and export flows has a big impact on the land use in South Holland. Table 1 in the appendix shows an extensive overview of calculations which shows how much space the consumptions of the citizens of South Holland use in other countries in and outside of the EU. These are large numbers and show already that a limitation of the flows cannot be achieved without having a change in diet. This because by having a change in diet approximately one-third of the space used for consumption can be reduced (PbL, 2019). This can be seen in Figure 66. On the next page, it is explained what the new diet should look like. Table 1 also shows the space that will come free in South Holland if there is no export to outside the EU anymore. Also, Table 1 shows the exact space coming free by having a change in diet for the different types of agri-food. These calculated surfaces in the table are expressed in the maps on this page.

Change in Diet and Transforming Areas

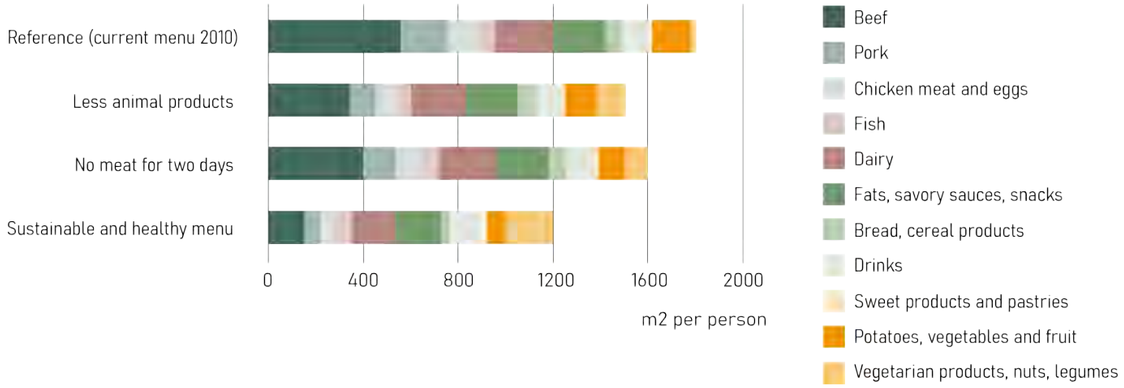
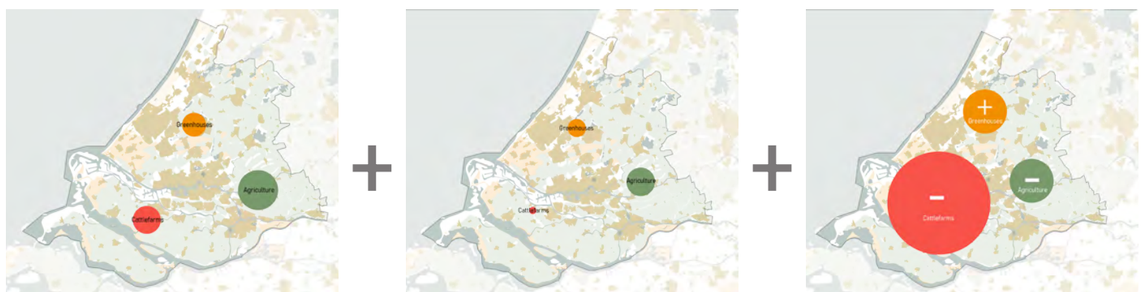


Fig. 66: Space needed and coming free in the future per category of agri-food (Source: PbL (2019), edited)

To make the space coming free in Figure 65 possible, it is important to achieve a change in diet. Figure 66 shows what the new diet should contain to achieve a healthy and sustainable way of living. It shows that most space becomes free by a reduction of meat consumption, but also a reduction of dairy and fats is contributing. The most important changes from the current diet are less meat, less alcohol, less coffee and sugar, more vegetables and more fruit (PbL, 2019).



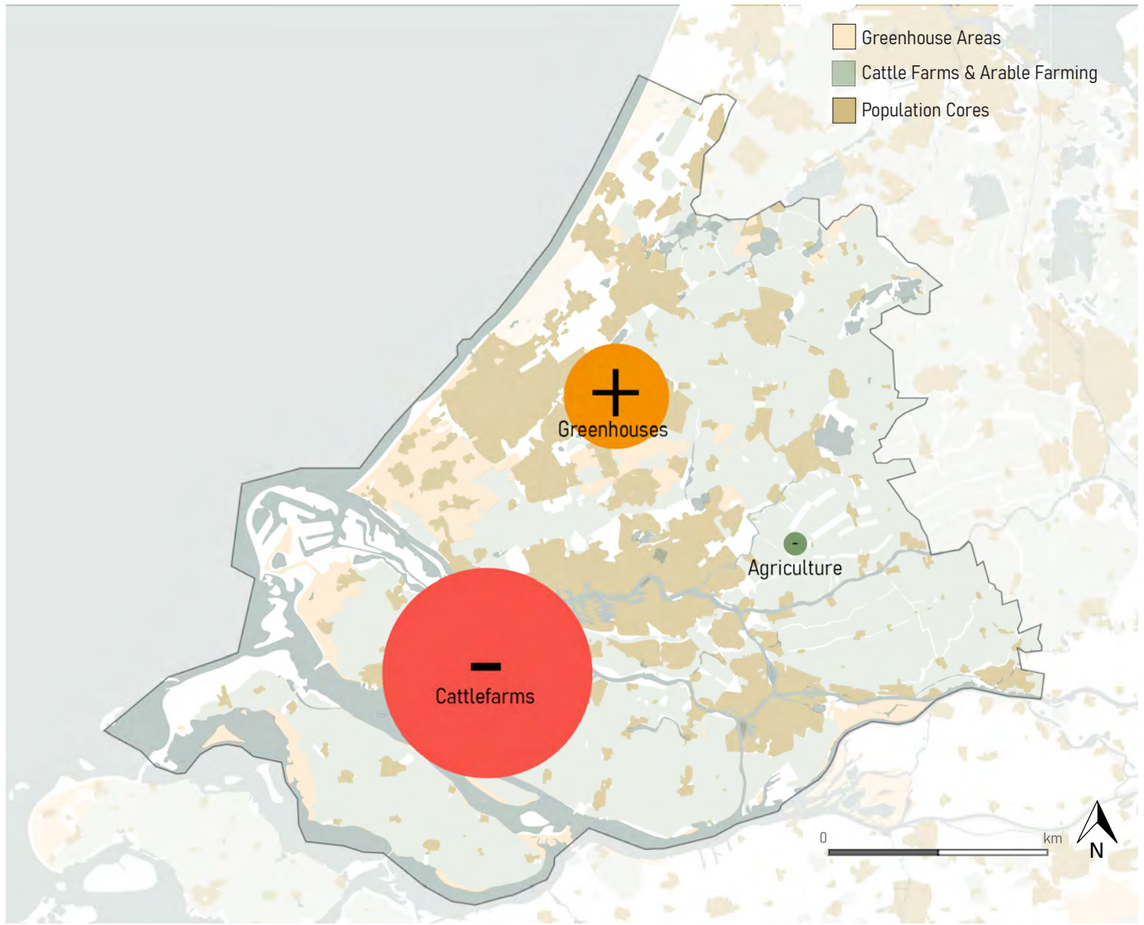


Fig. 67: Space needed and coming free in the future per category of agri-food (Source: See Appendix, Table 1)

The calculations showed in the maps on the previous page derive in a concluding map which shows the total amount of space coming free in the province of South Holland or are needed extra by 2050. This map is shown in Figure 67. It shows that a big area of cattle farms will become free. Also, for arable farming, very little area is coming free. But it can also be seen that extra space is needed for greenhouses. These spaces are created in the vision for 2050 and can be seen on the next page.

Transforming Areas

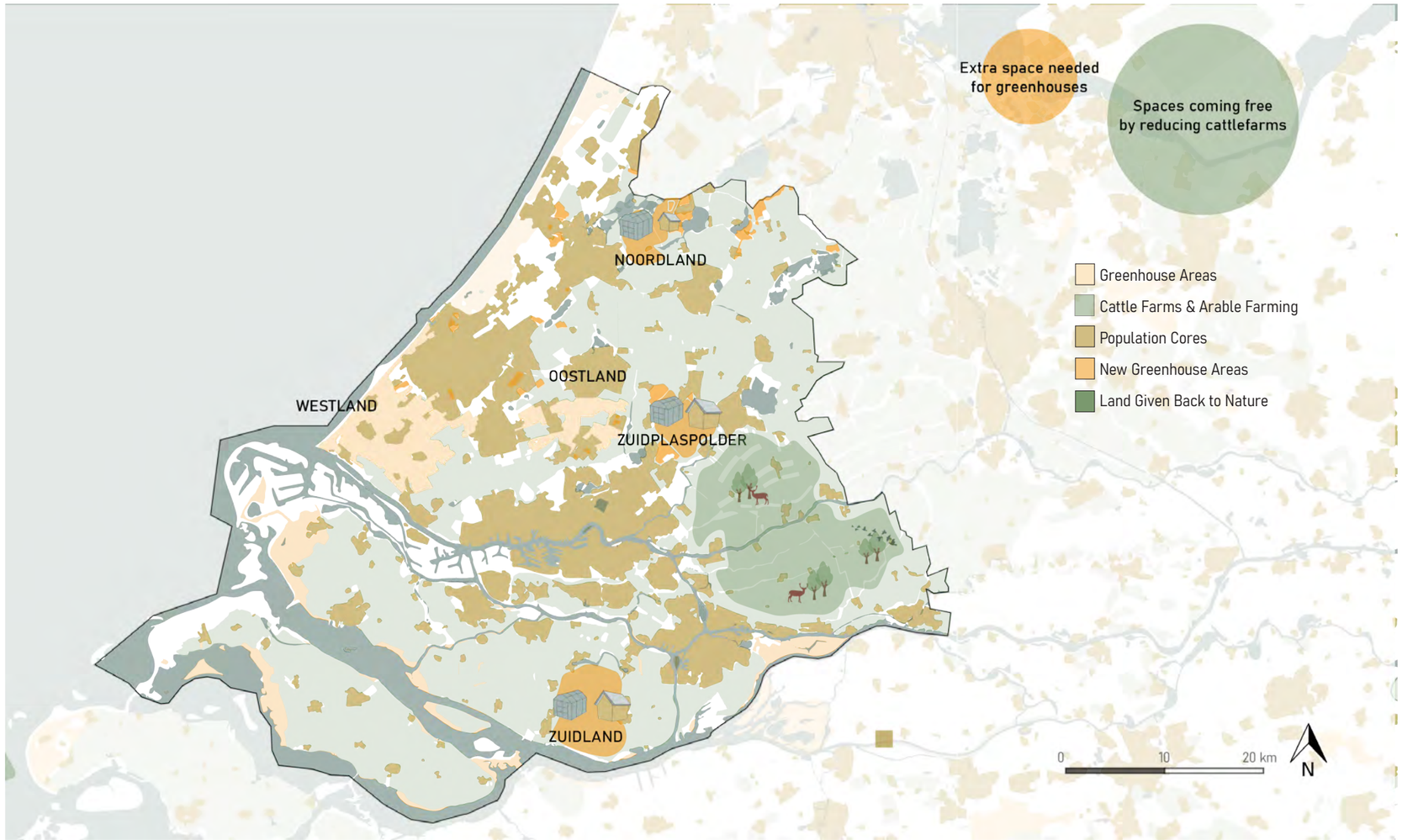


Fig. 68: New landuses in South Holland

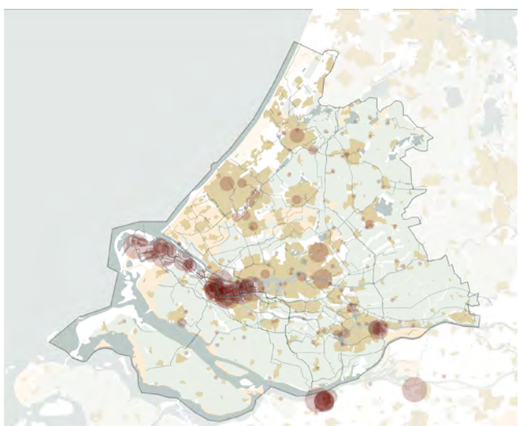


Fig. 69: CO_2 Pipelines and potential

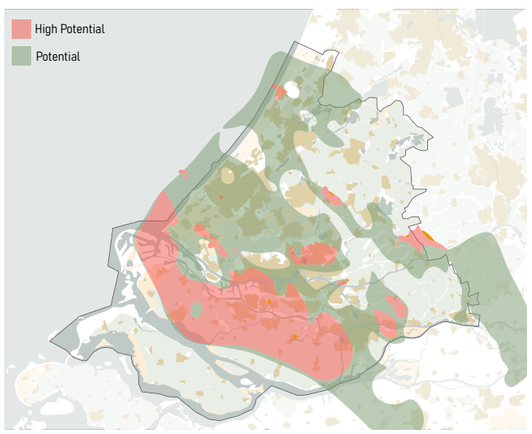


Fig. 70: Geothermal potential

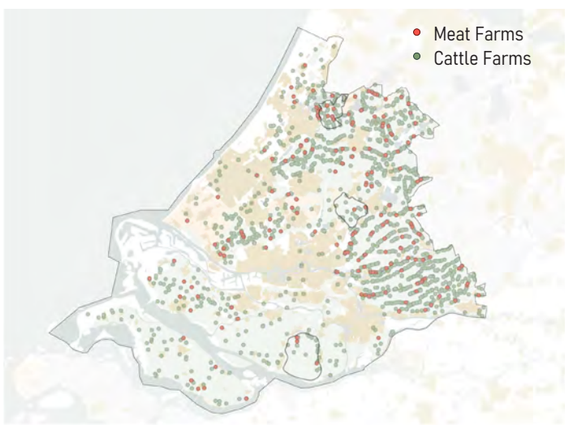


Fig. 71: Meat and cattle farms in South Holland (Source: LISA Data (n.d.)

On the previous page, the surface coming free from a reduction of cattle farms and the surface that is needed extra for greenhouses in the future became visible. These surfaces are shown on the map in Figure 68 as well. The map shows where these new areas will be created by 2050 and how land will be transformed. In the east, where the Green Heart is situated, a big area of cattle farms will become free and will be transformed into free nature.

The maps 69 to 71 are the arguments where new greenhouse areas could be created best in South Holland. The potential of reusing CO_2 and geothermal energy and the map which shows where the cattle farms are situated mostly, show that the new greenhouse areas can be created best in the “Noordland”, “Zuidplaspolder” and the “Zuidland”.

Fig. 72: Glass-axis

With the creation of a greenhouse area in the Zuidplaspolder and the already existing areas Westland and Oostland, a new axis can be created which goes through these 3 glasshouse areas. In this way, the greenhouse areas are connected well and can easily share knowledge.

Food Hubs

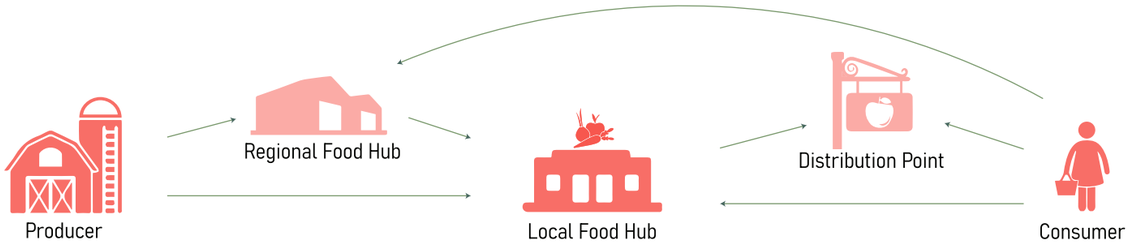


Fig. 73: Regional food system with food hubs

To make it possible to reduce the global agri-food flows, it is important to create a new system that can compensate for the current one. This system will be created by 2050 and will be fully focussed on regional food consumption and the participation of the consumer. Several food hubs will be spread out over the region with different characters. Therefore, facilities can be created to bring the producer and the consumer closer together. A direct marker will be created in which consumers know where their food is from and farmers get fair prices.

The new regional food system contains two different types of food hubs. There are regional food hubs, that are situated in big agri-food clusters like the Westland and there are local food hubs that are placed on different sites in the cities. In the new system, farmers can bring their products to either a regional food hub or a local food hub. Then the consumer can also come to these food hubs to get the goods that the farmer just brought there. In this way, there is a direct connection between the producer and the consumer. The food hubs can also function as a distribution network. The regional food hubs, which are mainly transformed distribution centres, collect the goods in the clustered areas and brings them to the local food hubs. From here, a second step can be added in which the food is brought from the local food hub to several distribution points in the city.

The food hubs play an important role in becoming a market for local food. Besides that, they will have educational and social facilities. The regional and local food hubs will have different characters but will serve the same functions to the different actors. Besides forming a market, there will be classrooms, a community kitchen, technical assistance for farmers, processing of food and business support. These functions make the new regional food system possible because farmers can learn and develop and consumers participate. This will create more awareness and a change of diet, which are important factors of the vision.

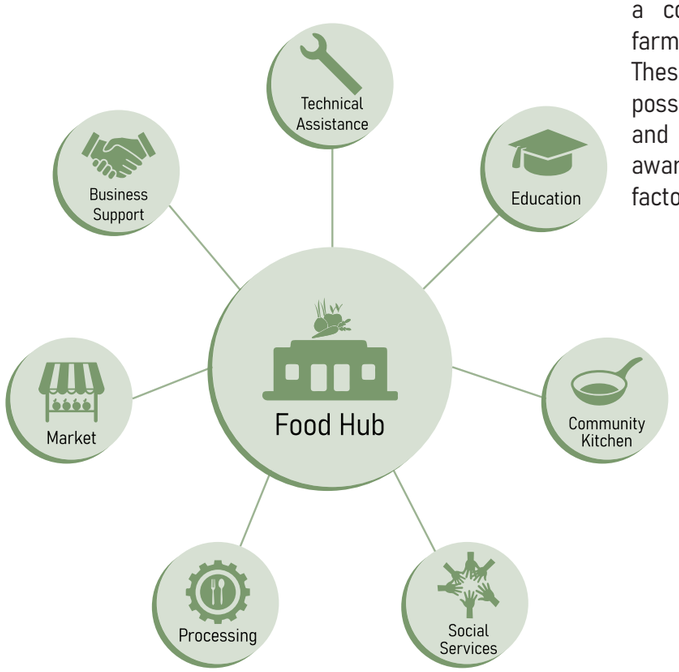


Fig. 74: Functions food hubs

To make the regional food system possible, it is important to know how many food hubs are needed and in which density. Good accessibility is important, so a maximum of 15 minutes of biking to a local food hub is desirable. The map in Figure 75 shows that a city like The Hague would need six or seven local food hubs while a city like Delft would need two or three. Also, a maximum drive of 15 minutes for the local farmers would be desirable. This shows that not every farmer in, for example, the Westland, would be close enough to a local food hub. That is why the Westland would need three regional food hubs.

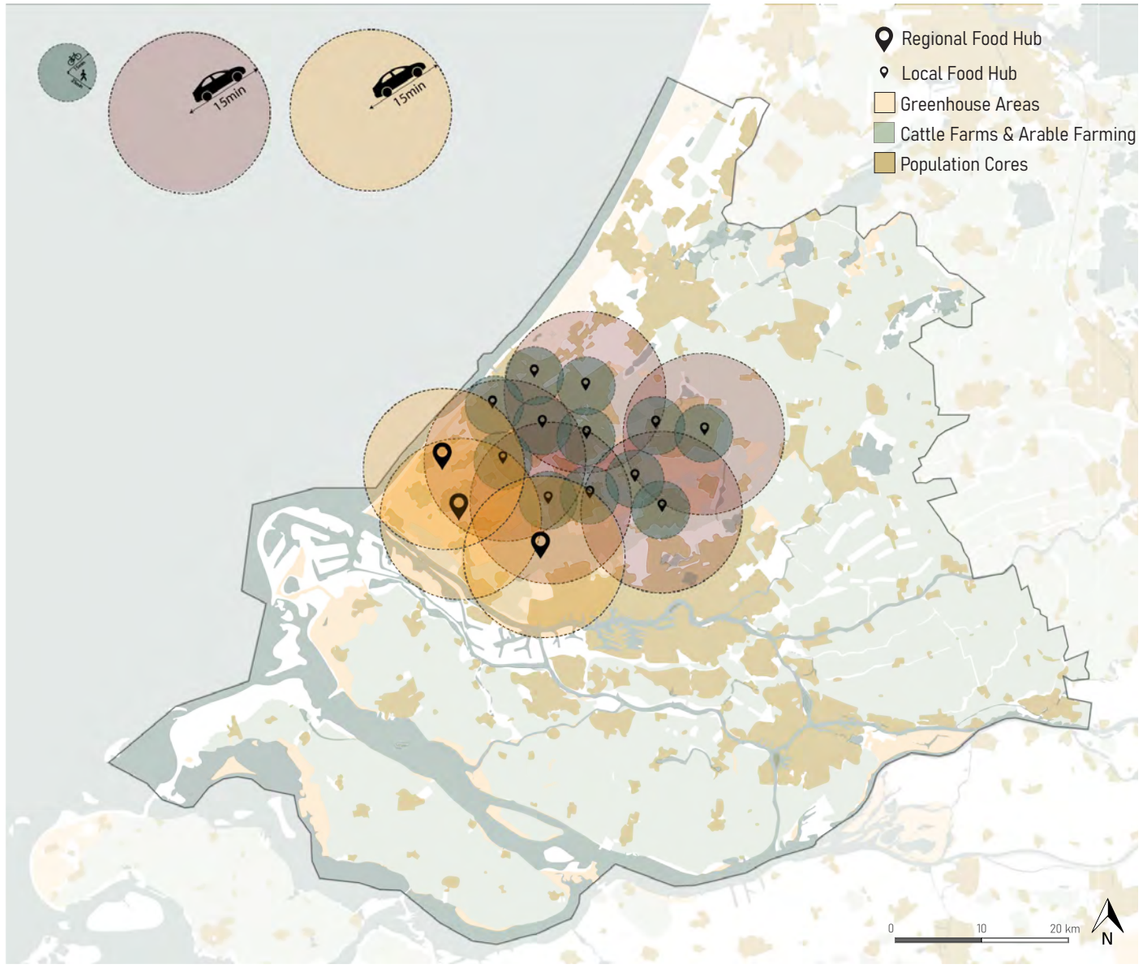


Fig. 75: New landuses in South Holland

Regional food hubs
Farmsite Character
1 for 200 companies

Local food hubs
City Character
1 for 100.000 citizens

Local Selling Points

1 for 10.000 citizens

Food Hubs

The illustration in Figure 77 shows the character of the regional food hub. These food hubs are created by transforming old distribution centres which are currently used for the big import and export flows. This makes that the regional food hub has a practical character and will be focussed on transportation to the local food hubs. But this does not mean that consumers are not welcome there. The regional food hubs will also contain local food selling and education points. In this way, consumers can learn a lot about what happens in the agricultural areas.

Fig. 77: Impression regional food hub (Source: Google StreetView (n.d.), edited)

Fig. 76: Impression local food hub

The illustration in Figure 75 shows the character of the local food hubs. These will be part of the city and very easily accessible. It will be an enjoyable place where children and adults can come to buy their food, learn about food processes or grow their own food. It will be a multifunctional place where there is not only learning about food but also about sustainable water and waste (re)use.

Knowledge Network (Ring)

Fig. 78: Ring Network

As explained, the food hubs play an important role in education about the sustainable use of resources. But also on a bigger scale, a lot of knowledge sharing could happen in South Holland. With the new densification and greenhouse areas and the already existing universities, many interesting places arise around the train lines from Leiden, through The Hague, Delft, Rotterdam, Gouda, Alphen a/d Rijn back to Leiden. That is why in the vision for 2050 a "train ring" will be strengthened. The big advantage of this ring is that with its tentacles to Utrecht, Amsterdam and Dordrecht and with its train cross in the middle, it is very easily accessible from anywhere in the region. Within a suitable travel distance, you are on the ring from which you can easily go to all the interesting agri-food places surrounding it.

In 2050 a direct train will ride in circles on this ring. For this, cooperation between R-net and NS will be established and a new piece of rails near Gouda will be created. To make the accessibility to the ring even better, new tram connections through the Westland and south from the Port of Rotterdam will be established.

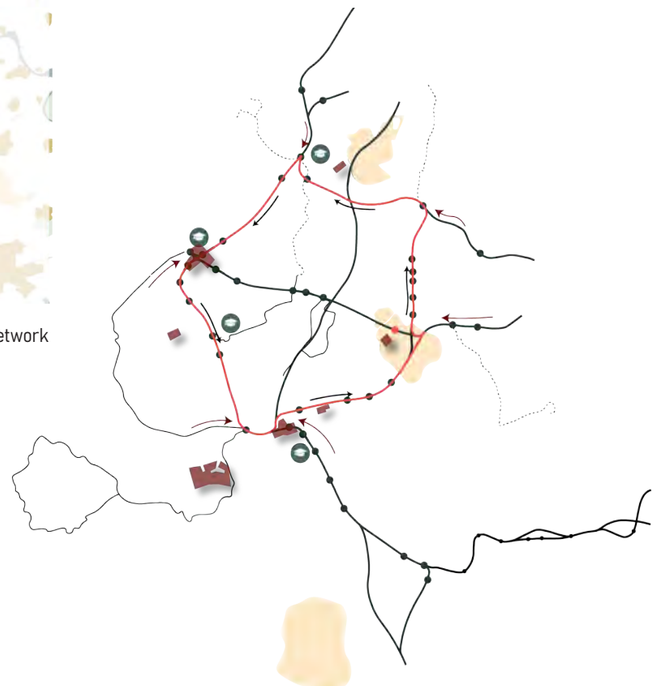


Fig. 79: Ring Network

Connection Countryside & Cities

To achieve the goal of having more awareness and changing the diet of consumers, it is important to connect the city with the countryside. Therefore, it is necessary to bring the countryside to the city and densification to the countryside. In this way, the strict border between living and producing can be broken and people will be aware of the fact where their food comes from. Cities and countrysides would look very different (Figure 82). The collages below show how the city transforms into a green urban farming landscape and how the countryside is joined by many visitors during the day.

Fig. 80: Future Urban Landscape

Fig. 81: Future Rural Landscape

Fig. 82: Section from The Hague to Westland

Water & Waste Hubs

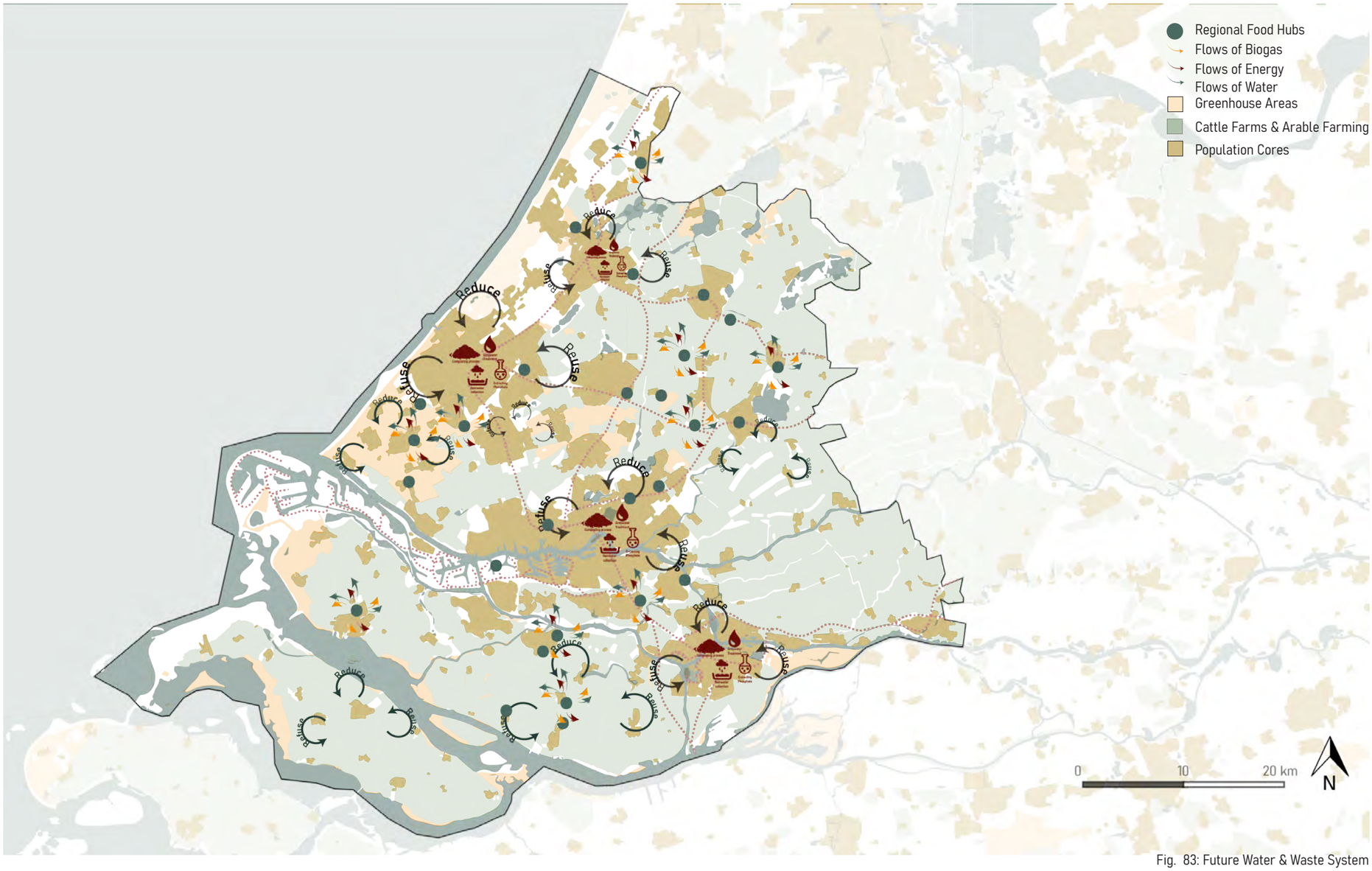


Fig. 83: Future Water & Waste System

When moving towards a regional food system there is a big opportunity in combining this change with new technical systems. For example, new water and waste systems could function very well with the previously explained food hubs. In these food hubs, there can be a great focus on the R-ladder of circularity. With a focus on the reduce, refuse and reuse of water and waste, way less pollution would be created. The hubs could learn a lot about efficient use.

Besides the function of the food hubs as education, the regional food hubs could also play an important role in the transportation of valuable nutrients. The regional food hubs are not only a place where farmers can bring their food but they will also be combined with a distribution function to collect food from the farmers. This distribution function could also have a valuable function of bringing compost from the dump to these farmers and water from the farmers to the fertilizers and back. Also, the regional food hubs could offer technical assistance for a well functioning waste and water system on the farm itself. In this way, big waste and water flows can be DownScaled.

This focus on DownScaling the flows also returns in the city. By innovative interventions, water and waste can get treated inside of the city which will avoid big transport distances. This innovation will be established by creating a good connection between the regional food hubs and create a network of water and waste knowledge.

Regional food hubs play a central role in the collecting and spreading of valuable nutrients.

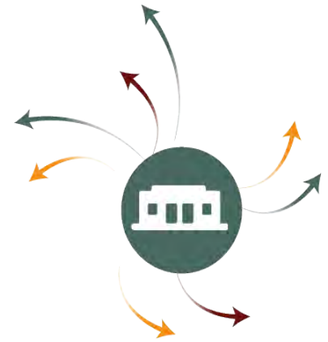


Fig. 84: Regional Food Hubs

Flows stay as much as possible in the city by innovative interventions.

Fig. 85: Flows in the City

A network of knowledge via the regional food hubs share innovations and improvements.

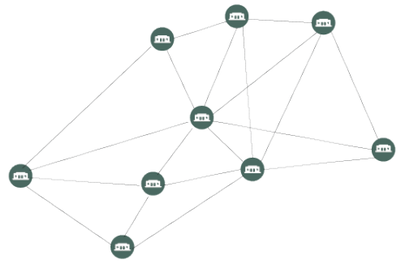


Fig. 86: Knowledge Network

CO_2 Pipeline System & Seaweed Farm

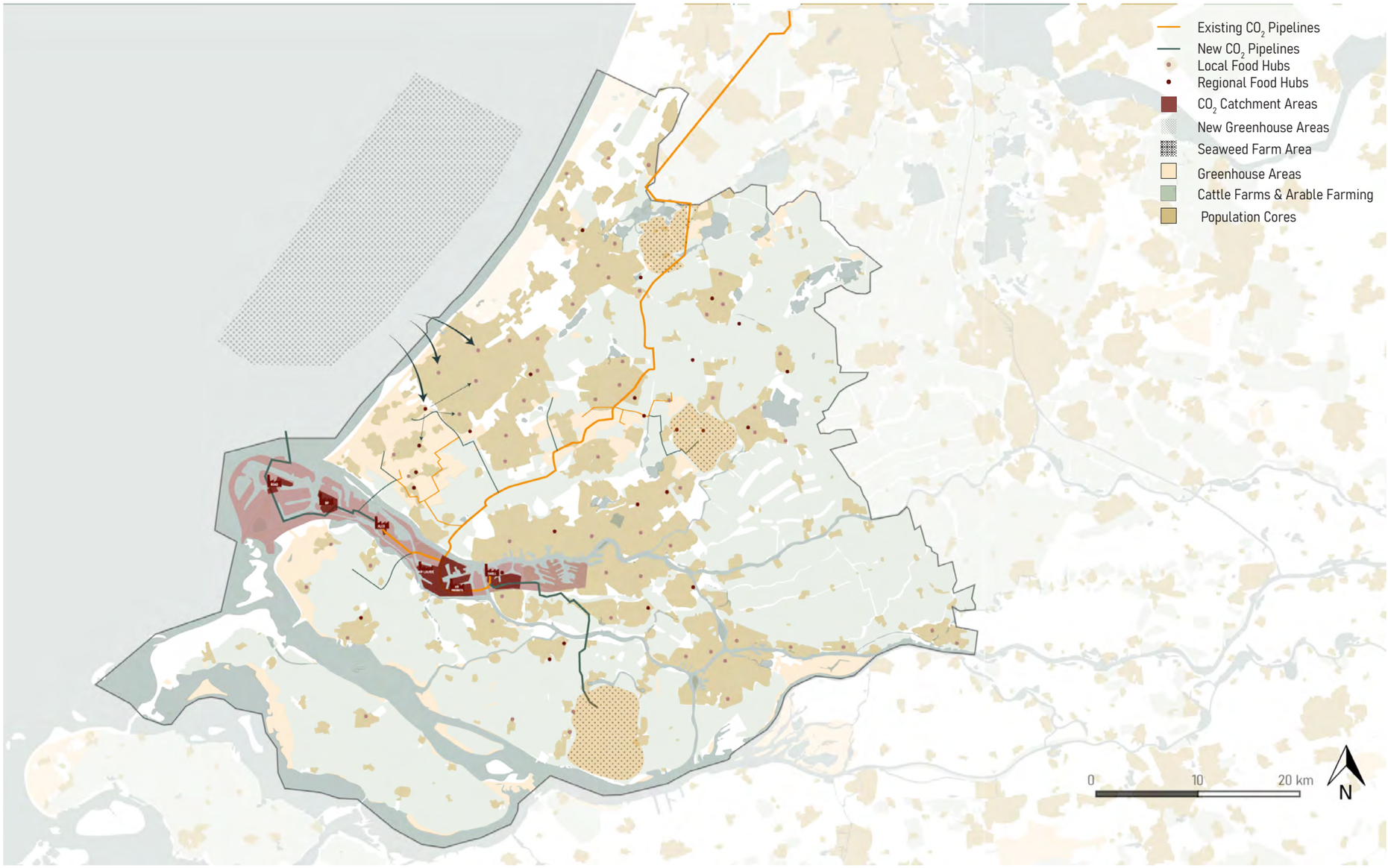


Fig. 87: CO_2 Pipelines and Seaweed Farm

With the big transformations of land in the vision, opportunities arise to combine this with a new CO_2 pipeline system. By making use of existing pipelines and building a few new pipelines, a great connection can be made between the new greenhouse areas and the Port of Rotterdam. The CO_2 coming free in the port can then be efficiently reused, which contributes to creating a circular system. This is a big opportunity that the newly transformed areas bring since these areas can be designed from scratch which makes that they can be adjusted to the needs of the CO_2 system easily.

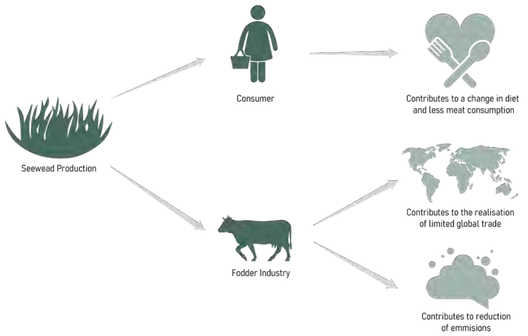


Fig. 88: Contibution seaweed production to vision

Another big opportunity for the province of South Holland is to make use of seaweed production in the North Sea. This seaweed can be brought to both the consumer and the fodder producer. From here it can help in several goals of the vision. For the consumer, it can contribute to a more sustainable diet and for the fodder, it can be a replacement for soya, a product we import now a lot from outside the EU. This contributes to the DownScaling of international flows and to the goal of reducing emissions.

The seaweed production can be connected well to the food hubs in the west of the province. From here it can be brought to food hubs over the whole region. In this way, the seaweed will be easily accessible for all the consumers as well as farmers.

New Jobs

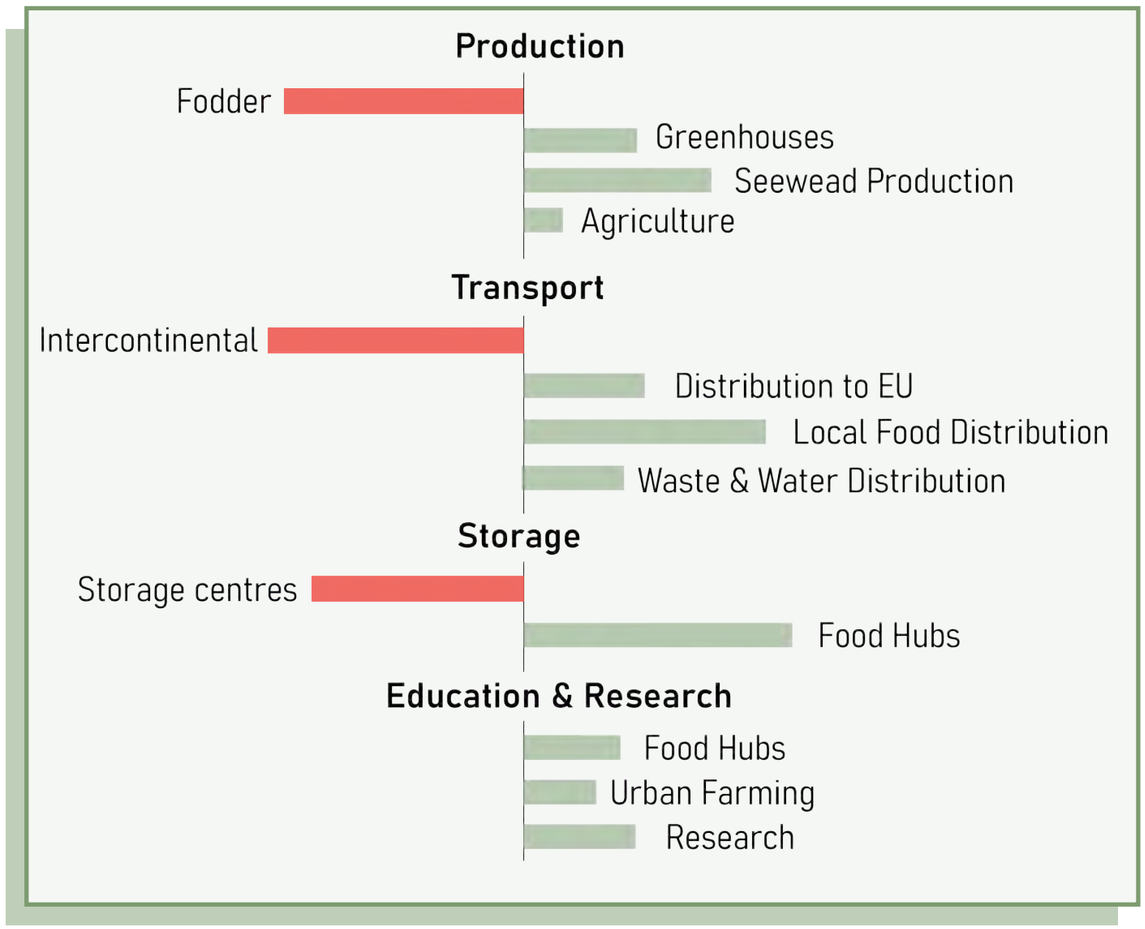


Fig. 89: New jobs in the circular economy of 2050 (Sources:: PZH (2019), Know Your Farmer, Know Your Food (n.d.) & Jenkinds, et. al. (2014)

To decrease the big dependency of the Netherlands on the global agri-food flows, it is important to build up a new economy. The reduction of flows will cause a lot of jobs to disappear but in the vision, there is also enough room for new jobs. These can arise in new distribution systems, food hubs and research and education. With this, independence for the Netherlands in the agri-food sector can be created. Also, the researched added value of the new system contributes to the new economy.

Fig. 90: Added Value Circular Economy (Source: PZH (2019))

Total Vision Map

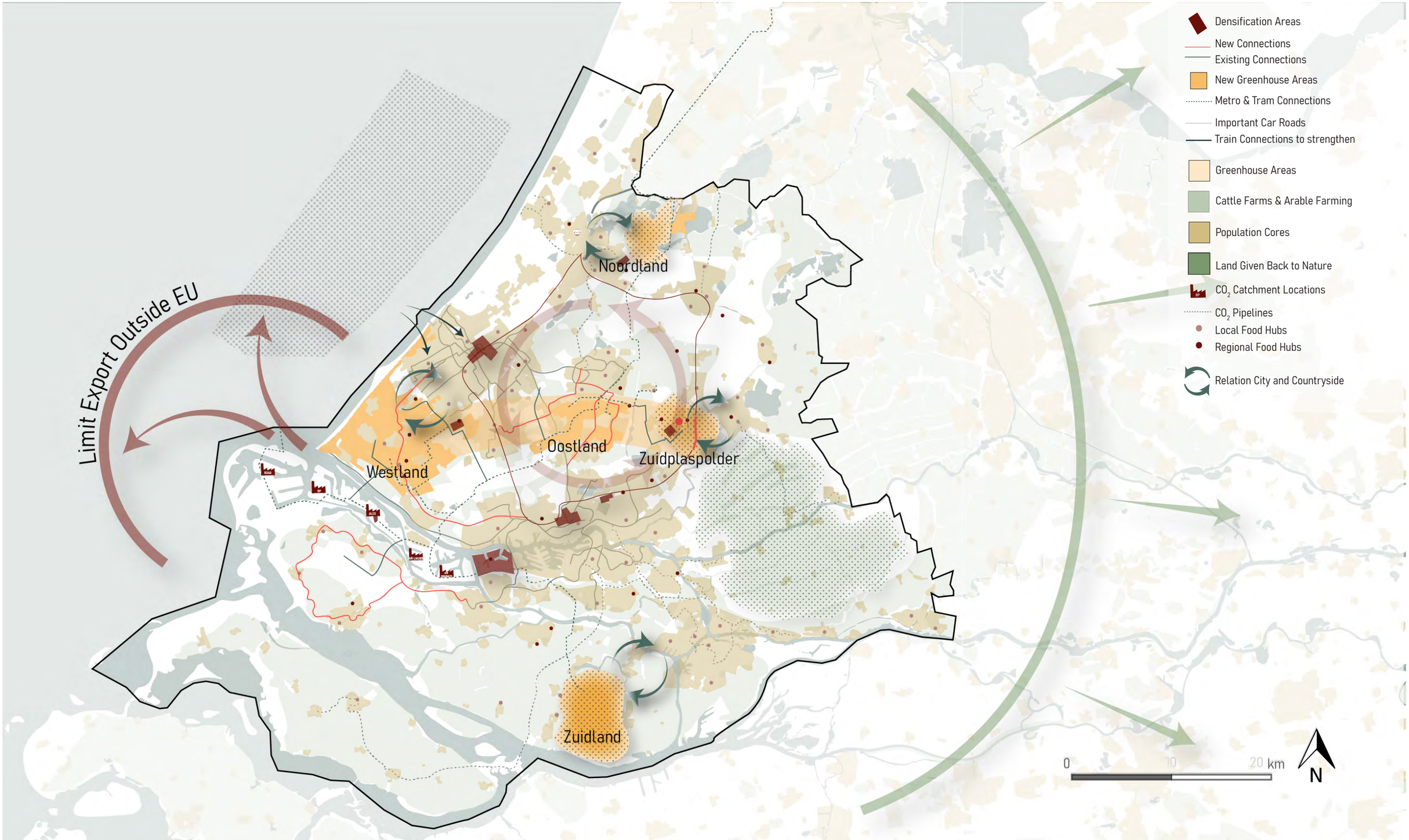
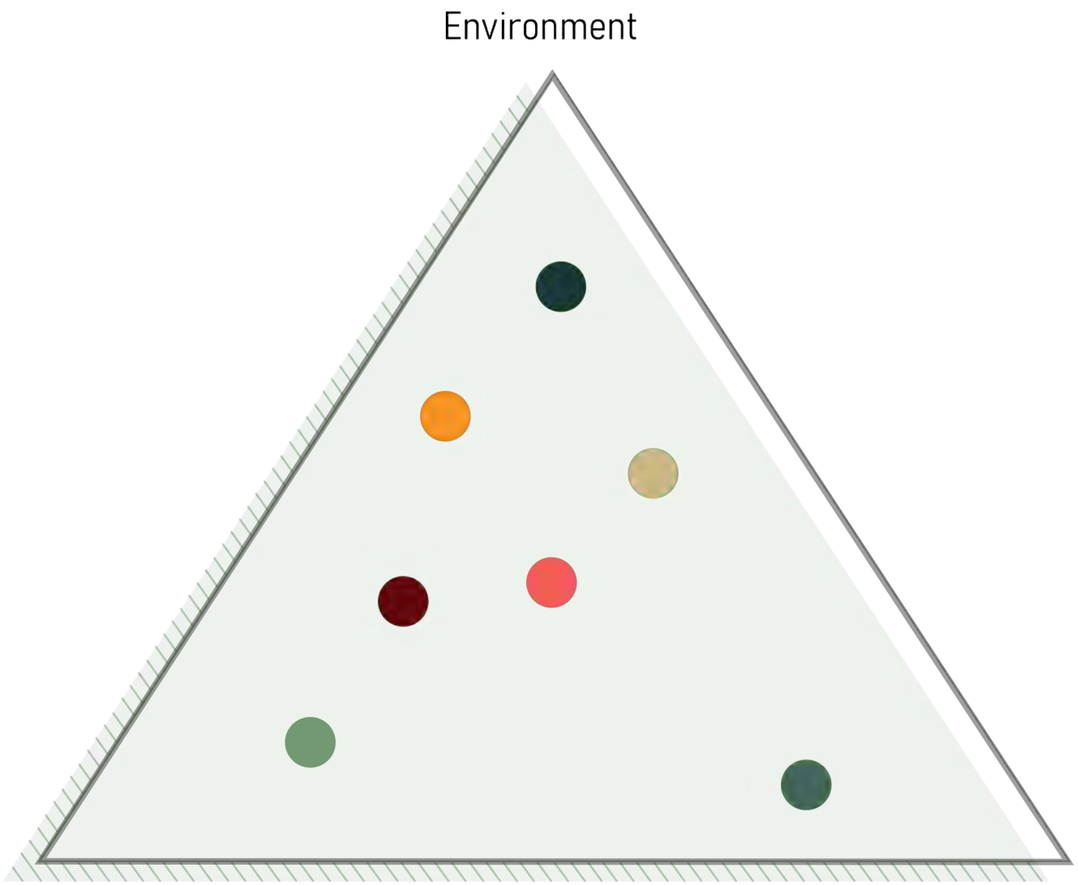


Fig. 91: Vision Map

Conclusion



- Limit import/export flows outside EU
- Build a regional food system with food hubs
- Create a regional knowledge network
- Create a link between cities and rural areas
- Create a waste & water system based on R-ladder
- Build a sustainable CO_2 and seaweed network
- Create a new economy with new jobs

Fig. 92: Assessment Sustainability Vision

An important part of the research question is that the new regional food system should be sustainable on all three levels: the economic, the social and the environmental level. To assess this, the vision principles can be put in the sustainability framework.

From here it becomes visible that the solutions in the vision together cover all levels and thus that the proposed vision can be called sustainable.

06.
Strategy

Introduction

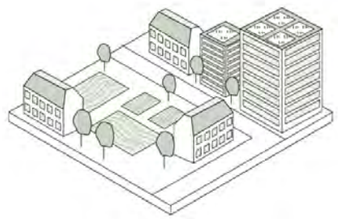
To achieve the vision, which is explained in the previous chapter in 2050, a strategy has been created. This strategy involves a toolkit of the strategic interventions, a general phasing, various regulations, a stakeholder analysis and some strategic interventions that are explained in depth. The phasing of the strategy is separated into four phases, these are explained on the following page. In the stakeholder analysis, compared to the analysis of South Holland new stakeholders are introduced and possible synergies and collisions are investigated. The interventions consist of the establishment of living labs and food hubs, the sustainable use of fertilizer and the development of a seaweed farm. Lastly, to reach a more sustainable agricultural sector a low-carbon agricultural marketing scheme is explained.

The Toolkit

To achieve the goal of a regional and circular agri-food system, a toolkit is developed that contains the main principles which are mentioned in chapter four. The toolkit is divided into five categories: sustainable city, policy, knowledge network, transformation of countrysides and sustainable greenhouse system.

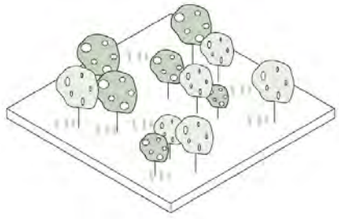
Sustainable City

Urban Farming



Establish an urban farming system with the community as a way to increase consumers' emphasis on the agri-food chain.

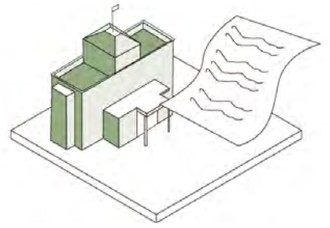
Food Forest



Food forests can have a positive effect on the environment, produce food, and at the same time have the effect of educating and raising consumer awareness.

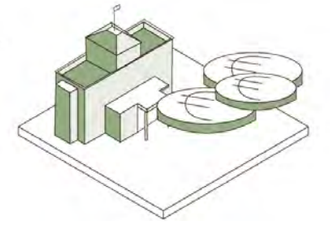
Policy

Regulation



The government has to formulate relevant regulations to stimulate the establishment of a regional agri-food system.

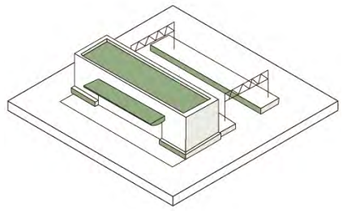
Financial Support



The government has to provide financial support to stimulate the establishment of a regional agri-food system.

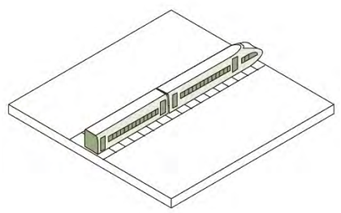
Knowledge Network

New Station



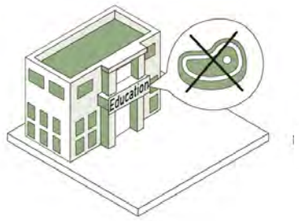
Build new stations to accelerate the connection of knowledge locally.

New Train Line



Establish a new route to form a chain of knowledge dissemination.

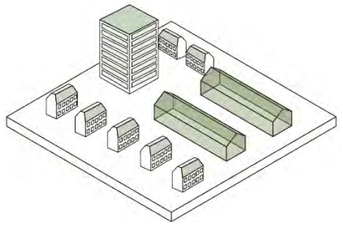
Education System



Dissemination of knowledge about sustainability through educational and knowledge institutions to accelerate that consumers establish a sustainable lifestyle.

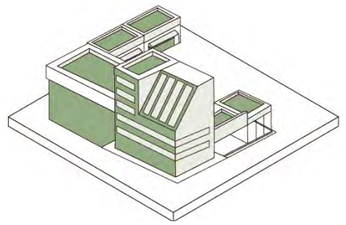
Transformation of Countryside

Living Lab



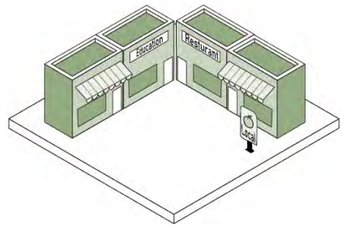
A living lab as a transformation area, where new interventions will be tested. The new system will be created by expanding from this living lab.

Regional Food Hub



A centrally located facility with a business management structure for merging, storing, processing, distributing and marketing the produced regional food.

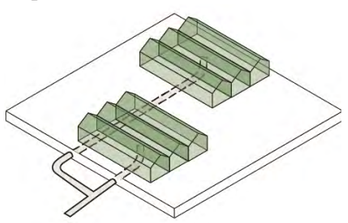
Local Food Hub



A facility that combines educational and cultural sevices with local food markets where consumers can directly buy food from the farmer and gain knowledge about sustainability.

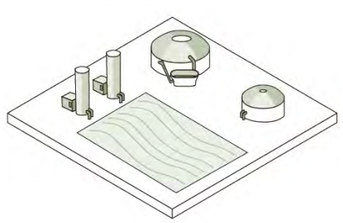
Sustainable Greenhouse System

CO_2 Pipeline Extension



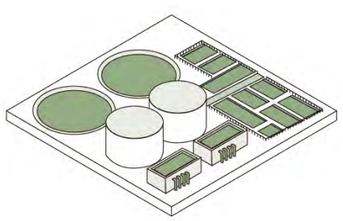
Extending the transportation pipelines of carbon dioxide to new greenhouse areas to recycle and reuse carbon dioxide from areas where there is a surplus.

Composting System



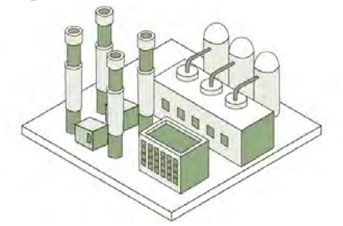
Establish a compost system on the countryside to increase proces efficiency. Consumers also are encouraged to collect their waste and sell it to farmers to strengthen interconnection.

Water Treatment & Fertilizer Hub



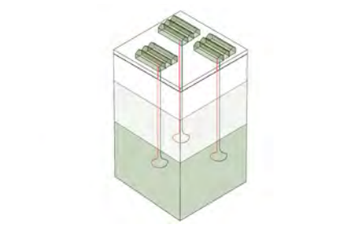
Expand the system for extracting phosphorus from waste water at the water treatment plants to recover this valuable raw material.

CO_2 Catchment Plants



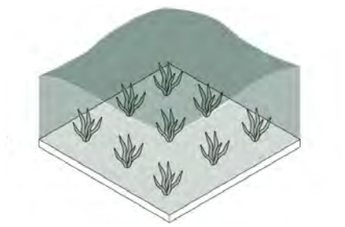
A facility to capture and collect the carbon dioxide emitted by industrial areas. At the same time, the carbon dioxide can be refined into raw materials and reused in greenhouses.

Geothermal Energy



Develop geothermal energy as a renewable energy source to supply the thermal energy demand of greenhouses to increase the sustainability of greenhouses.

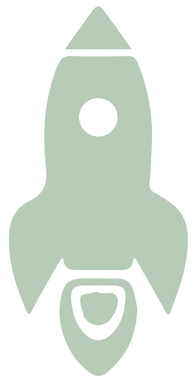
Seaweed Farming



Produce seaweed as a substitute for daily dietary protein sources and as a substitute for fodder.

Four Phases

Start-up Phase | **Try-out Phase** | **Expansion Phase** | **Pull back Phase**

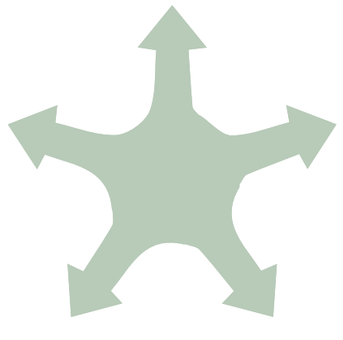


Build relations and awareness

Start from current small scale initiatives and let them grow, build the knowledge network and start education to develop awareness.

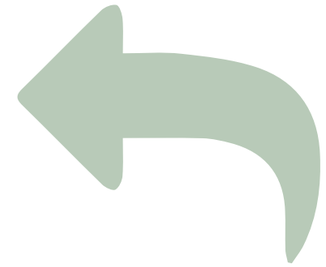
Do investments

Now that relations are established, investments can be made towards various strategic interventions and they can be tried out on the small scale.



Develop

Strategic interventions have been optimized and are ready to be Scaled-Up and be developed on the larger scale.

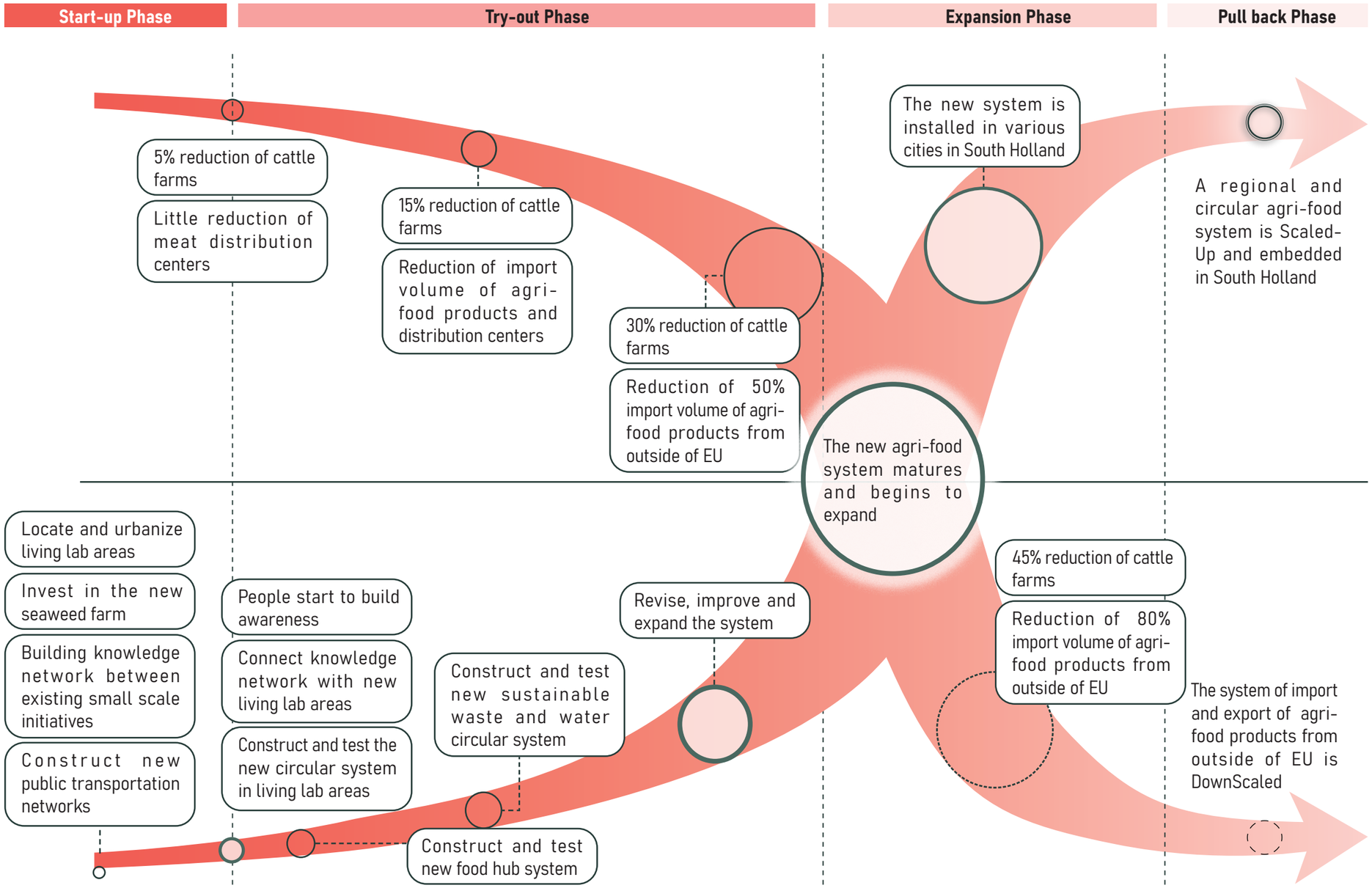


Pull Back

Pull back as a government and let the new circular and regional oriented agri-food system work independently.

The strategy proposed in this report can be achieved in four main phases. These phases form the guiding line through the phasing and each has its own character. The first phase is the start-up phase. Here, relations are built and the role of the government is mainly to support stakeholders and bring them together. In this phase, the government does the spatial interventions which support relations and makes the regulations needed for that. The second phase is called the try-out phase. In this phase, relations are made and investments will be done. Spatial interventions needed for the vision in 2050 will be tried out and optimized. The third phase is the expansion phase in which the new system will be spread out over the region with the support of the government. The last phase is about letting the sector become independent and pull back as a government.

Phasing



The four phases described on the previous page are defined further in the X-curve besides. Also, the regulations formulated on the next page are intended to support and encourage the implementation of strategies at all four phases.

In the start-up phase, the relationship between various small scale initiatives is established and the living lab areas are situated and urbanized. A knowledge network is created to make the consumer more aware of their current diet and to educate farmers about a sustainable agri-food system. At the same time, investments are made in the construction of a well-connected public transport network. This network facilitates the dissemination of knowledge by making a physical connection between the newly established living labs. The regulations at this stage will focus on reducing import and export flows, supporting the regional food system and creating a knowledge system to support innovation.

Because of the change in diet from the consumer, space will come to be free in the second phase. This space will be returned to nature. In the urbanized living labs, food hubs will be created and tested out until a small scale local food system is created. Therefore, the regulations at this stage concern the investments and subsidies for the construction of new development projects and facilities.

In the expansion phase, a regional food system is created and perfected by transforming distribution areas into regional food hubs. The development of a regional and circular agri-food system will gradually take place in South Holland.

The final phase is all about the government pulling back and letting go of the subsidies to let the regional system become independent.

Regulations

Start-up Phase

Policies:

- New policies must be drawn up to reduce import and export flows. In the start-up phase, this policy can start with import and export taxes on agricultural-related goods to and from outside the EU.
- This strategy includes a proposal to extract phosphorus from sewage water to use as a sustainable fertilizer. Therefore, policies and subsidies should be made for wastewater treatment plants to include this system.
- To make new and existing greenhouse horticulture areas climate neutral, policy must be drawn up for the use of CO_2 from industrial areas, geothermal energy and recycled water.

Investments:

- The first phase of the strategy is all about building a network and Scaling-Up small scale initiatives. Therefore, investments or subsidies should come free to support the initiatives.
- To build the network of knowledge, the region should be well interconected. This strategy proposes some interventions for new public transport lines. The government should invest in these new lines to have them realised.
- Financial support for the training of teachers on the topic of sustainability is also an important aspect of the creation of the knowledge network.

Try-out Phase

Policies:

- In the try-out phase, food hubs start to arise. To make them work properly, policies should be made that say that public functions like schools and hospitals should make use of these food hubs and should only use local food.
- To decrease the emissions of the agri-food sector, regulations should be implemented on the use of sustainable additives, like seaweeds, in fodder.
- In addition, more and more rules must gradually be introduced for import and export flows outside Europe and a non-sustainable diet must be discouraged by, for example, introducing meat taxes.

Investments:

- Because of the regulations made about climate neutral greenhouses, the government should support the extension of the CO_2 pipeline network that goes to the greenhouses.
- To expand the knowledge network created in the first phase even more, there has to come financial support from the government for agri-tech groups to share, disseminate and encourage adoption of advence in agriculture science and technology.

Expansion Phase

Investments:

- Since the expansion phase is all about Scaling-Up the food hub network, the government should invest in the construction and the extensive use of these hubs.

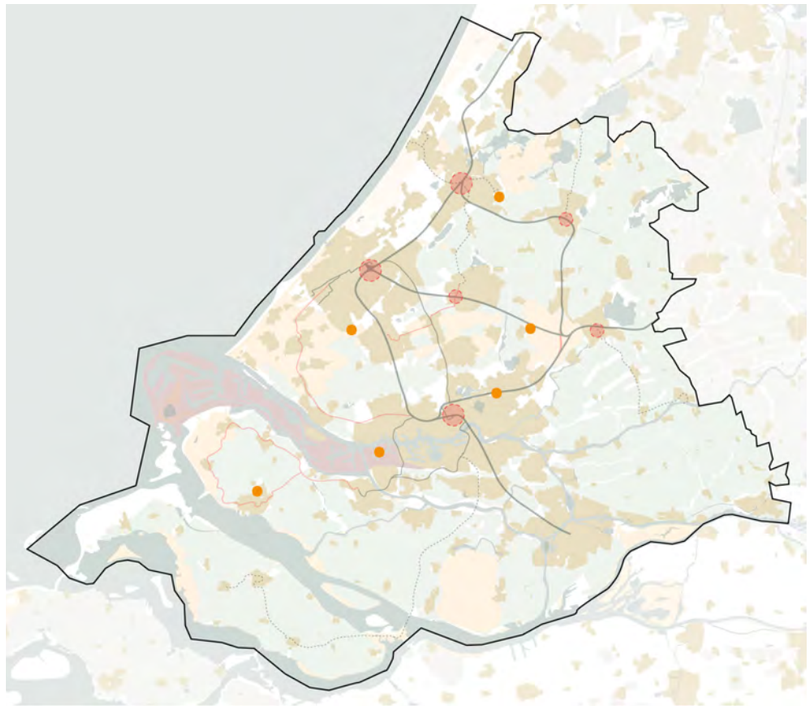
Pull back Phase

In the pull-back phase no additional policies are made and subsidies are stopped to let the new regional focussed agri-food system become independent.

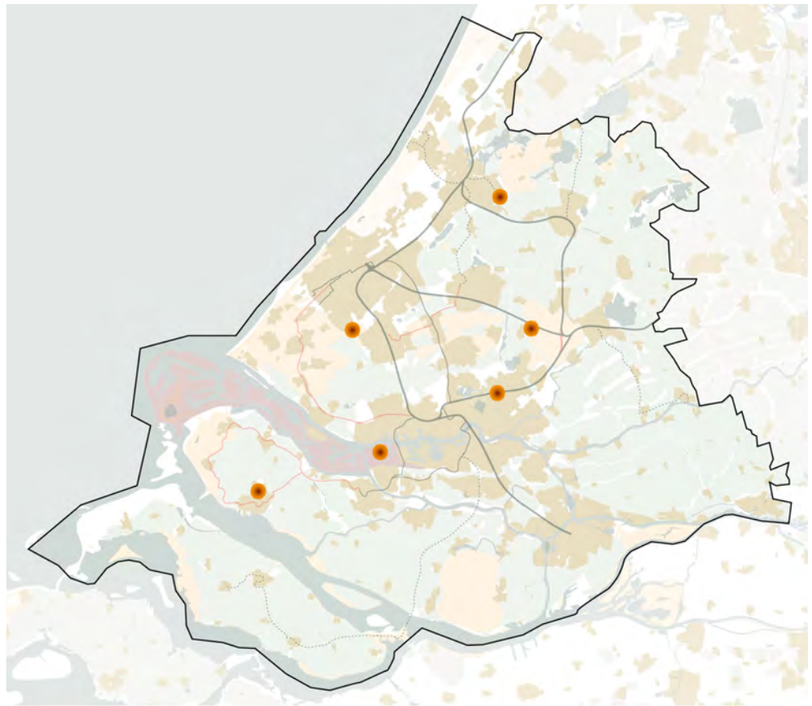
Strategic Interventions

Living Labs

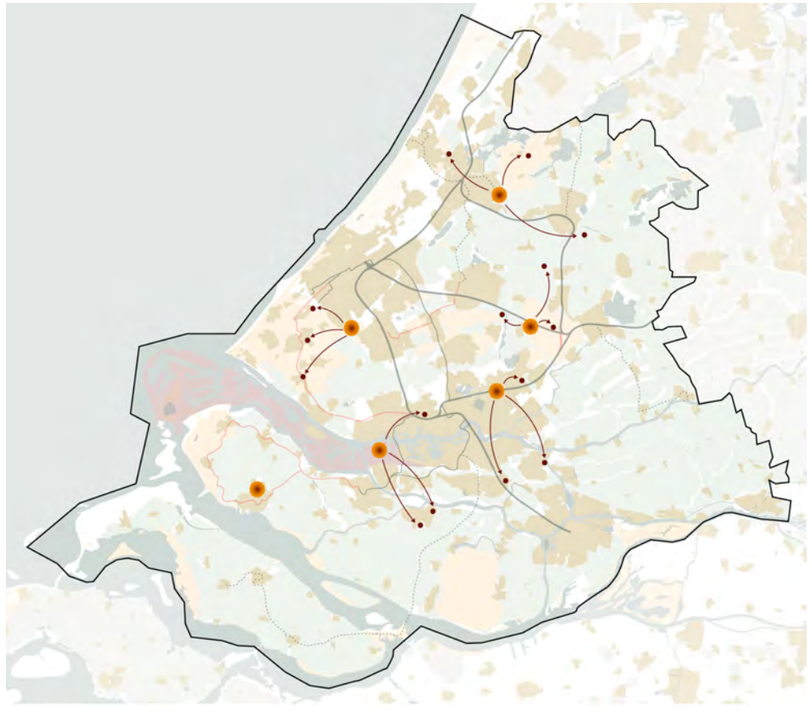
Phase 1 - Start-Up



Phase 2 - Try-Out



Phase 3 - Expansion



Phase 4 - Pull Back

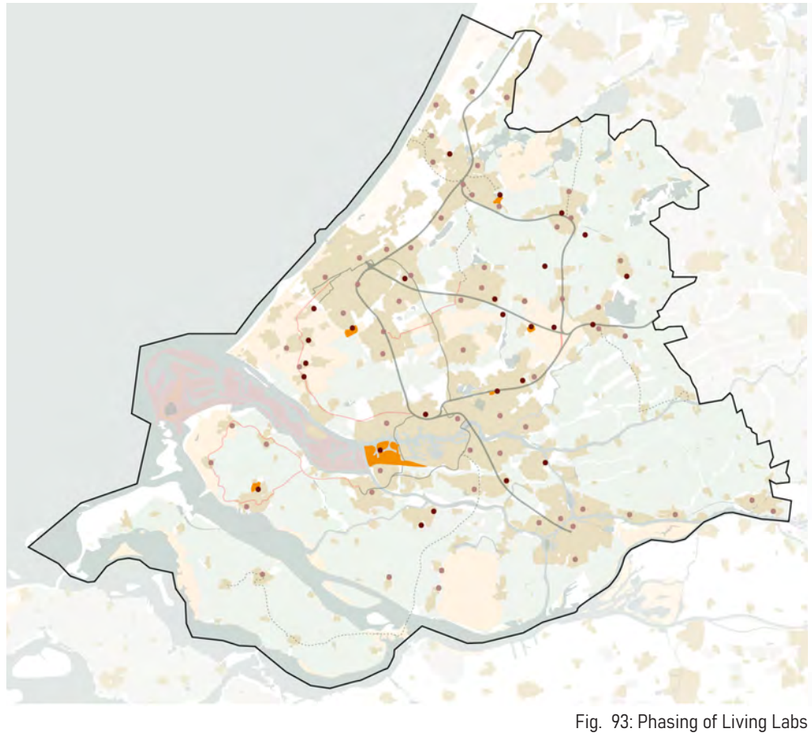


Fig. 93: Phasing of Living Labs

A living lab is concurring with the trend of the involvement of users in open innovation processes. It could be defined as “a user-centric innovation milieu built on everyday practice and research, with an approach that facilitates user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values” (Bergvall-Kareborn et al., 2009).

In this booklet, a living lab is interpreted as a transformation place, where new inventions will be tested in a new or already existing urbanized area. It is a place where the food hubs explained in the vision will start to develop to eventually spread out over the region. In the living labs, the food hubs can be tried out with a small population to see which size and function work best for a food hub. The living labs contribute to creating a relation between cities and countryside and awareness about the current diet among citizens.

In the first phase of the living labs, the areas are specified and urbanized. The focus in this phase is on the change of diet (rethinking) and building relationships between actors. These relationships are built by initiating meetings and conversations between key actors. Small scale initiatives are supported in this phase and are situated in densification areas nearby infrastructure to make knowledge sharing accessible.

When relationships have been established, the second phase begins. Investments can be made in the construction of food hubs in the living labs and the hubs can be tried out until they are used optimally by citizens and farmers. In this phase, it is also important to ensure that public functions (such as schools and hospitals) make use of these food hubs to allow them to grow.

Once the food hubs are optimized, subsidies should be released to let the food hubs grow and deploy them on a larger regional scale. The spreading of the food hubs is happening simultaneously with the transformation of distribution centres. These centres will be used less by DownScaling import and export flows.

In the final phase of the living labs, the government will pull back by stopping the subsidies and allow the system to become independent.

Strategic Interventions
Sustainable fertilizers

To make the region more circular and strengthen the relationship between farmer and the city, a system will be implemented where fertilizers are obtained more sustainably.

Our faeces contain phosphorus, which is a scarce substance that can be reused as a fertilizer. Water purification companies can extract the phosphate from the sludge that remains after purification of the sewage water. This is done by adding magnesium salts after the purification. If this process is carried out in a controlled manner, struvite crystals remain that can be used as a phosphate-rich fertilizer. In this way, farmers can feed their crops more sustainably (de-Bashan & Bashan, 2004). If the phosphate is extracted in the water purification companies, this could not only reach the farmer via the food hubs, but the ordinary citizen could also obtain this sustainable fertilizer in this way. This stimulates meeting and thus also the relationship between the farmer and the citizen.

Another way to make greenhouses and agriculture more sustainable is by reusing organic waste. In this strategy, a proposal is made to collect organic waste from surrounding towns and villages and distribute it to farmers from recycling centres. Regional food hubs could play a role in this distribution since they also provide distribution from and to farmers. To keep the chain as short as possible, the farmer could compost and use the waste himself. The first step in this process is to provide the farmer with knowledge about composting, after which the self-composting systems can be installed. The food hubs could contribute as an education centre for farmers to teach them about making their greenhouses and agriculture more sustainable.

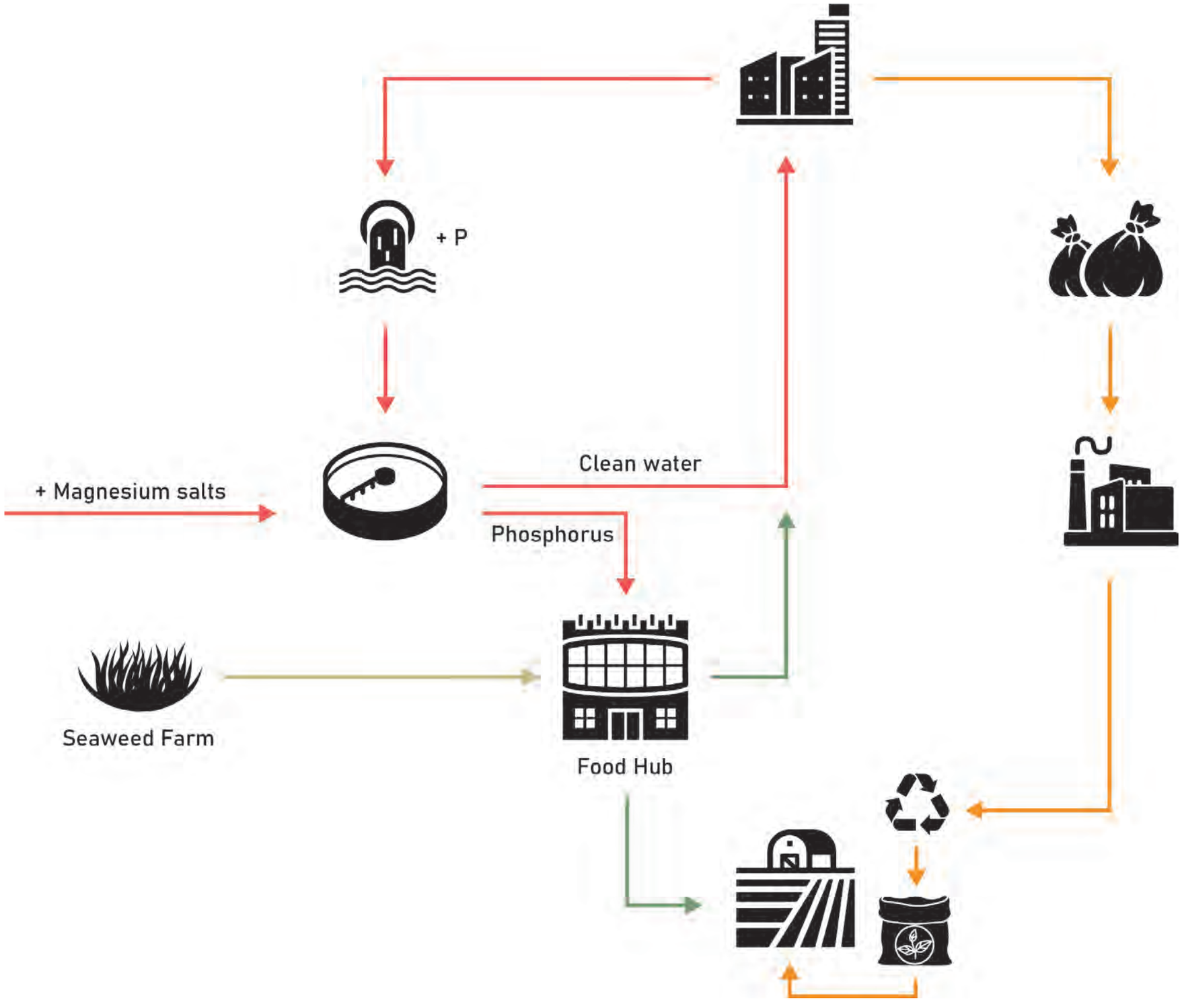


Fig. 94: Sustainable fertilizer to the farmer and the consumer

Strategic Interventions

Seaweed Farm

Phase 1

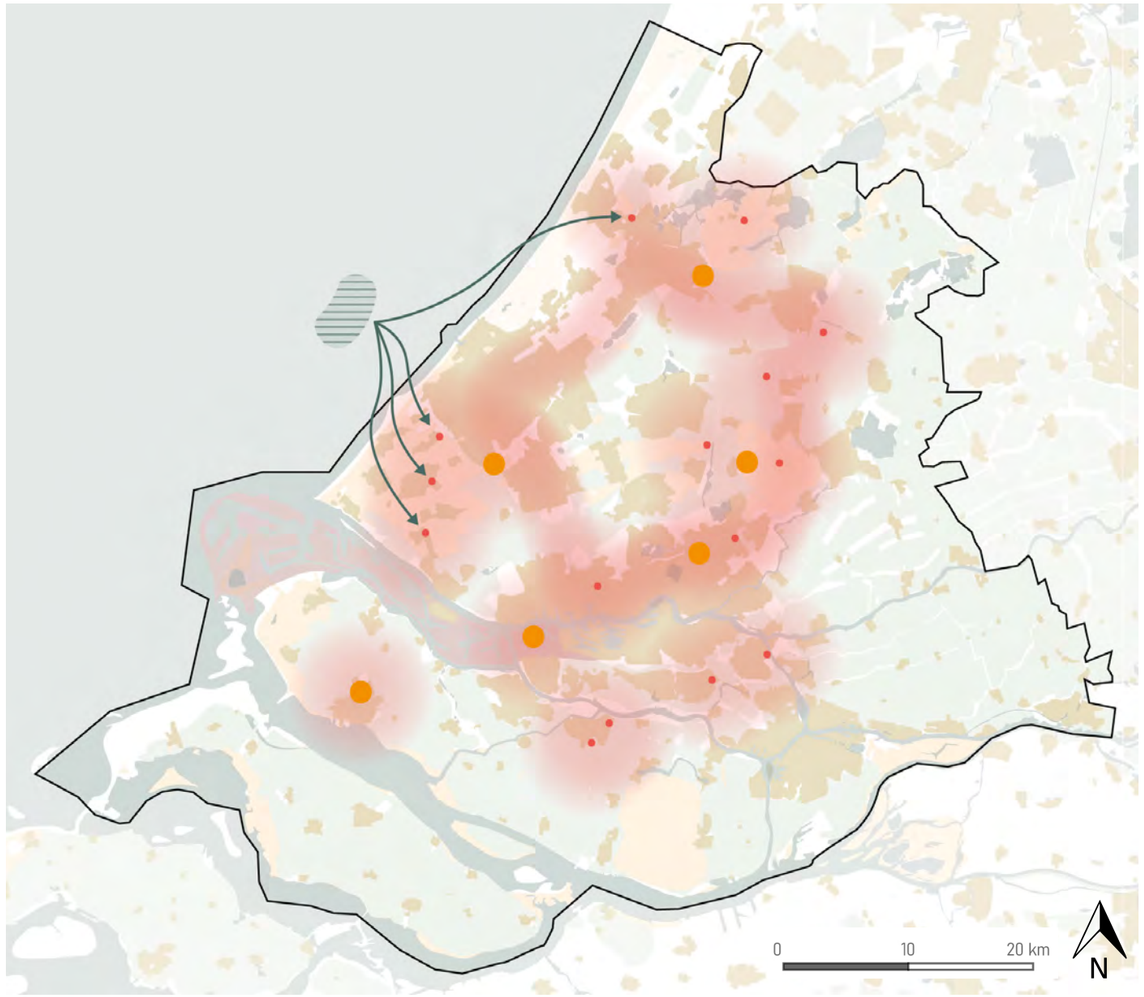


Fig. 95: Phase one of seaweed farms

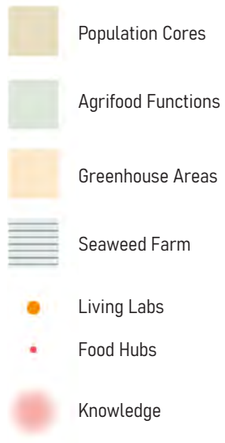
Phase 2

Fig. 96: Phase two of seaweed farms

Even if we eat less meat, more and more land is needed to meet human food needs. Seaweed can be a way out for this. When growing seaweed, only sunlight is needed, while the water is purified and it is a sustainable crop. Seaweed is easy to process into healthy food for humans and animals (Wageningen University & Research, 2020). Besides, research has shown that seaweed has great potential to limit methane production in cows when it is added to animal feed (Maia et al., 2016). Since the Dutch North Sea is suitable for growing seaweed (Froehlich et al., 2019), a large-scale study can be conducted into the actual reduction of methane emissions.

To conduct this seaweed system, the first step is to spread the knowledge about the advantages of the product. This can be done through the knowledge network and educational institutes in the regional food hubs. In this first phase, the seaweed farm is set up on a small scale, where the product is distributed to some regional food hubs. In this way, the consumer and the farmer cannot only gain knowledge about seaweed but can also get familiar with it.

In the second phase, when the market for the product has grown, the seaweed farm can grow as well. The product will be distributed and sold all over the region in regional and local food hubs. Livestock farmers and consumers can buy the product in the hubs, which could not only stimulate consumer awareness but can again also serve as a reason for the consumer and the farmer to meet.



Strategic Stakeholder Analysis

To implement the strategy effectively and reliably, newly added stakeholders related to the strategic interventions are added to the stakeholder diagram (Figure 97, shown in pink).

In the analysis diagram, stakeholders are divided into nine categories: governance, producer, transportation, knowledge, waste treatment and energy, construction, processing, supermarket and consumer sectors.

In the implementation of future strategies, it can be found that the synergy between stakeholders mainly occurs in three categories, the synergy of the sustainable living environment, the synergy of the knowledge network, and the synergy of the living lab and food hub. These three new synergies and the existing synergies have created a thorough and highly involved regional and sustainable agricultural food system.

Synergy

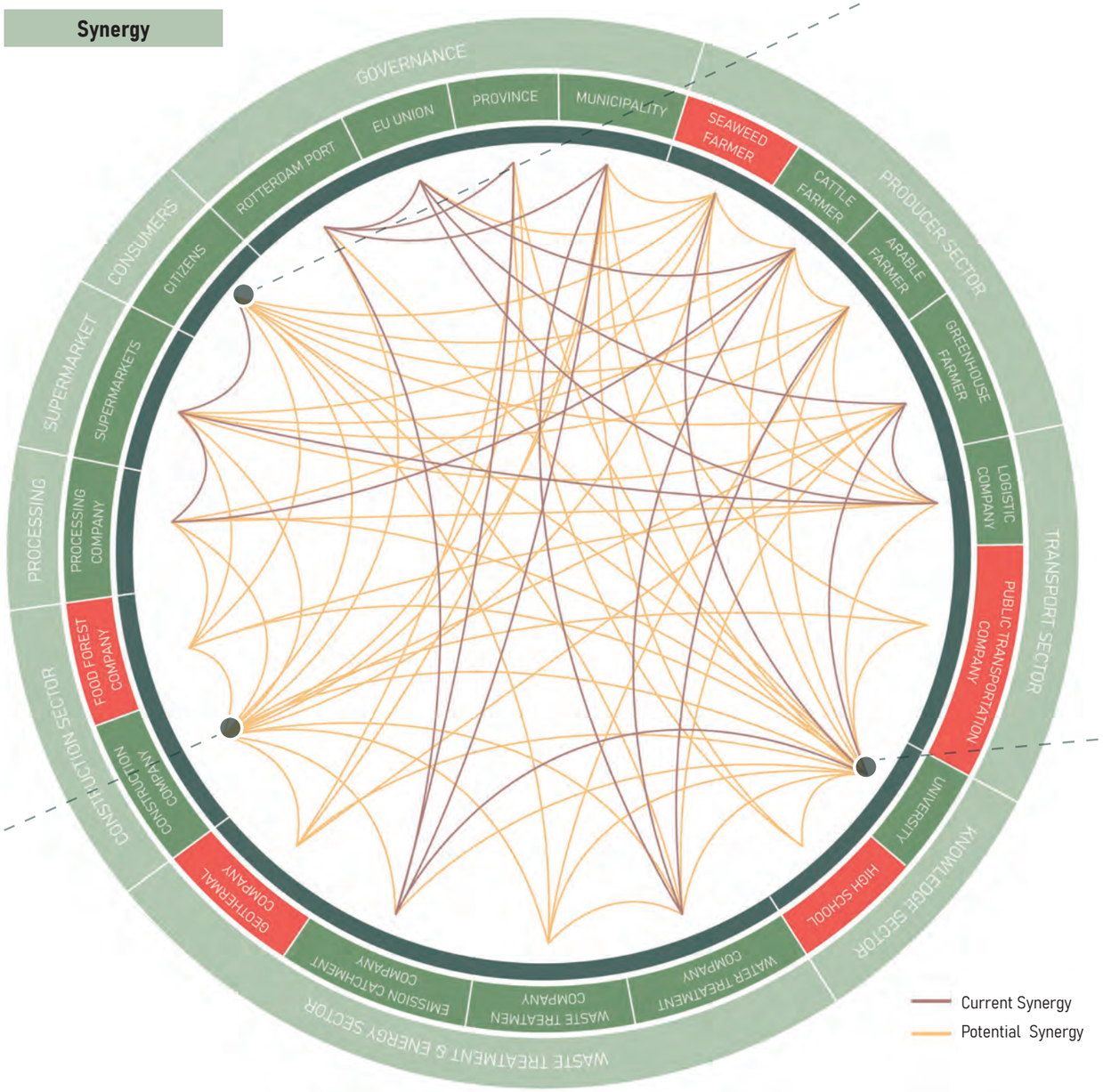
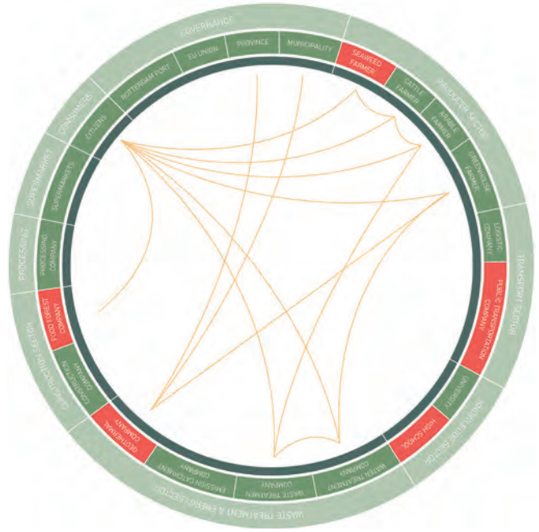


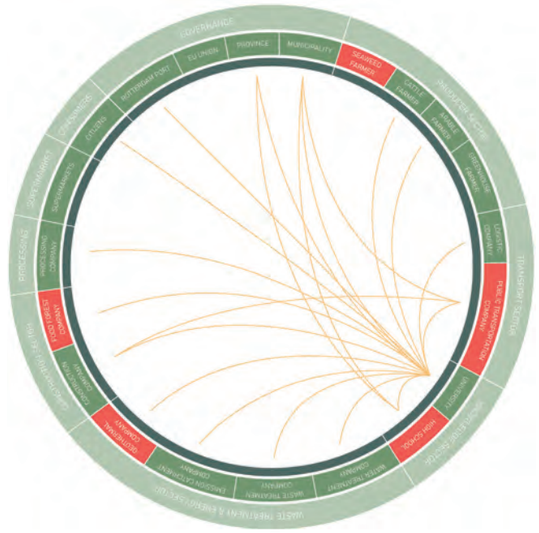
Fig. 97: Stakeholder synergies during strategic interventions

Sustainable Built Environment Synergy



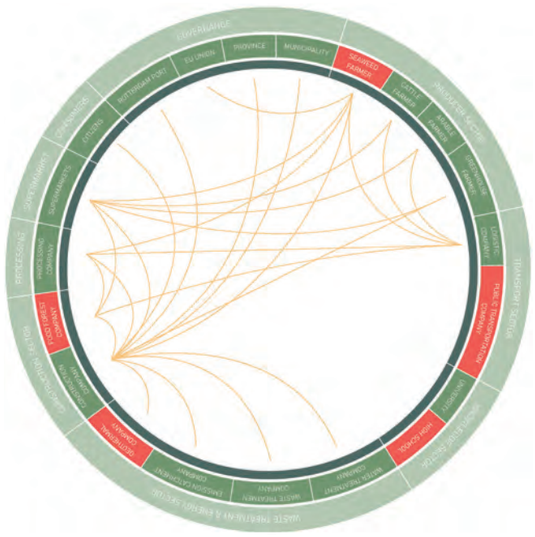
The potential synergy mainly occurs among the citizens. To build a sustainable living environment, a cooperative relationship between citizens, water treatment companies and waste treatment companies must be established to embed the reuse and recycle concept. At the same time, a cooperative relationship between farmers and consumers can be established through the local food hub in the city.

Knowledge Network Synergy



In the synergy of the knowledge network, the potential synergies happen between all the stakeholders to build up a transparent knowledge network for example universities, to stimulate the transition of sustainable and innovative knowledge.

Living Lab & Food Hub System Synergy



In the synergy between the living lab and the food hub, it can be found that the living lab and the food hub provide all stakeholders to build a cooperation space to reduce the inefficiency in the process of the agricultural food system.

Strategic Stakeholder Analysis

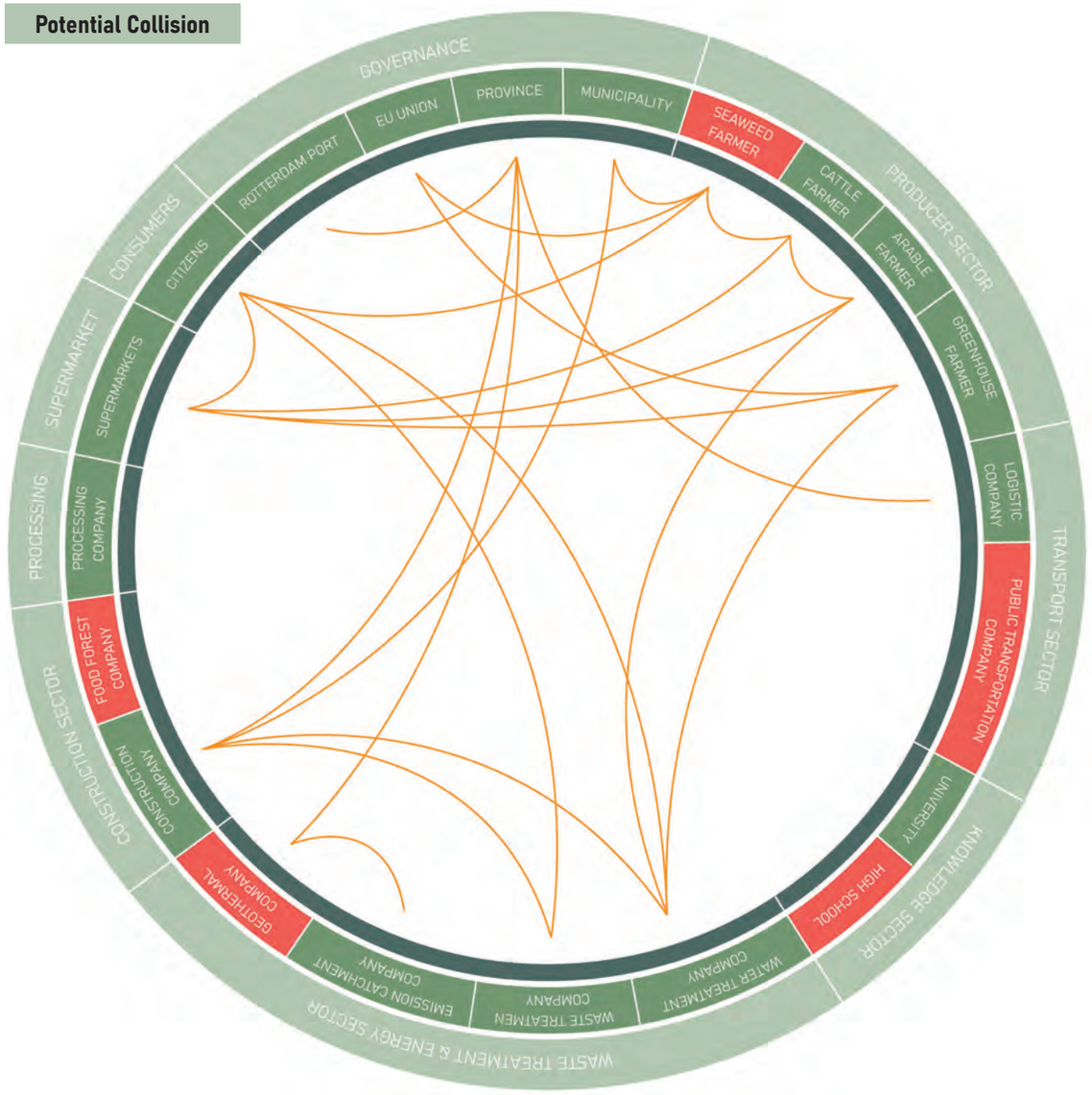


Fig. 98: Stakeholder collision during strategic interventions

It can be seen in the collision analysis that many collisions are caused by incomprehension and rejection of the new system. For example, people may not be able to accept the installation of a new waste recycling system in their homes. At the same time, we can see that many collisions originate from conflicts of interest between producers and supermarkets. It is not difficult to find that the conflicts are mostly about the interests and differences in values arising from cooperation. Therefore, the establishment of good knowledge and information dissemination can not only strengthen the cooperation between stakeholders but also effectively reduce the occurrence of collisions.

07.
Strategic Projects

Location of Strategic Projects

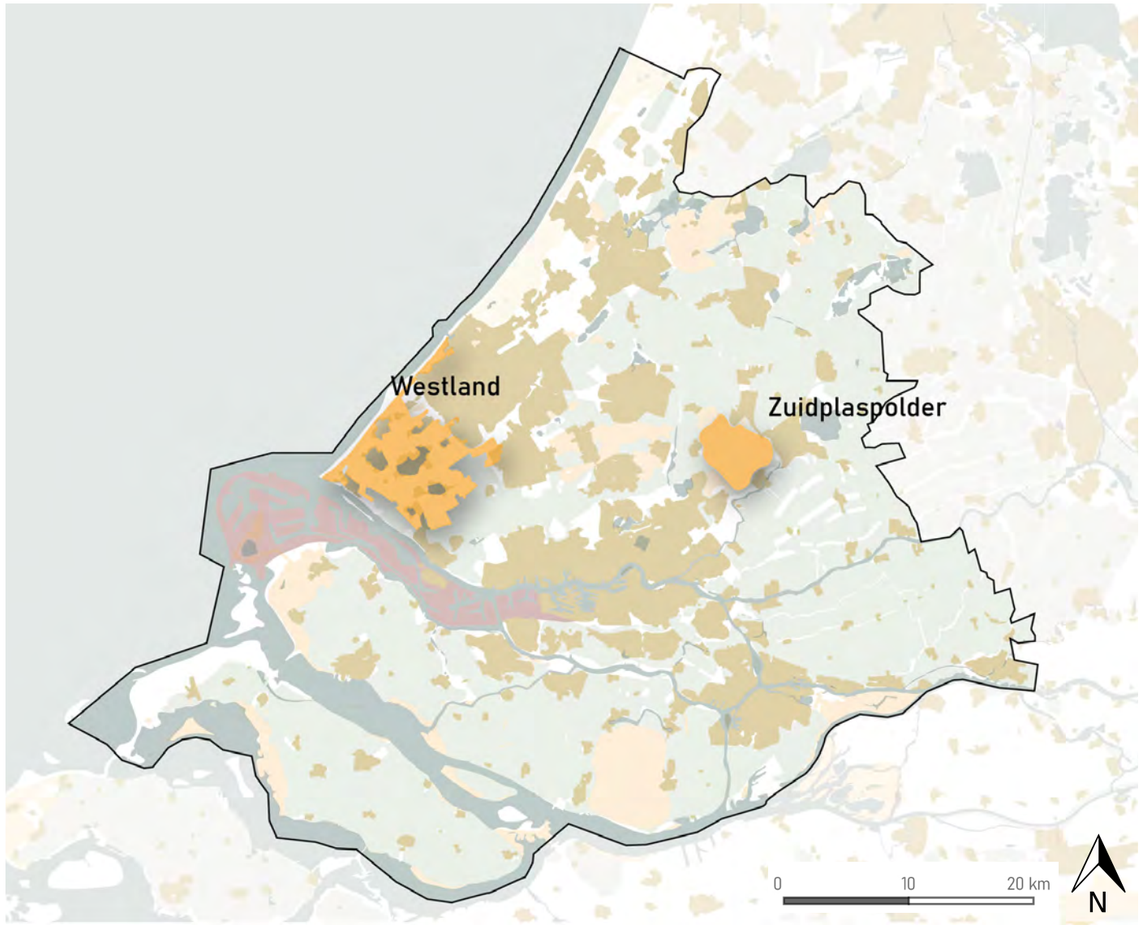


Fig. 99: Location of strategical projects

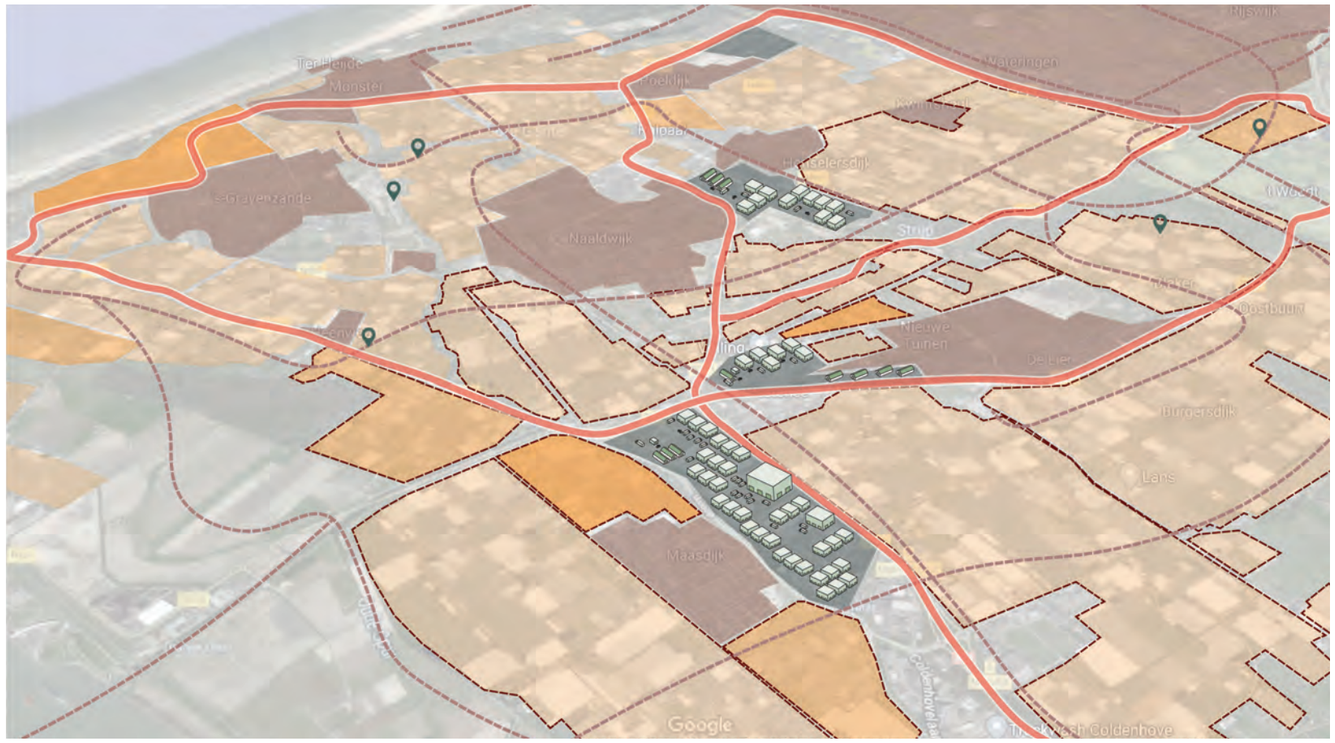
To show how DownScale-Up is spatially formed, two striking examples are given. The projects show the most important strategic interventions. The two examples are:

1. Westland
2. Zuidplaspolder
3. Port of Rotterdam

The first example shows how an existing greenhouse area can be transformed into a more sustainable and locally oriented area. The second example shows how a current cattle farm area is being transformed into a circular greenhouse area that focuses on the regional scale. The third project, the Port of Rotterdam, is focussed on its own transformation by moving import and export companies and therefore making place for a living lab and other functions.

Westland

Current and Final Situation



Old Greenhouses
Medium Old Greenhouses
Relatively New Greenhouses
Greenhouses Connected to CO_2 Network
Cities / Villages
Distribution Centers
Main Roads
CO_2 Pipelines
Small Scale Initiatives

Fig. 100: Schematic view of the current situation in Westland (Source: Google Maps (n.d.), edited)

Sustainable Greenhouses Connected to CO_2 Network
Cities / Villages
Food Forests
Distribution Centers
Main Roads
Tram Line

Fig. 101: Schematic view of the final situation in Westland (Source: Google Maps (n.d.), edited)

The strategic interventions in Westland are mainly focused on making the greenhouse industry more circular and on the development of a local agri-food system. As explained in chapter five the phasing is made up of four consecutive parts: the start-up, try-out, expansion and pull-back phases. The phasing of Westland is then also divided into four different kinds of interventions: governmental, network, living lab and greenhouse, and food forest interventions.

In the current situation, only half of Westlands greenhouses are connected to a CO_2 network. Old oil pipelines can be reused for the transport of CO_2 from the Port of Rotterdam to the area of Westland. Therefore, the first step is to connect the rest of the greenhouses in Westland to this network. In this first phase, also the living lab area indicated with a one in figure 112 is densified and relations are built between actors by starting meetings and conversations. By doing this, a sustainable knowledge network can be created more easily. Regulations from the government need to be set about the sustainability of greenhouses to enable a reliable and affordable CO_2-free heat supply for the entire area. These regulations can contain for example the use of geothermal heat and the use of purified water from waste treatment plants that is currently discharged to the North Sea as irrigation water (Poot, 2012). Because of these regulations, some greenhouses can be demolished because they are too old and others become more sustainable.

The second phase starts when the living lab area is densified and space has come free for the development of food forests. In the living lab, a food hub can be constructed and can be tested out over the years until a small scale local food system is created. At the place where the old and demolished greenhouses stood, food forests will be located. Therefore, the first step is to prepare the soil and make a design for each specific spot. Once this is done, the food forests can be developed.

The third phase of Westland can start when the food hub is ready to Scale-Up and be spread out over the region. Because of the DownScaling of import and export flows, distribution centres can be transformed and reused as regional food hubs. Food forests can also start to contribute to the newly established regional agri-food system and they can be used for educational purposes for primary and high schools for example.

The last step to be taken is to pull back as a government and let the regional agri-food network grow and become independent.

Westland

Phasing

Fig. 102: Phase 1 (Source: Google Maps (n.d.), edited)

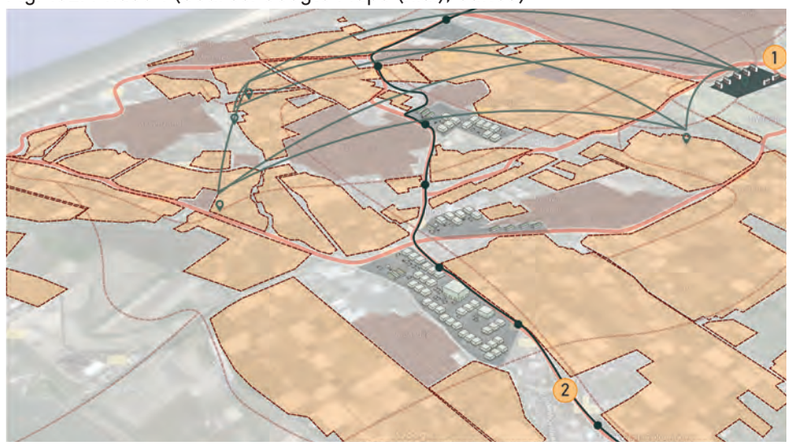


Fig. 103: Phase 2 (Source: Google Maps (n.d.), edited)

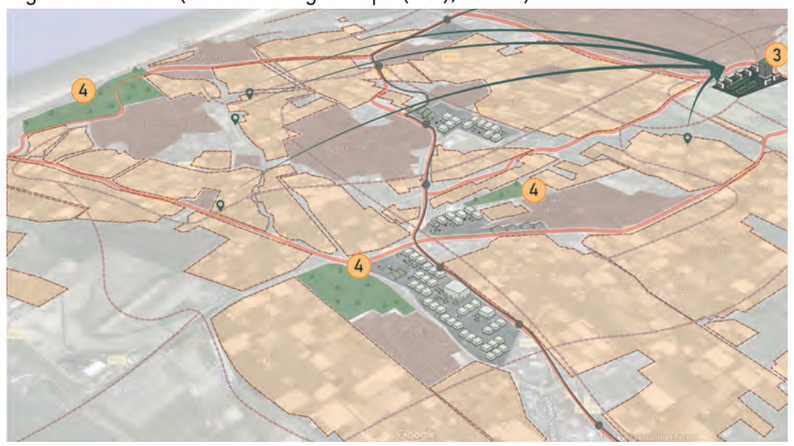
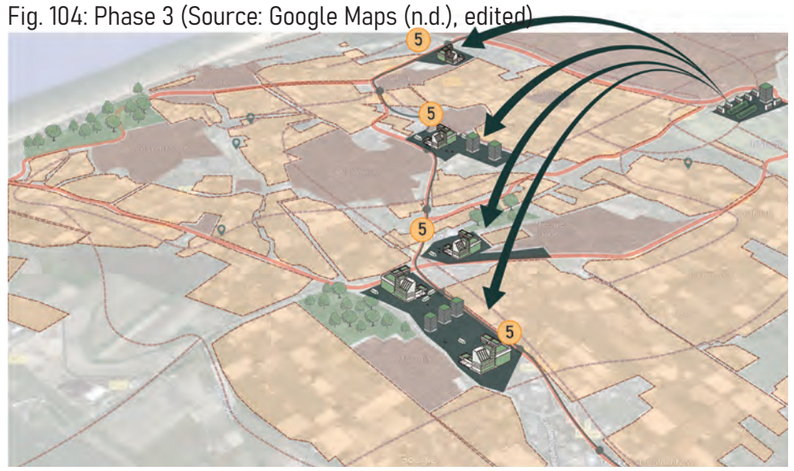


Fig. 104: Phase 3 (Source: Google Maps (n.d.), edited)



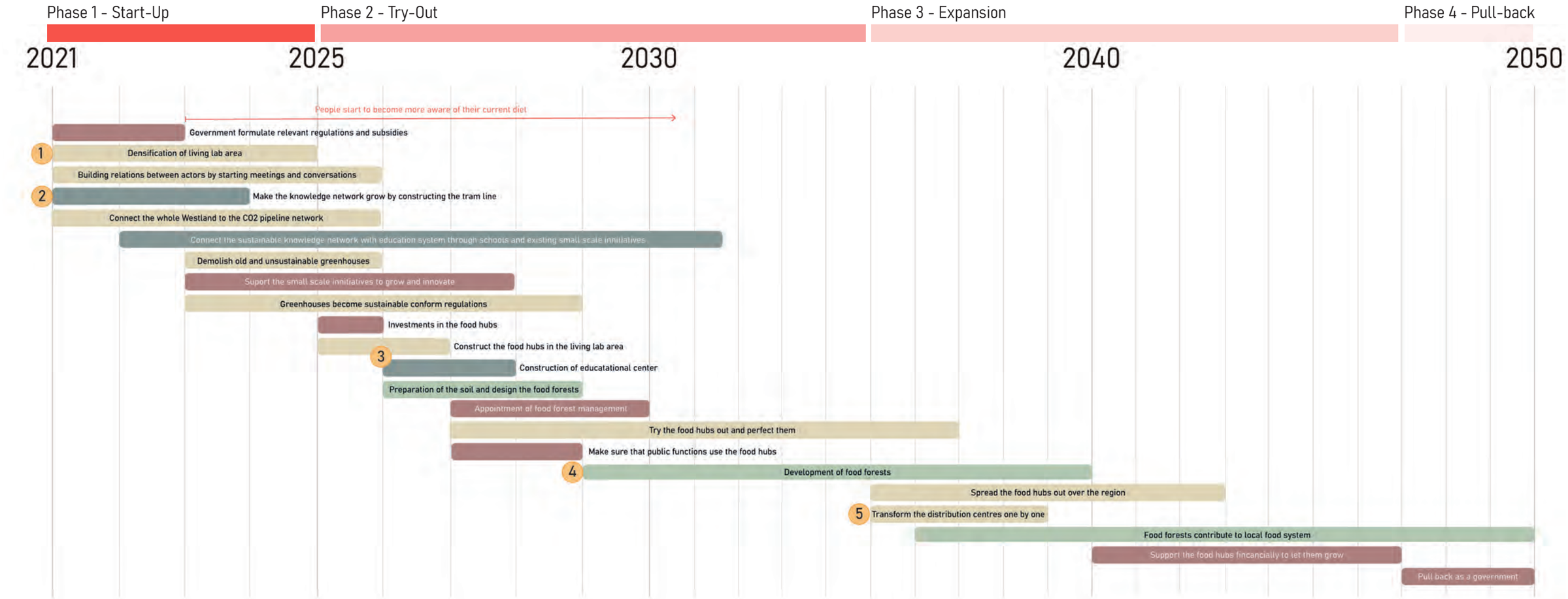


Fig. 105: Time Line Westland

Westland
Before and After

1

Fig. 106: Living next to greenhouses in the current situation (Source: Google SreetView (n.d.))

Fig. 107: Living next to a food forest in the future situation (Source: Google SreetView (n.d.), edited)

From living next to greenhouses to living next to a food forest.

2

Fig. 108: Distribution centre in the current situation (Source: Google SreetView (n.d.))

Fig. 109: Transformed distribution centre to a food hub (Source: Google SreetView (n.d.), edited)

How an unattractive distribution centre can be transformed to an attractive regional food hub.

Westland
Before and After

3

Fig. 110: Greenhouses and cattle farming (Source: Google SreetView (n.d.))

Fig. 111: Living Lab location (Source: Google SreetView (n.d.), edited)

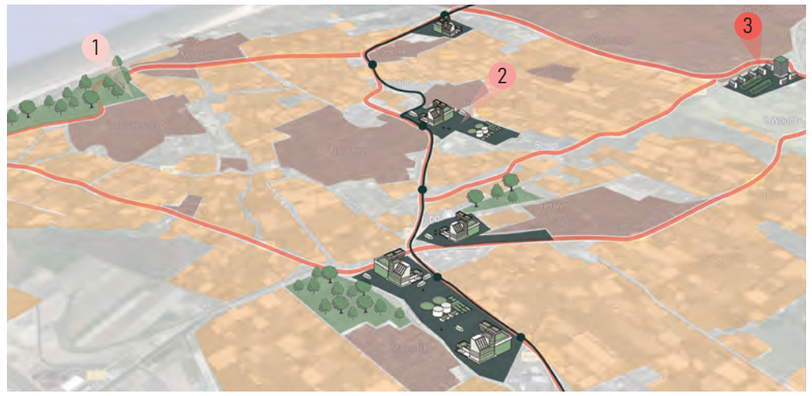


Fig. 112: Locations of impressions in Westland (Source: Google Maps (n.d.), edited)

The living lab area is now an area of mostly quite old greenhouses. These greenhouses will be either demolished or turned into an educational centre as shown in Figure 111. Because of the densification of the area, the food hub and this education centre meeting between farmer and citizen is encouraged.

Westland

Stakeholder Analysis

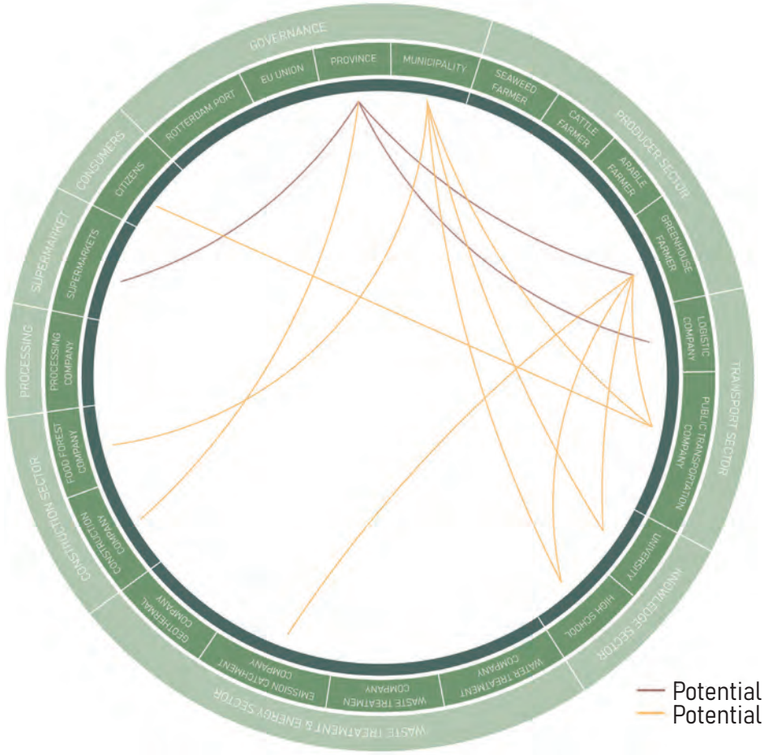


Fig. 113: Stakeholder analysis in the first phase

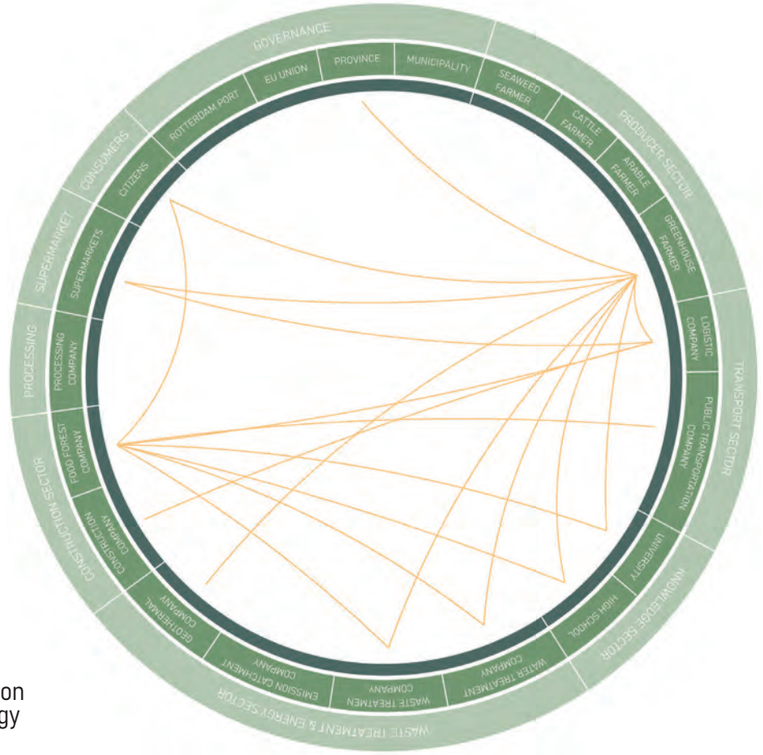


Fig. 114: Stakeholder analysis in the second phase

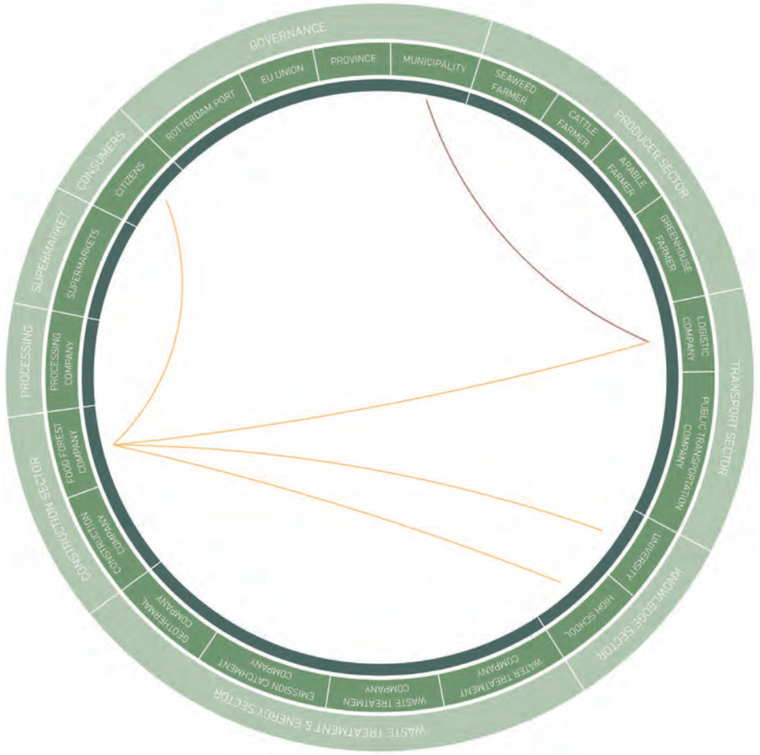


Fig. 115: Stakeholder analysis in the third phase

Phase 1 - Start-Up

The most important stakeholder synergies and collisions may occur with the greenhouses. In the first phase, new regulations about the sustainability of greenhouses will be implemented. Therefore, a potential collision may occur between greenhouses and the province. Through the establishment of the knowledge network, new synergies might occur between educational authorities and the greenhouses.

Key Stakeholders

- Citizens and Farmers

Government

- Province of South Holland
- Municipality of Westland

Energy sector

- OCAP

Construction Companies

- Zwarts
- VK-Bouw
- Jongerius

Transport Sector

- R-Net
- NS

Knowledge Network

- Wageningen University and Research
- Delft University of Technology
- Erasmus University
- Leiden University
- The Hague University of Applied Sciences

Small Scale Initiatives

- Boeregoed
- Stadstuinderij Buitenleef
- etc.

Phase 2 - Try-Out

In the second phase, the food forests will be developed. Therefore, many synergies will be taken place with this stakeholder. For instance, universities and high schools can learn and research from projects in the food forests. Also, citizens can play an important role in the establishment of the food forests, they can be part of the management team or can help to maintain the area. The synergy between greenhouses and citizens start to play up through the living lab and the construction of food hubs.

Key Stakeholders

Government

- Municipality of Westland
- Food Forest Management

Waste and Water Treatment Sector

- AZWI Nieuwe Waterweg
- Milieustraat Monster and Naaldwijk

Supermarket

- PLUS
- Jumbo
- Albert Heijn
- etc.

Phase 3 - Expansion

In the expansion phase, food hubs will start to Scale-Up and spread out over the region of Westland. A potential collision might occur between distribution centres and the municipality of Westland since they will be transformed and lose their original character. With the transformation of the centres, new jobs will start to occur. Therefore, this collision will not be seen as a big problem within the DownScale-Up strategy. With the growth of the food forests, their synergies will also grow and strengthen.

Key Stakeholders

- Citizens and Farmers

Government

- Municipality of Westland
- Food Forest Management

Zuidplaspolder
Current and Final Situation

Fig. 116: Schematic view of the current situation in the Zuidplaspolder (Source: Google Maps (n.d.), edited)

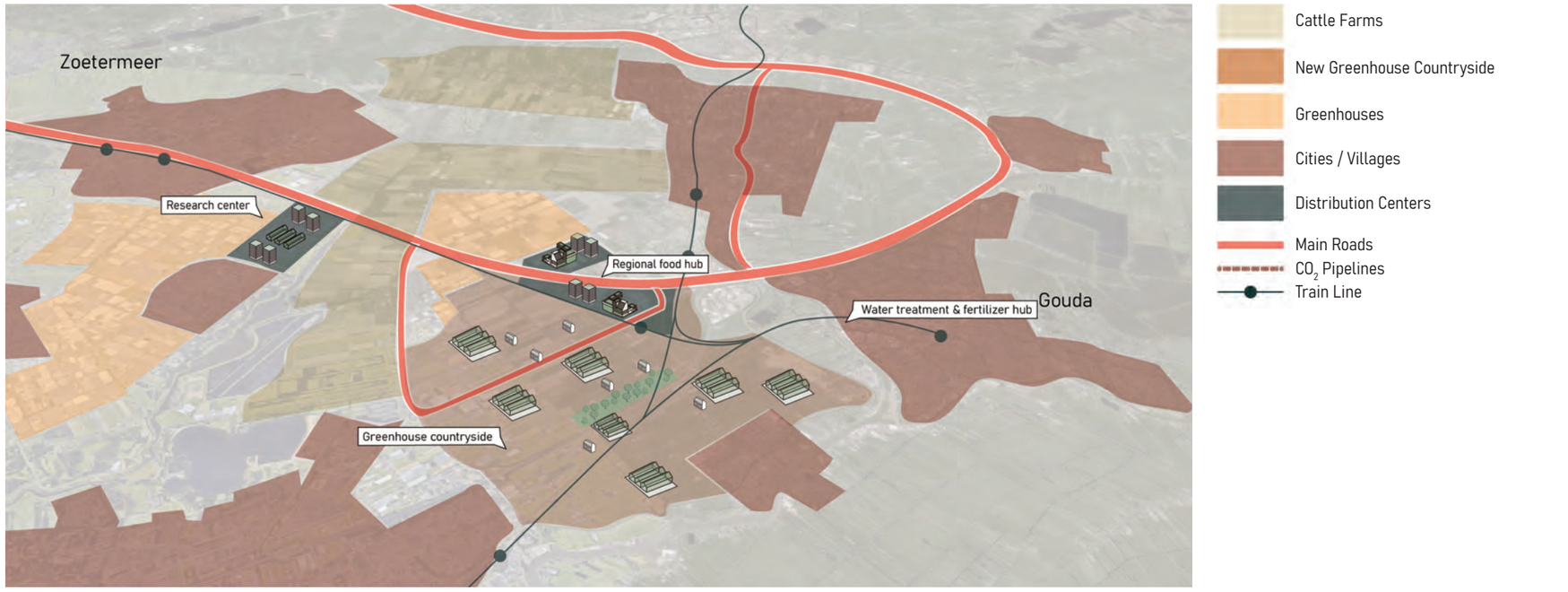


Fig. 117: Schematic view of the final situation in the Zuidplaspolder (Source: Google Maps (n.d.), edited)

The first phase starts with building up the relationship between the sustainable knowledge department in the municipality of Zuidplaspolder and the small scale initiatives in the surrounding cities and villages. Meanwhile, to efficiently exchange the knowledge in the future, the construction of a new train line also happens in this phase. It is also important to improve the road system in the Zuidplaspolder for further development as a new living area.

In the second phase of the transformation of Zuidplaspolder a living lab is constructed. Many new types of systems and facilities will appear in or close to the

village and residents in Zuidplaspolder will be allowed to test the feasibility of the new local and circular agri-food system. A Zuidplaspolder train station can be seen as a way for experts and interested parties to conduct field research and investigations.

A new regional food hub is constructed in one of the former distribution centres in the second phase. Farmers can directly sell the food on-site to local citizens or transport their products to the food hub and sell directly to consumers.

In the third phase, other distribution centres can be transformed into a new education hub that serves as a research centre for new knowledge and technology, delivering sustainable knowledge to citizens, and at the same time providing knowledge and technical support for the regional food hub and local farmers.

In the final situation, Zuidplaspolder has a brand new landscape. The area that was mainly dominated by cattle farming is transformed into a new village that combines sustainable greenhouses and attractive living areas.

Zuidplaspolder

Phasing

Fig. 118: Phase 1 (Source: Google Maps (n.d.), edited)

Fig. 119: Phase 2 (Source: Google Maps (n.d.), edited)

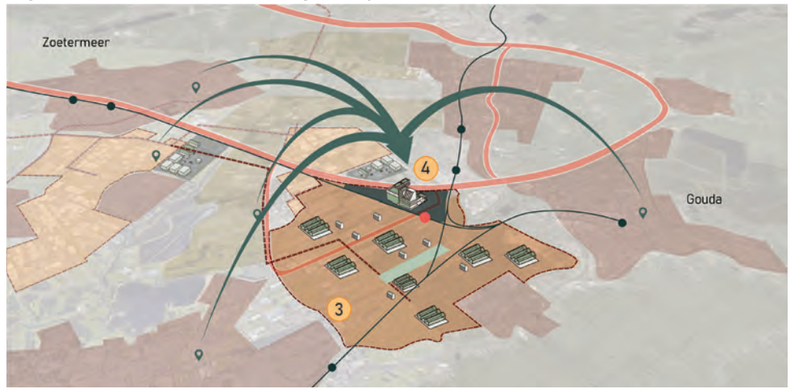


Fig. 120: Phase 3 (Source: Google Maps (n.d.), edited)

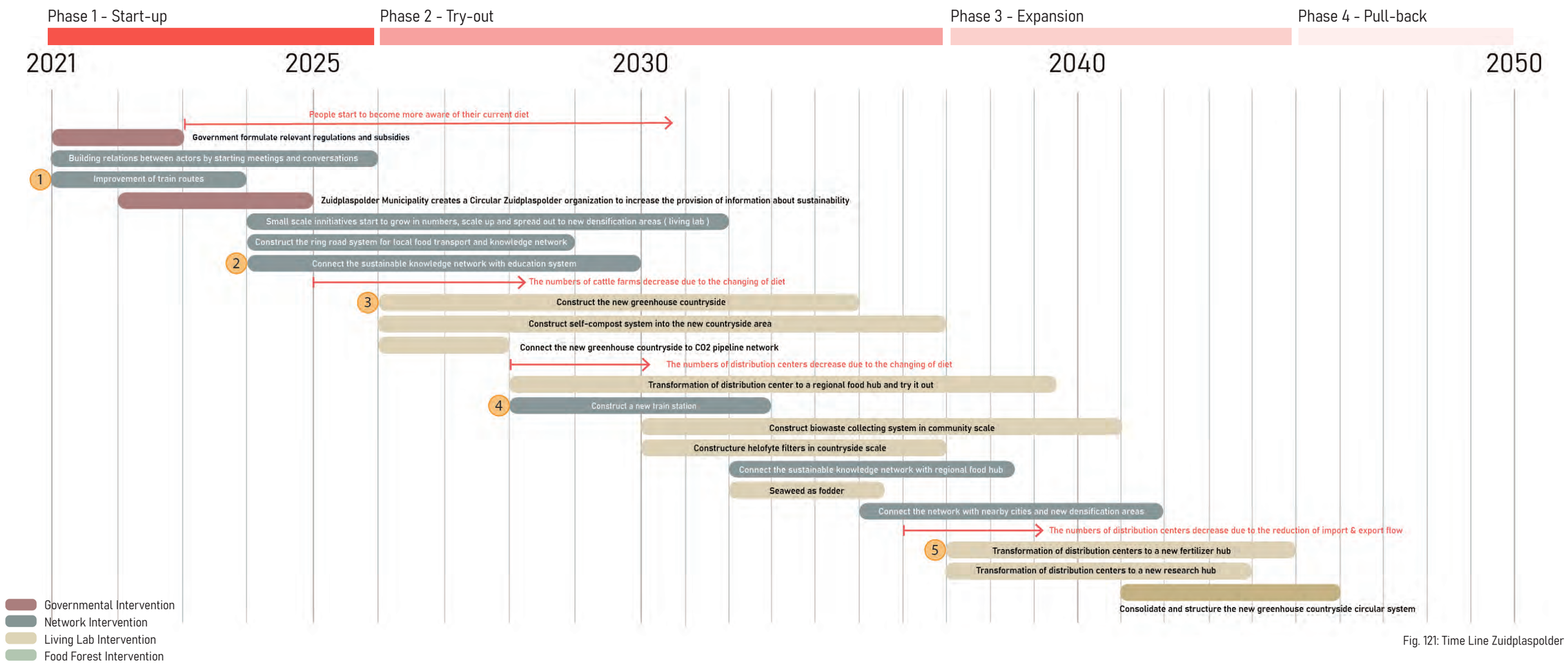


Fig. 121: Time Line Zuidplaspolder

Zuidplaspolder
Section and Impressions

Fig. 122: Current situation at Zuidplaspolder (Source: Google StreetView (n.d.))

Compared to the current and future Zuidplaspolder, it is not difficult to find that under the re-establishment of the local and circular agri-food system, the landscape has changed drastically.

The flat and cattle farm dominated land becomes a new greenhouse residential mixed village that combines sustainable greenhouses, social spaces and living houses. This is a newly promoted residential lifestyle, allowing residents to comfortably live next to greenhouses.

Fig. 123: Impression of the future Zuidplaspolder (Source: Google StreetView (n.d.), edited)

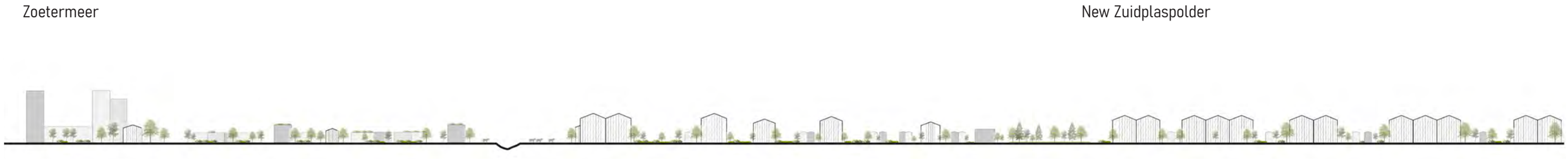


Fig. 124: Section of Future Zuidplaspolder

Zuidplaspolder
Stakeholder Analysis

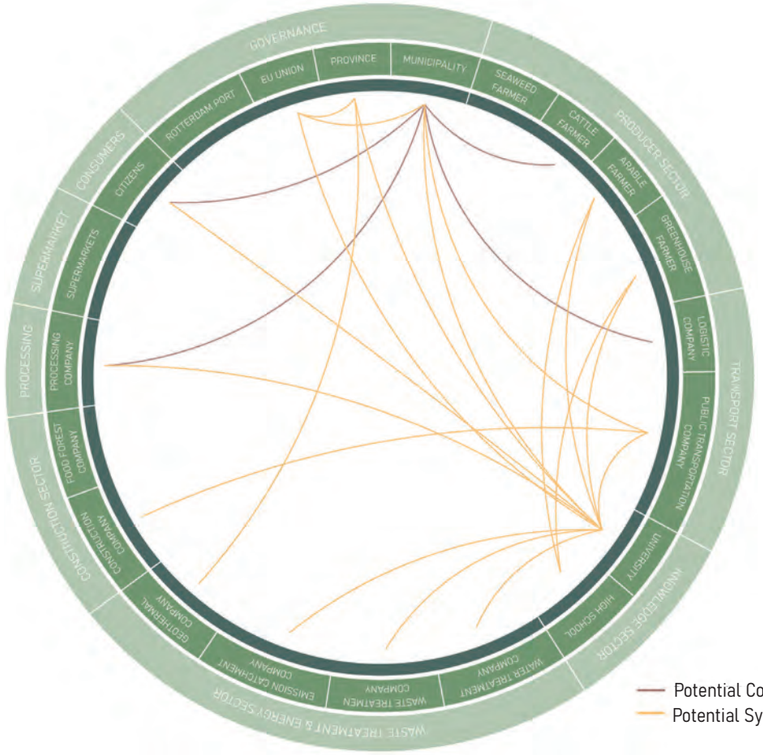


Fig. 125: Stakeholder analysis in the first phase

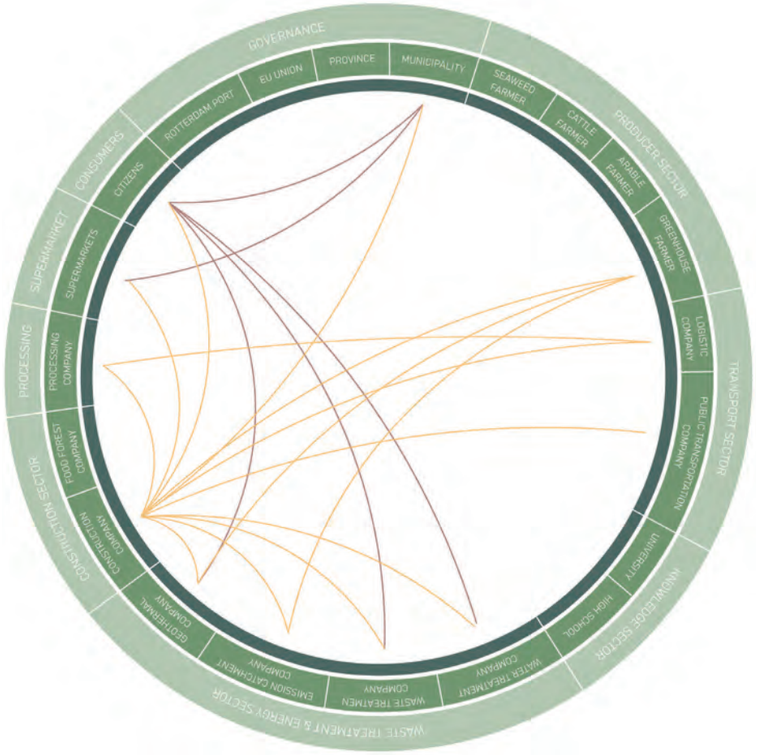


Fig. 126: Stakeholder analysis in the second phase

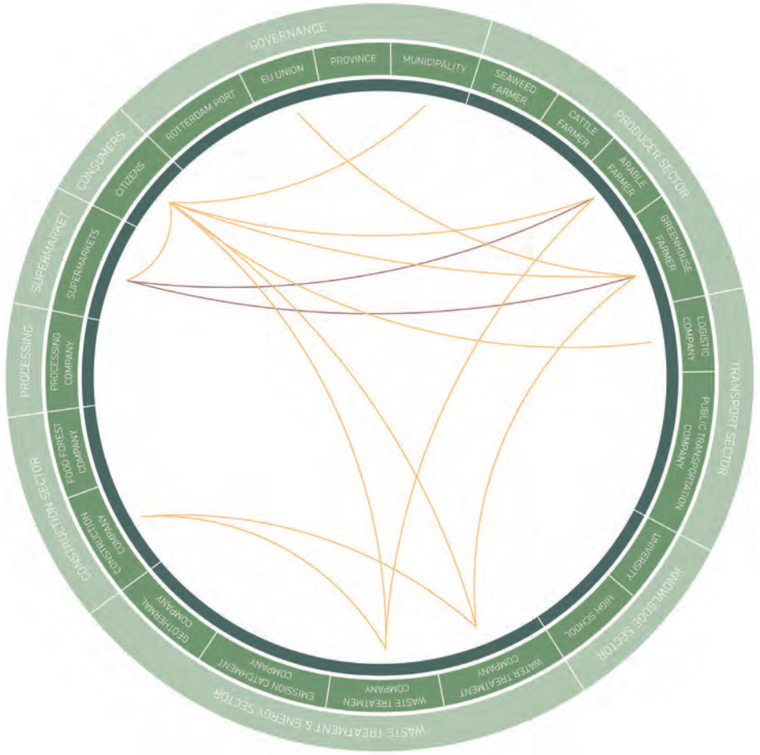


Fig. 127: Stakeholder analysis in the third phase

Phase 1 - Start-Up

At the start-up phase, the main purpose is to establish a complete knowledge and information exchange network, so many stakeholders are involved. The synergy between the universities and various stakeholders allows experts to provide the most innovative and accurate information. A university is a place of information exchange so that relevant stakeholders in various professional fields can exchange information effectively and quickly with each other. However, because of the new policies that limit import and export and the change of the sustainable diet at this stage, consumers, people in the import and export industry, and farmers may have disagreements with the government.

Key Stakeholders

- Citizens and Farmers

Government
- Province of South Holland
- Municipality of Zuidplaspolder

Transport sector
- NS

Knowledge sector
- Wageningen University and Research
- Delft University of Technology
- Erasmus University
- Leiden University
- The Hague University of Applied Sciences
- Healthy 'R

Phase 2 - Try-Out

At the try-out stage, the synergy between the municipality and construction companies lies in the more effective implementation of new sustainable policies. The synergy between construction, logistic and processing companies, can effectively plan and integrate the transporting, processing and sales functions of the food hub. Greenhouses, farmers, construction companies, CO_2 capture companies, and geothermal companies need to cooperate in planning and arranging pipelines, find the most suitable location for new greenhouses, and achieving the goal of building a sustainable greenhouse system. In the construction of new residential areas, construction companies and waste treatment companies need to cooperate to study how to build a new type of building that can effectively recycle and collect waste. The type of the new houses may be unacceptable to residents, so there could be a collision between these stakeholders. However, the communication generated by the collision may also promote the construction of a perfect new system.

Key Stakeholders

Government
- Municipality of Zuidplaspolder

Transport sector
- P3 Logistic Park
- DACHSR Intelligent Logistic

Processing Sector
- Greenyard
- Combilo
- ROVEG

Supermarket
- PLUS
- Jumbo
- Albert Heijn
- etc.

Phase 3 - Expansion

The cooperation between consumers and producers enables them to obtain products and the profits they deserve in the shortest (most efficient) way, which can accelerate the implementation and establishment of local food systems. However, with the shortening of the relationship between consumers and producers, the role of supermarkets may be threatened and collision with producers may arise. The cooperation between the waste treatment and the water treatment company, together with construction companies, can lead to the design and the building of the new water treatment and fertilizer hub.

Key Stakeholders

- Citizens and Farmers

Waste and water treatment
- BWT Nederland B.V.
- Renewi
- Azwi

Port of Rotterdam

Fig. 128: Current situation of the Port of Rotterdam (Source: Kaart havengebied Rotterdam Active in Rotterdam Port|, n.d.)

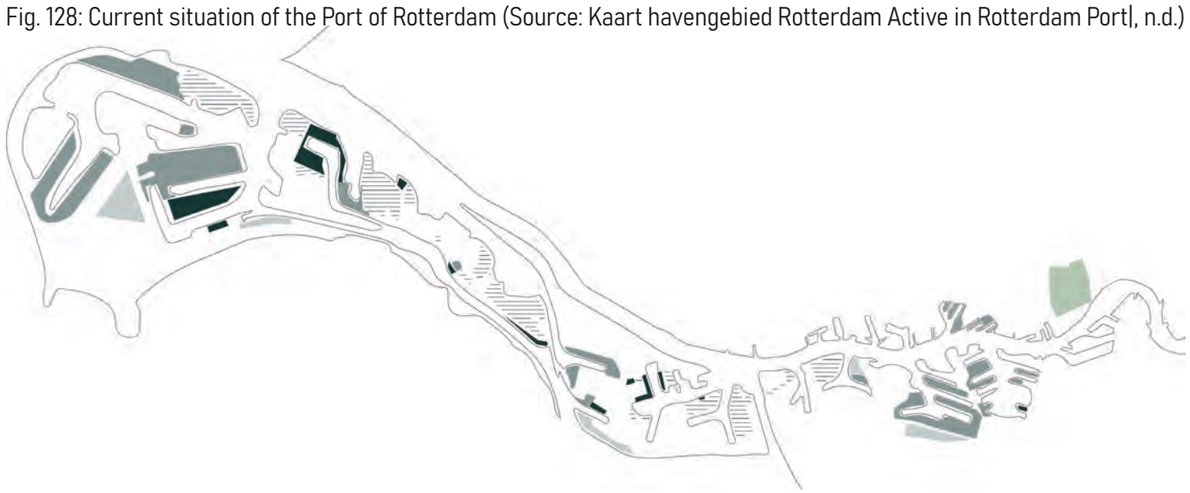


Fig. 129: Phase 1 of the Port of Rotterdam

The Port of Rotterdam is currently used as a distribution area for import and export. However, because of the policies about reducing the import and export flows, this area will be transformed into an extended area of an already existing urban living lab. This lab is located in the centre of Rotterdam next to the Central Station. It is a demonstration area that is set up as an urban living lab that studies various new technologies and systems that can promote the circular economy. Around the Waalhaven there is also a living lab that demonstrates a new sustainable housing typology. In combination with urban farming, they research a new type of living that is based on zero waste (Puerari et al., 2018).

The area that will be transformed in the Port of Rotterdam is the Waalhaven and Eemhaven. In the strategic development, the start-up phase is to establish a network of contacts between many small scale initiatives in the existing living labs and their surrounding areas.

In the try-out phase, the amount of import and export trading and transportation companies will decrease under the influence of the policies about reducing import and export flows. Therefore, factories and companies in the Waalhaven and Eemhaven can slowly be moved to areas in the port where buildings will become empty. In the empty buildings, a food hub can be started and tried out.

Fig. 130: Phase 2 of the Port of Rotterdam

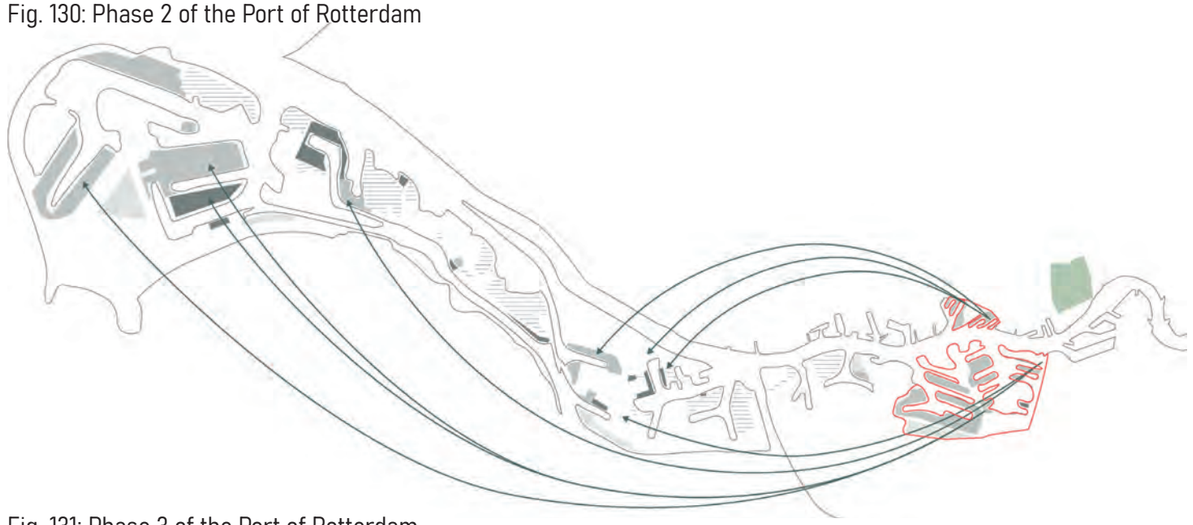


Fig. 131: Phase 3 of the Port of Rotterdam

In the expansion phase, the existing living labs will be expanded to the Waalhaven and Eemhaven and industrial buildings will be transformed into houses and locations for small scale initiatives that focus on urban farming for example. Thereby a new type of living will be created in combination with a regional food hub.

08.
Conclusions, Discussion & Reflection

Conclusion

South Holland has a big dependency on the global agri-food flows. With the Port of Rotterdam many jobs are related to these flows and the economic added value is big. But at the same time, the growing international trade is causing many sustainability problems as emissions by transport, an unfair economic system and environmental damage. This shows how the Netherlands is trapped in a system that is unstainable but at the same time very important for the economy.

This report proposes to DownScale-Up! With downscaled international flows and an upscaled regional food system, the situation explained above can be broken. A new economy will arise and fewer global flows will make the sustainability problems shrink. The slow trend of changing the diet of consumers will be strengthened to make these changes possible by the production of seaweed and participation in regional and local food hubs. Improved waste, water and CO_2 systems form an opportunity to make the changes happen circularly.

The strategy for the coming 30 years contributes to make this change possible. It uses already existing trends to implement the needed interventions for the future. For example, the housing need in South Holland and the densification needed for that, are used to develop living labs in which food hubs can be tried out on a smaller scale. Also, the growth of public transport use is a trend which is used to make the proposed rail ring feasible. The exponential X-curve shows how interventions and regulations can be implemented over time and how they interrelate with each other.

Two example projects have been further explained in this report. Westland is an area that has been focused on greenhouse production for a very long time. The project shows how this area could be transformed in the future to make the regional food system possible. Old distribution centres will be transformed into food hubs and the infrastructure will be improved. Zuidplaspolder is an area that is not a greenhouse area yet but will be transformed into it. The report shows the quality of living that will be achieved here. The example projects show how the interrelation between different interventions and regulations contribute to the realisation of the goals.

Assessment

The vision and strategy proposed in this booklet form an integral approach towards circularity. With the DownScaling and Scaling-Up happening at the same time, the current system is replaced by a new one and a new economy with a different paradigm can arise. The other components of the vision, like the new water and waste systems and seaweed production, contribute to making this change happen. In this way, all the proposed interventions lead to the same goal: DownScale-Up.

The research question asked at the beginning of this report was “How can a regional circular agri-food system be created that is economic, environmentally and socially sustainable?”. The booklet showed that the interventions which contribute to the regional food system and building down global agri-food flows serve an integral approach for all pillars of sustainability. The food hubs, for example, serve all pillars at the same time. It serves environmental sustainability by making it possible to downscale international flows and hereby limiting transportation and emissions, it serves economic sustainability because it brings jobs and gives farmers fair prices and it also serves social sustainability because it has an educational function and it is a place where social activities can take place. It can be said that the vision for 2050 doesn’t only limit sustainability problems by downscaling the old system but also serves new sustainable opportunities for all three pillars.

Fig. 132: Logo

Conclusion

DownScale-Up does not only meet the needs of the three pillars of sustainability but also contributes to international goals for sustainability set by the United Nations. These goals are called the Sustainable Development Goals (SDG's). There are 17 SDG's in total and the assessment framework below shows how the proposed vision and strategy contributes to the different goals.

It can be seen that the vision and strategies contribute to a lot of the SDG's. With the new regional food system, there is more education, responsible consumption, peace and justice and partnership for the goals. By creating a new economy the goal of good jobs and economic growth is achieved and the independency helps with the reduction of hunger and poverty. The downscaled international flows suit the goals of climate action and life on land and lastly, the new water and waste system contribute to clean water and good health and wellbeing.

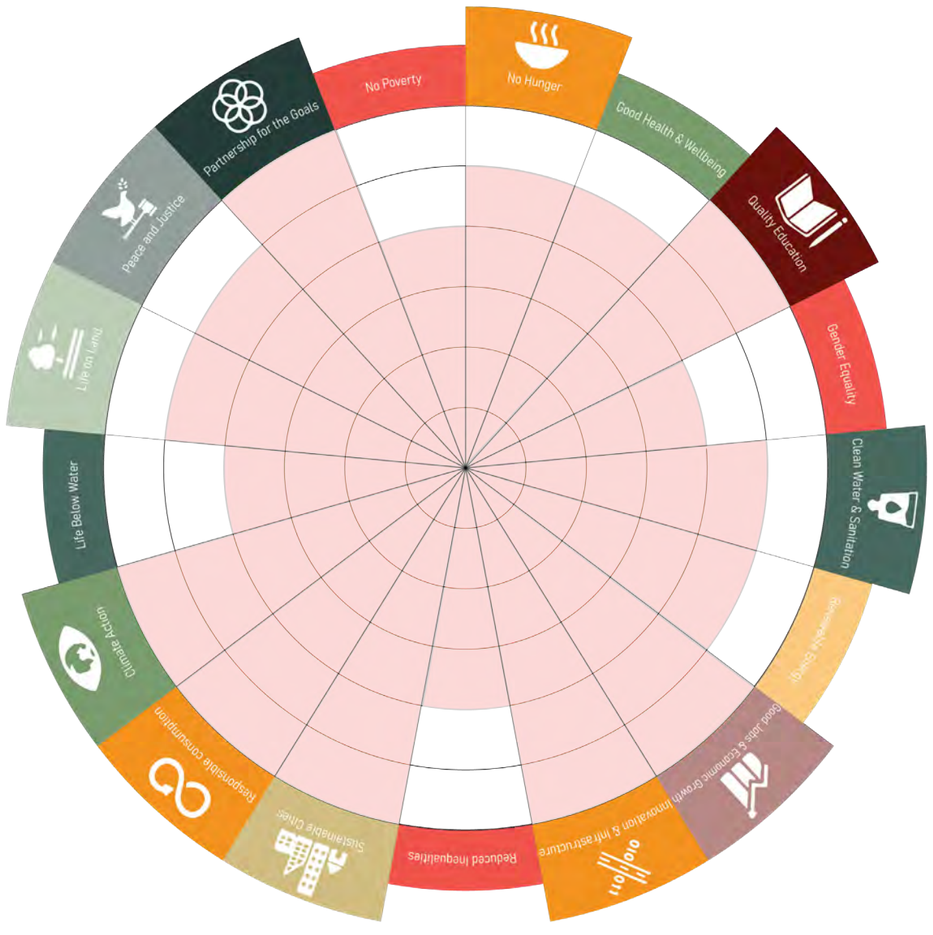


Fig. 133: Sustainable Development Goals assessment United Nations (n.d.)

Discussion & Reflection

Relevance
The research which is done in this report is focussed on an important challenge worldwide. Since the climate is changing rapidly, the importance of a circular economy grows. At the same time, the implementation of a circular economy into everyday life is a complex task. The feasibility, the spatial conditions and paradigm changes needed for a new system should be researched and designed well. The research in this report contributes to the overall knowledge about how a province as South Holland could turn into a circular economy. With the analysis, interventions and strategy, new ideas are delivered which could be used by other researchers to develop ideas further. How existing methodologies are used contribute to new understandings about implementing theory into practice.

Besides focussing on practical interventions and regulations which can be done by governments, the report also emphasises a societal change that is necessary to make a circular economy possible. It states that participation in the agri-food sector is an important value for a new system and that downscaling global flows isn't possible without achieving a change in diet by consumers. This shows the societal relevance of the project and that this booklet wouldn't only be valuable for other researchers to read but also for normal citizens to get an insight into their role in changing to a more sustainable world.

Further Research
The proposed interventions in this booklet give a good insight into how the region of South Holland could change towards a circular economy. Nevertheless, a lot of additional research can and should be done on the implementation of these interventions.

The research is mainly focused on the province of South Holland and the situation in the Netherlands but also makes proposals that affect other countries in the world. For example, when the international flows are downscaled to only the European Union, there will be big effects for other countries which we are exporting to or importing from. Before implementing these ideas it would thus be valuable to research the effects for other countries first and propose for these countries also a plan for further development. Especially when there are relations with less developed countries there is a responsibility of the Netherlands to take care of the situation in which these countries are left behind after implementing the interventions here.

Since the trade within the European Union would continue to exist, there will also be big changes here in the trade. Products that are now imported from outside the EU should be produced inside it now. This would also affect the land use in the countries around us. This would also be an interesting topic for further research.

Ethical issues and group reflection
As planners we are aware of ethical issues and that stakeholders can't be forced to change. That is why during the process and in the proposals, we mainly focussed on regulations and intervention which would trigger people to make a change. The approach was always to create stimulation and better accessibility to sustainable systems, instead of forcing people into undesirable situations.

During the process, we considered ourselves as communicative planners. We focussed on bringing stakeholders together with conversations and participation. That is also why the first phase of our strategy is mainly focused on building relations between stakeholders. Our approach was to bring stakeholder close together to stimulate cooperations. We considered these conversations the most important.

Besides the communicative planner, we also considered ourselves as advocacy planners. As mentioned, the conversation was important for us, but we also thought that it was important to consider the needs of the stakeholders who couldn't join the conversation. An example of this are farmers in other countries. Since the sustainability problems showed us that these farmers are trapped in an unfair system, we considered it important to defend their needs and speak for them in conversations. That is why we approached the research partly from the viewpoint of the advocacy planner and partly from the communicative planner.

09.
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10.
Appendix

Individual Reflections
Amber Luesink | 4563050

In today's society there are many challenges which have to do with climate change and an unsustainable way of living. To change this there is a responsibility for everyone in all sciences and sometimes it is hard to decide where to start from. In this project I learned what the role is of a regional designer in this. By researching literature and creating a vision it became clear how spatial interventions can lead to a paradigm change in society and that regional designers have great power in making changes happen. By defining the complexity of a problem and finding an integral approach for a solution, little spatial interventions can achieve big changes. Also, understanding the different strategic steps in a process and knowing how they can strengthen each other is a great tool for strategic planning.

Our project was focussed on international agri-food flows and how these cause big sustainability problems. The challenge of this problem statement was the question how interventions in South Holland could contribute to a worldwide problem like that. What is the power of our province in a global perspective? Can we even make a change? Is it fair to exclude our citizens from a world market with economic benefits? Eventually we chose to not limit all the import and export flows but only those outside of the European Union. In this way we found an optimized way of contributing to a world with downscaled global flows and a focus on local food production, but not excluding the citizens of South Holland from the economic benefits of trade. This shows that asking ourselves critical and ethical questions lead us to thoughtful decisions.

Our projects builds on a good relation between research and design. In the project I learned about appying different theories and methods on our vision and strategy. The complexity often caused confusion but when finding a way through this, the results from theory brought us to a comprehensive vision. The alternation between sketching, reading literature, making decissions and start over brought us to new insights. Also the alternation between working on the problem statement, the analysis, the vision and the strategy made that the narrative became clearer over time.

An extra challenge of this project was working in the COVID situation. The online environment brought extra challenges in teamwork and there was an extra emphasises on communication. Surprisingly, this also showed an extra relation between research, design and decission making. Knowing that it was sometimes hard to understand each other, there was a trigger to explain yourself very well. This trigger made that you think deeper about the arguments of what you are proposing and a stronger relation between research and design is established. On the other side, the COVID situation also brought disadvantages for the argumentation for the project. For example, site visits or interviews on the street weren't possible which made it a bigger challenge to relate proposed ideas to everyday life.

During one of the SDS lectures of Remon Rooij we were asked to share a metaphore which described our process so far. Our metaphore was "two steps forward, one step back". I think this is still accurate to describe our process during the last 9 weeks. The complexity of the project often made that we had to take steps back and rethink certain ideas again. It made that sometimes we had to start over to strengthen our ideas. In the end I think this lead us to a nice result and proposel for 2050 in the future.

Rosa de Kruif | 4694562

The following reflection will dive in more deeply into the following question: 'What is the relation between research and design in a regional strategic design project which aims to a circular economy?'

In the current situation, cities are globally consuming 60 to 80% of natural resources, producing 75% of all greenhouse gas emissions and 50% of global waste (Camaren & Swilling, 2012). To reduce these huge emissions and waste streams, cities need to make the transition to a circular economy (Liang & Zhang, 2011). According to Geissdoerfer et al. (2016), knowledge about the relationship, differences and similarities between sustainability and the circular economy is relevant to gain conceptual clarity. But also the knowledge of the goals and interests behind the use of these terms by the involved stakeholders will contribute to this conceptual clarity.

In our project, we dove in the agri-food sector and how to create a regional agri-food system which will be circular, out of the current global system which is mainly linear based (Metabolic, 2018), including all its import and export flows. Before we came to this vision, we had to do a lot of research which lead us to the actual insight of the unsustainability on an environmental, social and economic level of the current agri-food system. Then, we also did a lot of literature based research, including opportunities to make the transition to a circular agri-food system and which stakeholders would be involved in this transition.

During this design project, we found out that there isn't an actual moment that you 'stop' researching and start with the designing part. It is really integrated with each other. When you run into something while designing for instance, you need to do research first before you can continue with the designing part. Because of the complexity of this regional scaled project, the amount of research was really big. As a group, we often tackled this integrated process by for instance two people researching and two people designing at the same time.

To give an answer on the question 'What is the relation between research and design in a regional strategic design project which aims to a circular economy?', I can conclude that in the first part of the project, the research part is leading, but at the and this research and design is really integrated and they alternate continuously.

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Yuru Chou | 5203899

What is the relationship between research and design in your group project?

For the development of planning and design, we have always mentioned that design and design must be based on a large amount of data collection, multi-party research, and repeated discussions before we can put forward a reasonable planning and design proposal and idea.

Therefore, when setting the problem, we collected data from various parties and found that the Netherlands is the world's second exporter in the import and export of agricultural and livestock products. Although it stimulated economic development, it also created many sustainability problems. Therefore, our future vision is to establish a sustainable and circulating regional food system. A local food system is an increasingly popular topic nowadays,"A rising interest in buying local products is an opportunity for businesses in the three cities. Here, the'place' of production is equally important as a marketing tool as it is for other practical considerations. "(Cities of making Brussel, May 2018) Because of the locality system can achieve the goal of circular economy more effectively. However, today's large-scale retailers and supermarket systems have blocked the development of local food systems. "The strong position of retail organizations are a threat to the sustainability of the Dutch horticultural system"(Cities of making Brussel, May 2018)

In order to come up with a self-sufficient regional food system, we have done a lot of data calculations. The most surprising finding is that the fruits and vegetables produced in the greenhouses of South Holland are not enough to match the demend of South Holland. Therefore, adding greenhouses to facilitate the establishment of local food systems has become the key to our strategic development. After research, it is found that a large number of greenhouses are located in the Westland. This phenomenon is not conducive to the establishment of a localized food supply system. At the same time, under the new planning of South Holland Province, it is also pointed out that the structure of Westland must be restructured. "The solution proposed by the Province of Zuid Holland and Westland municipality is to restructure the glass-houses, being more efficient in the use of space in order to free up land for uses that would increase the liveability of the area"(Cities of making Brussel, May 2018) So our strategy is to find suitable places to move and build new sustainable greenhouses.

Through mapping of data in QGIS, we finally reached a conclusion and proposed a set of strategies to facilitate the conversion and construction of the greenhouse. At the same time, not only help to release the space for further develop the liveable area in the Westland, but also achieve our goal and establish a regional circular agri-food system in the South Holland

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Henriette Hugenholtz | 4549759

"Design is a way of inquiring, a way of producing knowing and knowledge; this means it is a way of researching." (Downton, 2003, p. 2)

This reflection intends to answer the question of what the relationship between research and design was in our group project. For us, research has played a very important role in the realization of our vision and strategy. We started with a discussion on what our personal interests were and did an extensive literature research on the region and current situation. This is where our focus was developed on the import and export flows of the agri-food sector. The focus did not lead us immediately to spatially design challenges, but mostly to challenges on changing the current system. It was therefore particularly difficult for us to stay within the boundary of the agri-food sector and our developed vision. This is where the teachers were a great help and pulled us back to the scope of our project.

Talking about research for design, we not only did literature research but also a GIS analysis with the help of the LISA data and an online excursion. It was a shame that we did not get to do an on-site research and thereby did not get a real feeling of other parts of the region outside of Delft and its surroundings, but I do not think it affected our possibility to do enough research on the region too much.

When looking back at the process, the concept of research by design was an important part. The strategy is a good example of this concept. This is where we really started to design and think different parts of our vision through. It was also where we encountered new problems and had to go back to the process of research for design. Discussing our newly found design interventions with each other and with the tutors gave us new insights on how to approach a problem and missing links between the various interventions.

Concluding I would like to say that this project was a circular process of research for and by design. The two concepts are closely connected in our project. With the research the problem of unsustainable import and export flows became clear and by designing it showed us what this meant for the region of South Holland. Research by design helped us formulate relevant regulations and helped us develop strategic and spatial interventions.

Source:
Downton, P. (2003). Design Research. RMIT Publishing.

Calculations Transforming Space

	Consumption South Holland in ha per person	Consumption South Holland in ha		Agricultural Landuse in South Holland in Ha		Difference in Landuse and Land Consumption		Part that comes from NL		Part that comes from EU		Part that comes from outside EU			Space needed for what we import now (outside EU) corrected by change in diet		Space occupied for export outside EU		Devision of space becoming available by change in diet		Netto Result
	Based on Source 1	Based on Source 1		Based on Source 3				Based on Source 2							Based on Source 4		Based on Source 4&5		Based on Source 2		
		3.700.000 inhabitants						Percentage	Number	Percentage	Number	Percentage	Number		1/3 less space needed						
Horticulture				12.484		-13.416									3280		2122		-5912		7070
Fruit	0,0035	12950						33%	4273	33%	4273	33%	4273								
Vegetables	0,0035	12950						65%	8417	30%	3885	5%	647								
Agriculture				30.074		-43.926									10680		5112		5912		-344
Potatoes	0,0066	24420						90%	21978	10%	2442	0	0								
Fruit	0,0035	12950						33%	4273	33%	4273	33%	4273								
Vegetables	0,0035	12950						65%	8417	30%	3885	5%	647								
Grain	0,02	74000						10%	7400	75%	55500	15%	11100								
Cattlefarms				63.862		-500.051									17266		10856		35473		-29063
Dairy products	0,037	138128						90%	124315	10%	13812	0%	0								
Eggs	0,0050	18785						100%	18784	0%	0	0%	0								
Beef	0,07	259000						10%	25900	80%	207200	10%	25900								
Pork	0,03	111000						100%	111000	0%	0	0%	0								
Poultry Meat	0,01	37000						100%	37000	0%	0	0%	0								
Total	0,183	714132		106.420		-607.713			371759		295271		46842				18091		35473		

Source 1: Compendium voor de Leefomgeving (2015), Landvoetafdruk 1990 - 2010, retrieved in March, 2021, from https://www.clo.nl/indicatoren/nl007507-voetafdruk-landgebruik

Source 2: Planbureau voor de Leefomgeving (2019), Kwantificering van de effecten van verschillende maatregelen op de voetafdruk van de Nederlandse voedselconsumptie, retrieved in March, 2021, from https://www.pbl.nl/sites/default/files/downloads/PBL-2019-Kwantificeren-opties-voetafdruk-voedsel-3488.pdf

Source 3: Centraal Bureau voor de Statistiek (2021), Landbouw; gewassen, dieren en grongebruik naar hoofdbedrijfstype, regio, retrieved in March, 2021, from https://www.cbs.nl/nl-nl/cijfers/detail/80783ned

Source 4: Centraal Bureau voor de Statistiek (2020), Landbouw droeg in 2019 evenveel bij aan de economie als tien jaar eerder, retrieved in March, 2021, from https://www.cbs.nl/nl-nl/nieuws/2020/19/landbouw-droeg-in-2019-evenveel-bij-aan-economie-als-tien-jaar-eerder

Source 5: Centraal Bureau voor de Statistiek (2018), Export naar landen buiten de EU groeit relatief sterker, retrieved on March, 2021, from https://www.cbs.nl/nl-nl/nieuws/2018/15/export-naar-landen-buiten-de-eu-groeit-relatief-sterker#:~:text=Inmiddels%20gaat%2029%20procent%20van,export%20lag%2026%20procent%20hoger.