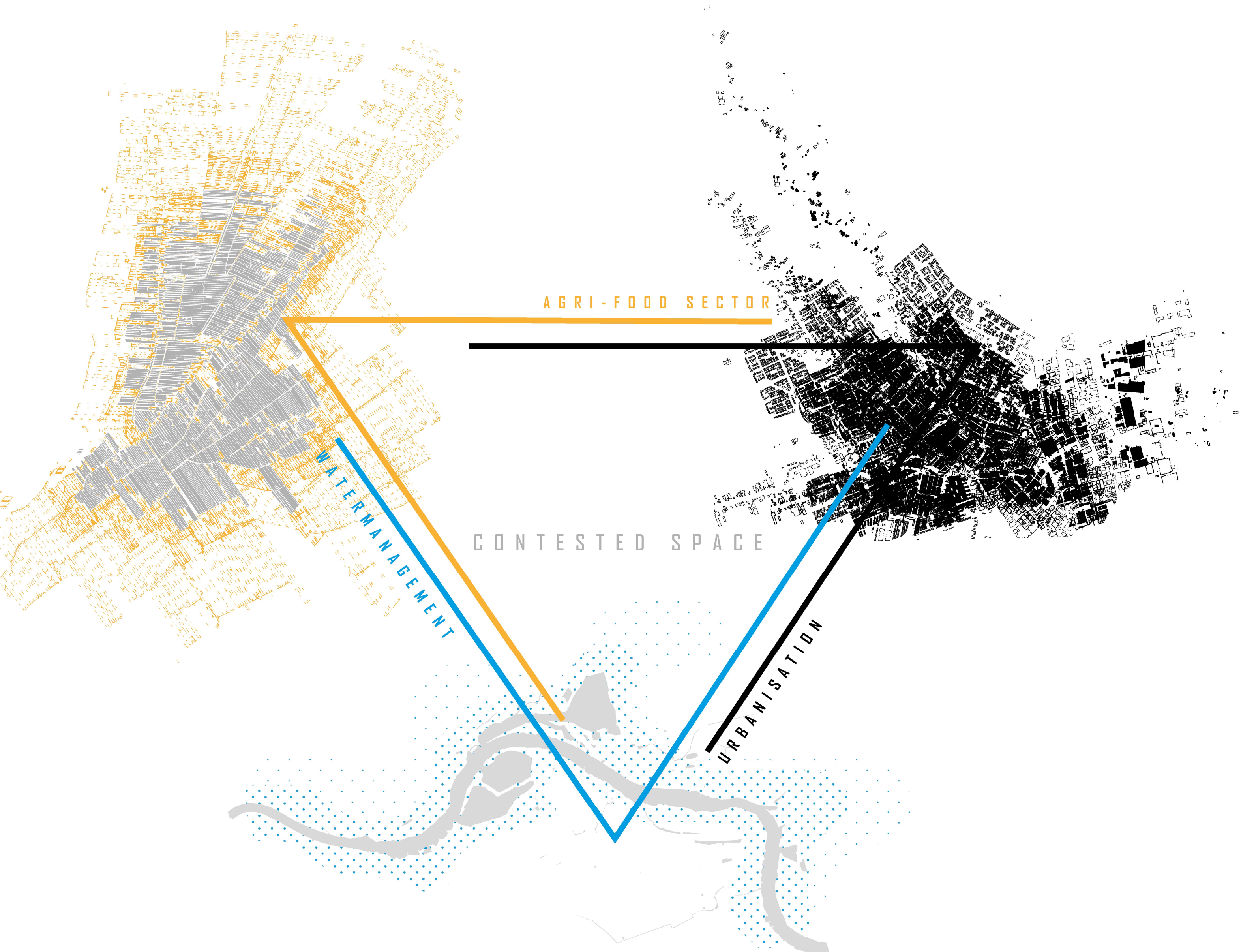
GROWING SMALLER

OPTIMIZING PRODUCTIVITY WITHIN AN INTERSECTURAL CIRCULAR SYSTEM TO RELIEVE THE PRESSURE ON LAND



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Key words: South-Holland, circular agriculture, waterscapes, flood protection, spatial justice, social justice.

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PREFACE

The report that lies in front of you proposes a regional planning and design vision to create a circular system for food and organic waste cycles in the province of South-Holland. Within this theme, a focus has been placed on the food production chain in the region. The report is written by a group of five students as part of their masters in Architecture, Urbanism and Building Sciences - track Urbanism, at the Technical University of Delft. It is a product for the two courses that are taught in the third quarter of the first year of the master: "Research and Design Studio: Spatial Strategies for the Global Metropolis" and "Research and Design Methodology for Urbanism". The classes, studio sessions and individual research has been done in a total of nine weeks.

The process of researching, designing and writing was influenced by the measures taken for the Corona crisis. For us, these measures resulted in full-time online work from our own home, which started halfway through the nine weeks. It took each of us some time to get used to communication through online programs, but in the end we found a good way of working and managed to produce this report.

We would like to thank our studio supervisors, Remon Rooij, Marcin Dabrowski and Claudiu Forgaci for their excellent guidance and support through this research and design process. Thanks to them, we were able to make a quick switch to working online and keep our motivation throughout the full nine weeks. We also want to thank Marcin Dabrowski and Roberto Rocco for the great and fun methodology classes that helped us with putting together this report. To our colleague students in the studio: we want to thank you for your feedback, debates and inspiration during presentation and studio sessions.

Despite the circumstances, we very much enjoyed working on this project and we hope you enjoy reading the report.

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April 9, 2020

ABSTRACT

The province of South-Holland is located in a delta, where the Netherlands have been changing the landscape for centuries to keep out the water and create the productive, highly urbanised and well connected landscape it is now. Due to climate change, the water system brings about an increasing pressure in both the rivers as well as the sea. In addition, economic and demographic growth pressure the agricultural production system and urban system. Instead of reclaiming land from sea and rivers, this report aims to find a a collaboration between the three sectors. It will enable the people of South-Holland to work together with the water and create a more balanced landscape.

To create this balanced landscape, this project researches the possibility of protecting the province of South-Holland from climate change while producing sufficient food and keeping the region livable. Three systems (water, agriculture and urbanisation) are analysed on both their individual system as well as the synergies between them. Using these three systems, a vision and strategy are formed for South-Holland in 2100, where the landscape is transformed into a water based productive landscape in which the synergies between the three elements are key. This landscape ensures the realisation of three goals: 1. Productivity by creating dense agricultural hubs, 2. Safety from the water for the whole province, and 3. Livability for the people by creating healthy and desirable densifying urban systems. A toolkit of six intervention typologies is created with a focus on innovation in water, agriculture and/ or urbanisation while keeping a liveable environment. By implementing the interventions on the synergies between systems they create the balanced landscape. This landscape results in the need for a healthier and local diet for the inhabitants and the creation of new green and blue infrastructure will increase liveability. Additionally the food economy of the region will be more efficient and resilient.

Key words: South-Holland, circular agriculture, waterscapes, flood protection, spatial justice, social justice.

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AGRI-FOOD SECTOR
WATERMANAGEMENT
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URBANISATION

1.INTRODUCTION

1.1 SHORT HISTORY OF DUTCH LAND RECLAMATION

Sometimes the sea swallows land, and sometimes the natural process of sedimentation creates new patches.

In one of the lowest river-deltas of the world, the south-west delta in the Netherlands, inhabitants learned to adjust to the natural reality of flood-risk over hundreds of years. Building an understanding on how to deal with, and eventually decreasing flood-risk by creating ditches and dikes. The most essential function of these systems was to make land fit for agricultural production (Wagenaar, 2017). The natural landscape has continuously been 'improved', defined by the hydrological mechanisms of canals, dikes and windmills, in order to form a safe and productive environment. All this money and ingenuity was invested in keeping the land productive, in order to meet the food demand of the fast growing cities.

The rational grid pattern divided parcels, most often coinciding with ownership. The peatlands were dug out to provide fuel, creating lakes. Those lakes then could be drained in order to form polders, giving back highly productive and fertile soil to the agricultural sector (Wagenaar, 2017). Along the shores, the natural process of sedimentation was guided and accelerated by creating the ditches and dikes which colonized former seascapes.

Over the course of several centuries, the flood-risk from the sea has been continuously decreased by drastically shortening the shoreline of the Netherlands. Next to the slow process of creating polders and taking land from the sea in phases, most striking are the Afsluitdijk (1933) and Oosterscheldekering (1986). This development of the Dutch shoreline over time is visible in figure1.1.1 underneath, with the province of South-Holland in the midst of the south-west delta region.

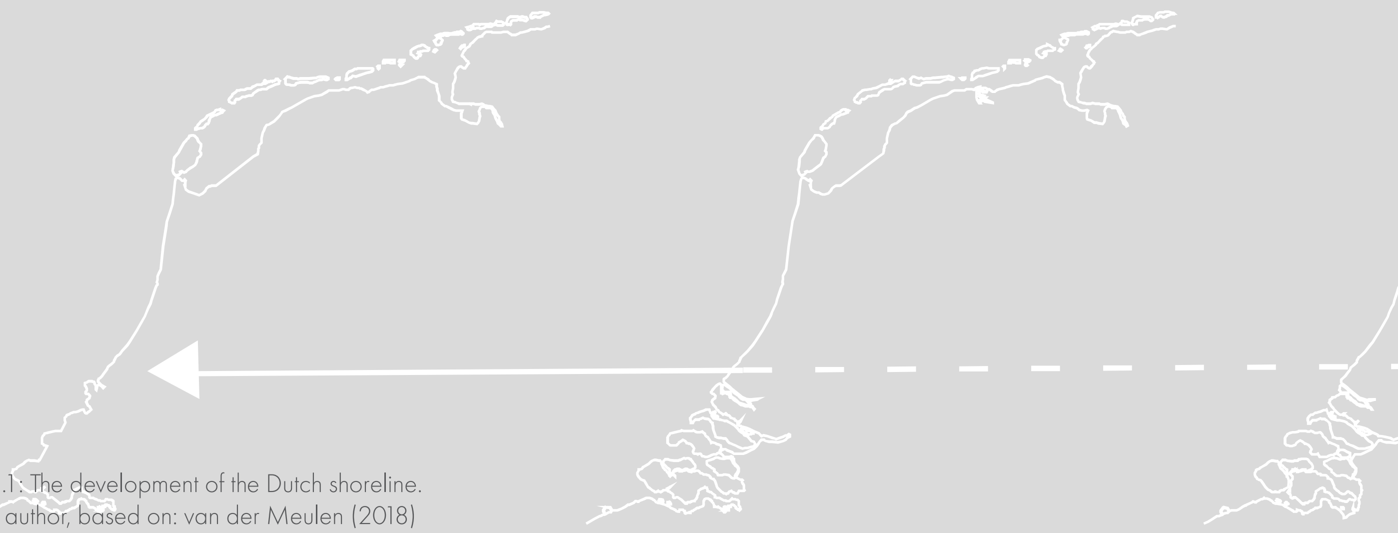
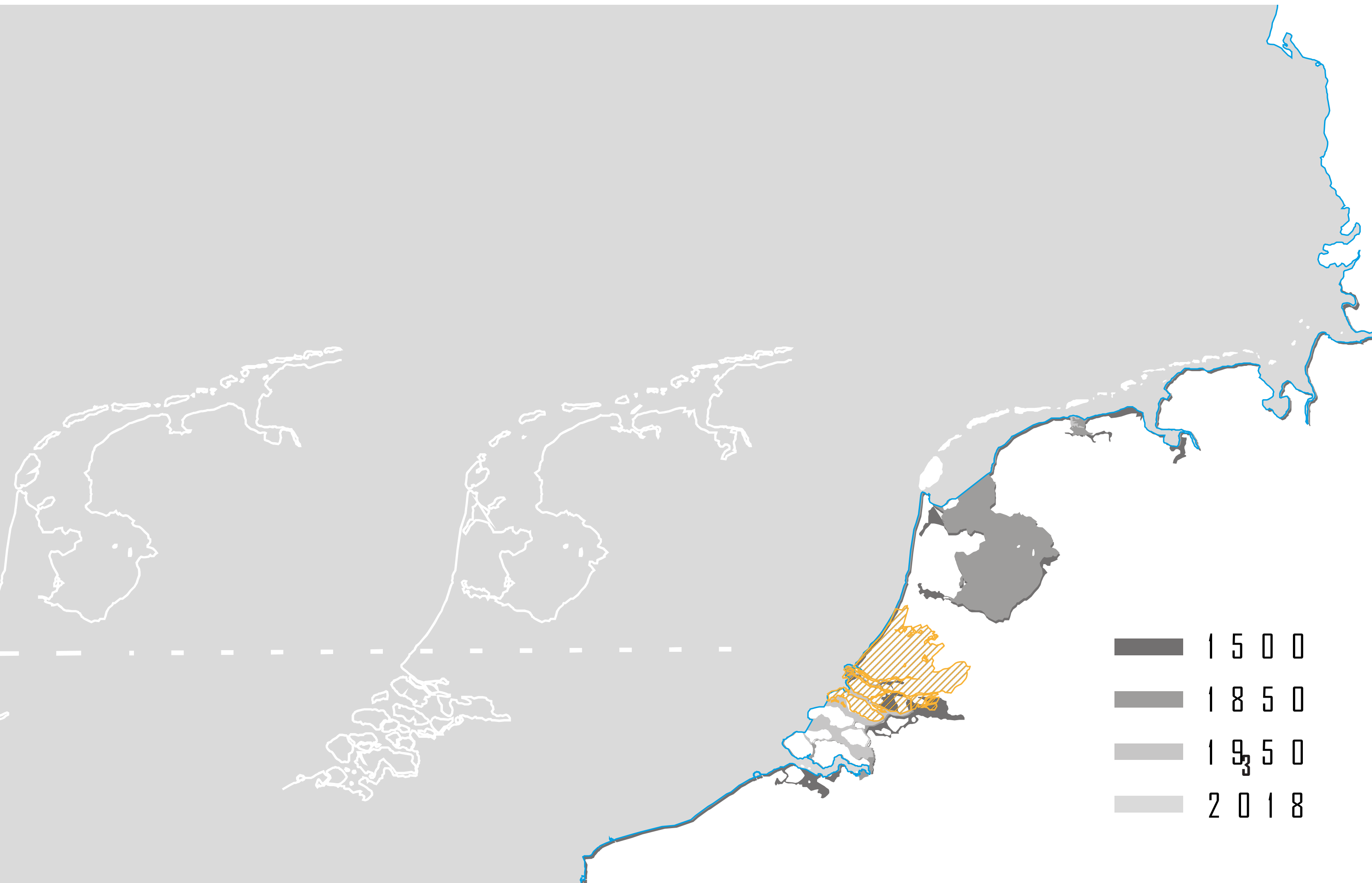


Figure 1.1.1: The development of the Dutch shoreline.
Figure by author, based on: van der Meulen (2018)

LOOKING BACK IN HISTORY, WE SEE A CLEAR LINE OF EVENTS REPEATING ITSELF. CITIES GROW INTO THE AGRICULTURAL AREA, NEW AGRICULTURAL AREA HAS TO BE CREATED TO MEET THE FOOD DEMAND, WHICH LEADS TO THE ERASING OF NATURAL CONDITIONS AND CONSUMES WATER BODIES.



Agriculture was rightly seen as the bases of prosperity in the 17th century. In order to feed the growing population In the mid-seventeenth century, polder making reached its heigh-day. Especially in Noord-Holland, where agricultural lands increased with 40% in the matter of just several decades (Wagenaar, 2017). In this typical Dutch landscape, natural conditions are erased to form a new rational landscape, pushing out the inland water to create a most efficient agricultural production system.

Over the course of the next centuries, dikes have been continuously heightened, both along rivers and shores. This process is demanded by building water-pressure of rising sea level, heavy storms, fluctuating river levels and growing population in the pressured areas. Today, when we first start to conceive the results of climate change, we see the importance of flood protection increasing. The current system does not have the robustness and resilience we need to cope with the upcoming challenges, says Deltacommissaris P. Glas in an interview with AD.

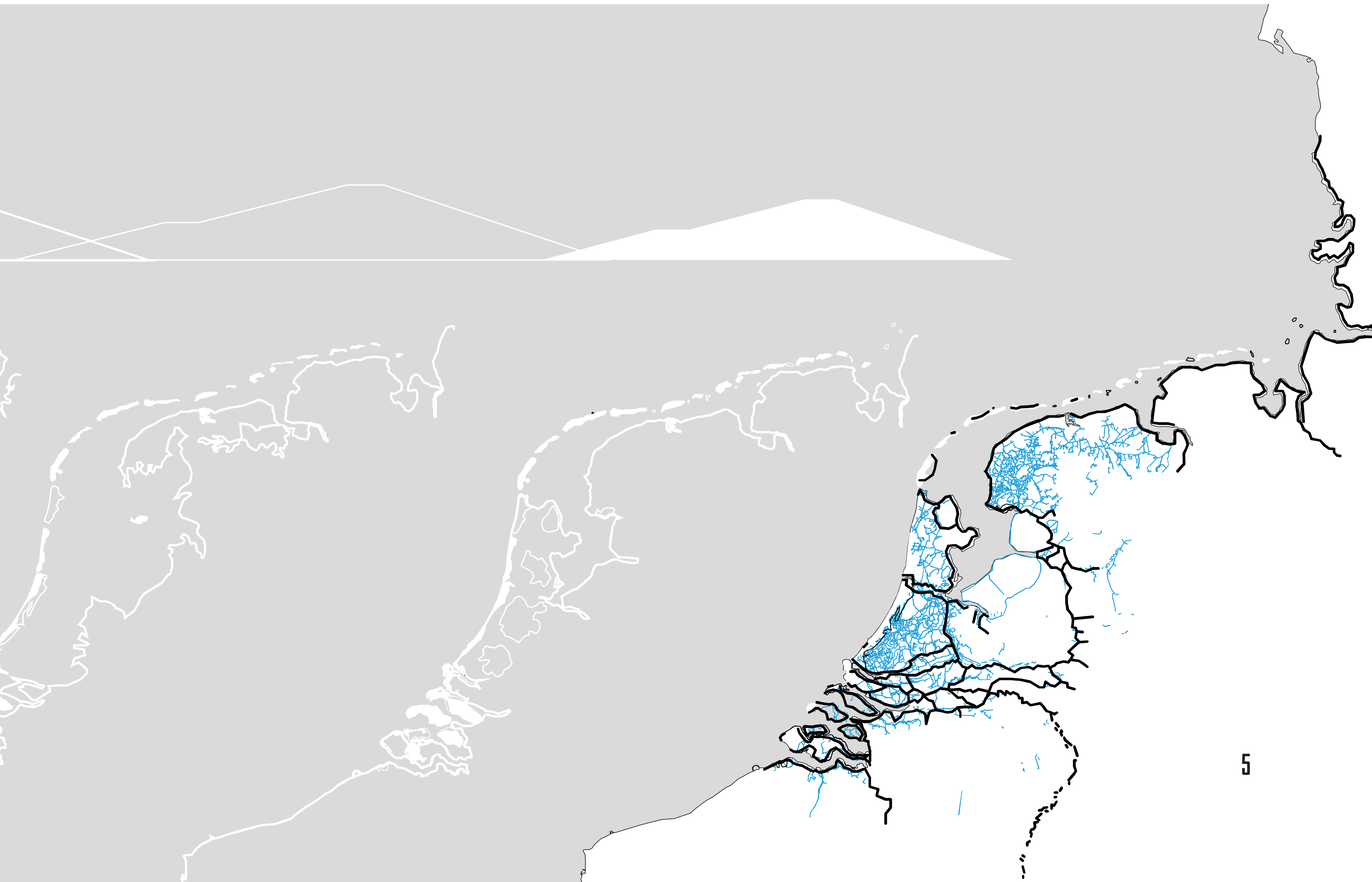
Scientists plead for letting the sea act more freely instead of continuously heightening the dikes. The tides can then deposit sand for shore reinforcements in a natural process (van der Aa & van Dongen, 2019).

This coincides with the warning by research institute Deltares, that in the near future we will need 20 times the current amount of sand to keep reinforcing the shores in the way we do now (van der Aa & van Dongen, 2019).

Next to the protection against water, and creating distance between it and the population, we also need to led the water in, to store and buffer it when draughts hit the country and threaten fresh water supply to urban areas and agricultural production (van der Aa & van Dongen, 2019). The picture below shows the system of primary (black) and secondary (blue) dikes. Next to it, the height and width of dikes the Netherlands would need in order to keep a safe living environment with the rising sea level, and the low-lying land threatened by the sea level at different heights.

Figure 1.1.2: The dikesystem and pressure from water.
Figure by author, based on: van der Meulen (2018)

THE TECHNIQUES DEVELOPED TO CREATE POL-
DERS DEFINED THE LANDSCAPE AND BROUGHT
OPPORTUNITIES FOR EXPANSION AND CULTIVATI-
ON OF PREVEOUSLY UNINHABITABLE PLACES.



"IN THE PAST THOUSEND YEARS OF WATERMA-NAGEMENT IN THE NETHERLANDS, WE'VE DONE A LOT OF THINGS RIGHT, BUT ALSO A LOT WRONG"

P. Glas
Deltacommissaris
(van der Aa & van Dongen, 2019)

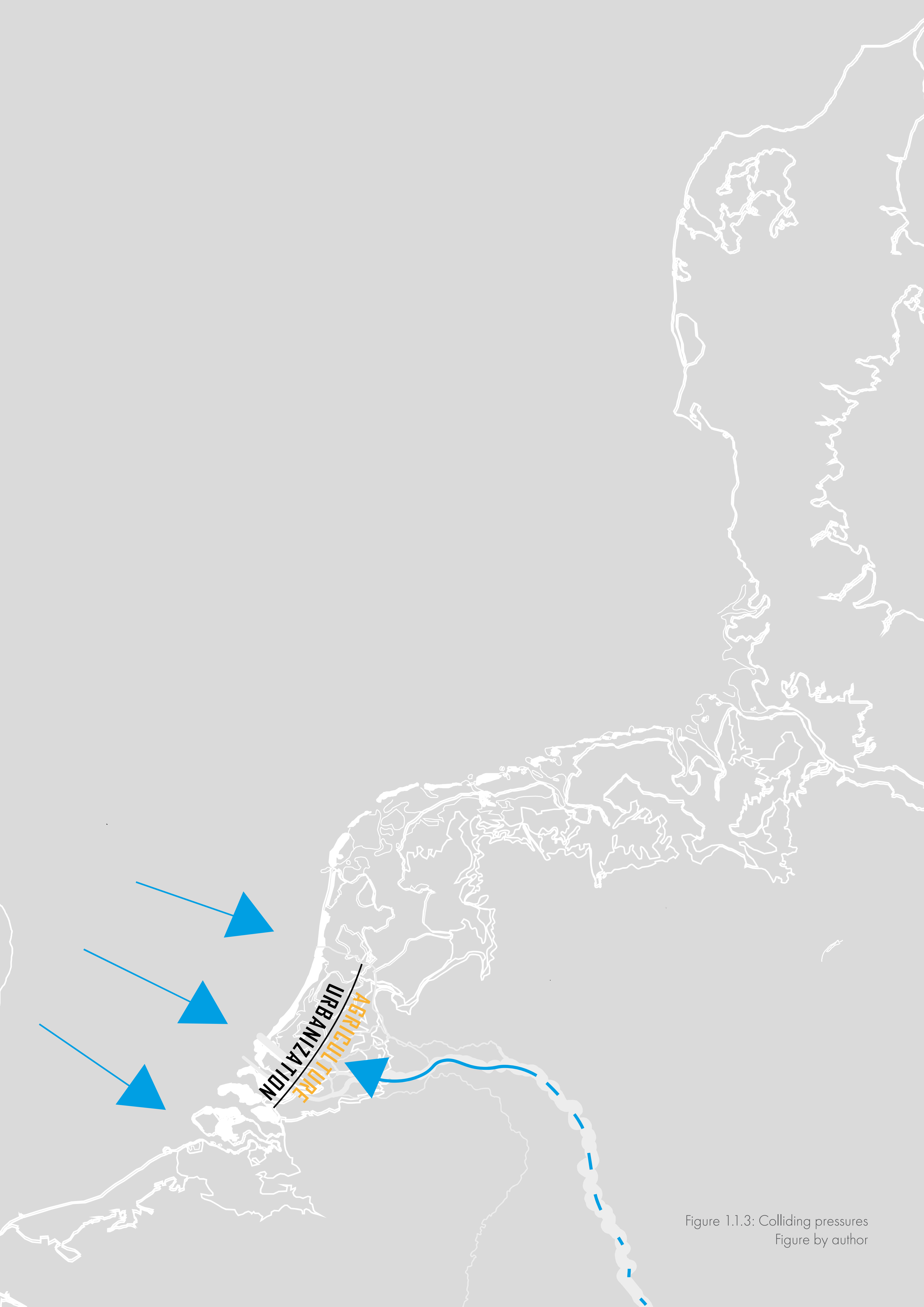


Figure 1.1.3: Colliding pressures
Figure by author

1.2 PROBLEM STATEMENT

WATER

The Dutch have always treated water as a technical issue which can be solved by civil engineering. This attitude was highly effective, creating a landscape defined by the hydrological mechanisms of canals and dikes. Due to this extraordinary Dutch consistency, nature was pushed more and more out and replaced by human settlements and productive agricultural lands. When cities expanded into the agricultural lands, agriculture took lands from the water (Wagenaar, 2017). Despite the effectiveness, this approach began to generate a number of potentially critical negative consequences, of which the turning point became catalysed by climate change (Saeijs, 1991).

The Netherlands already has a growing problem of soil subsidence (Nelen, 2017), and access to fresh water is under threat (Meyer, 2014). In addition to this come new, even more serious problems whose scale is difficult to predict. The Royal Netherlands Meteorological Institute (KNMI) predicted for sea level rise ranging between 0 and 1,5m in 2100 (Fig.2.1.6) (Kopp, 2017). It is also projected that the frequency of river flooding will increase and their extremes may increase by up to 50% (Meyer, 2014).

From an economic perspective - the estimated cost of solving these problems with old methods is simply too expensive even for such a well developed country (van der Meulen, 2018). Building heavy infrastructure and constantly increasing the dykes will no longer be sufficient. It is crucial to find innovative solutions on how to protect the lands of the country and the province by working with water and not acting against it. We have continuously push out the water, but the water is beginning to push back.

AGRICULTURE

Increasing food demand and changing climate conditions force agricultural sector to keep productivity. According to the research, Dutch population expected to reach 17.5 million in 2038. In order to feed this larger, more urban and richer population, food production must increase by 70%. (Centraal Bureau voor de Statistiek [CBS], 2008)

However, the pressure for more production is increasing due to climate change. Climate change has both direct and indirect effects on agricultural productivity including changing rainfall patterns, drought, flooding and the geographical redistribution of pests and diseases. The vast amounts of CO_2 absorbed by the oceans causes acidification, influencing the health of our oceans and those whose livelihoods and nutrition depend on them. (Food and Agriculture Organization of the United Nations [FAO], 2016)

Furthermore, the strengthening of the dike system and the expansion of the urban area compete with the agri-food system for limited land, where there is a need for a system change to become circular to save the agricultural land. (European commission, 2019)

URBANISATION

Another challenge for the region is the vast population growth. As a part of the national goal of building one million new homes, South Holland needs to build 290,000 new dwelling until 2040. While 80,000 have been built until 2016, another 150,000 need to be built until 2030 and additional 60,000 until 2040 (Provincie Zuid-Holland [PZH), 2017: 12).

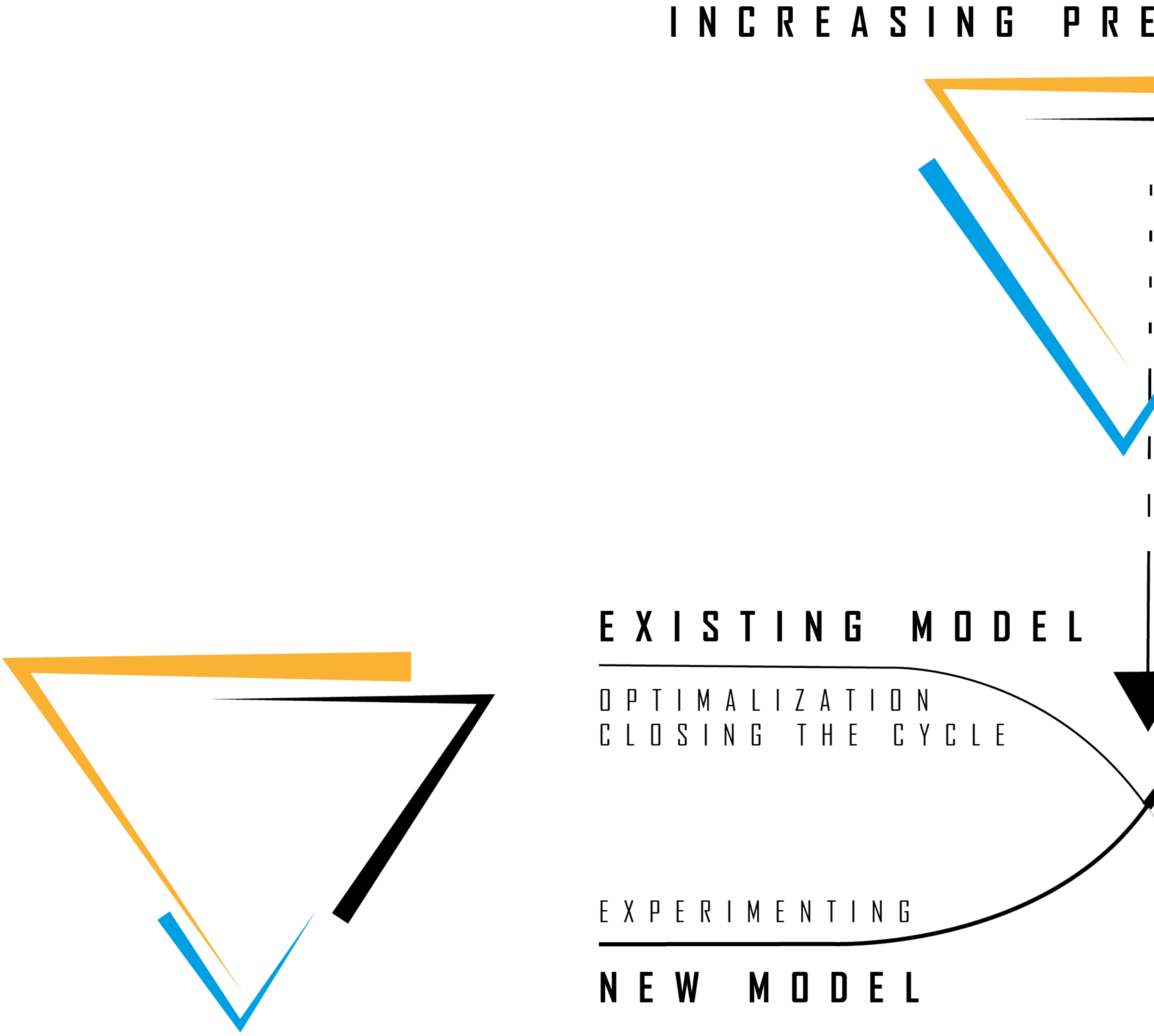
There are two approaches to accommodating a growing population. Both put pressure on the existing spatial distribution of South Holland. The first option is to spatially expand the cities into the surrounding land. Space that is currently used for agriculture would become part of the urban areas. Furthermore, people living in the central parts of cities could further loose their connection to the rural areas and the food production.
The second possibility is that cities grow within their existing borders. Although this form of growth does not expand the cities into the surrounding land, it puts pressure on the spatial system. If the population of cities grows, space needs to be found for new infrastructure, like streets and public transport between cities. Furthermore, more recreation areas would be needed (Holden and Norland, 2005, p. 2159) and existing natural areas might suffer from more visitors, since people living in compact cities travel further distances for recreation (ibid.).
Overall, the population growth in South Holland puts pressure on the agricultural sector and natural areas. The mitigation of the effects of growth is necessary and new services for the growing population need to be provided.

CONCLUSION

In conclusion, South-Holland is facing an increasing pressure on land. The climate crisis is creating effects such as rising water levels, and an increasing need for storm water drainage and water retention during dry spells. In addition, economic and demographic growth lead to an increasing demand for housing and infrastructure. This results in densifying cities that will pressure their surroundings with air- and groundwater pollution, heat stress and water surpluses. (Provincie Zuid Holland, 2017) A third pressure is formed by the agri-food sector, where there is a need for both growth to be adequate for the growing world population and a system change to become circular. (European commission, 2019) These pressures result in a challenge for the province where a sufficient amount of agricultural products is produced on a limited amount of land, with minimal waste and impact on the climate, to acquire space for the urban demands and water retention.

PROBLEM STATEMENT AND CONCEPT DIAGRAM

Figure 1.2.1: problem statement, figure by author



SSURE ON LAND

[NEW]
EXISTING MODEL

STABILISATION
SPREADING

REPLACING

OLD MODEL

1.3 CONCEPTUAL FRAMEWORK

As indicated in our research question and problem statement, this project is structured around the three themes of flood protection, changes in the food industry and the liveability of the region. In the following chapter, we will introduce the concepts we use to tackle these challenges and how they work together to lead to our regional vision. The concepts for flood protection are subsumed under the term "Resilient waterscapes". The productivity and resilience of the agricultural sector is achieved through a "Circular food industry". And the overarching concept to achieve spatial justice and liveability is called "Liveable and compact settlements".

RESILIENT WATERSCAPES

WATERSCAPE

The Netherlands has adapted the landscape with polders and dikes for a long time to protect against the flooding threat. Waterscapes, defined as landscapes formed around the natural water system of the area, be it natural or man-made formation, are without a doubt part of the Dutch identity. The traditional way of adaptation was based on the possibility of predicting the functioning of water systems and subordination of nature to the will and purpose of man. The turning point was the experience resulting from the Delta Works interventions where heavy and expensive infrastructure aimed at reducing the length of flood banks, closed the natural flow of water at the mouth of the delta, and had drastic consequences for the natural environment (de Vos, 2006). It resulted in extinction of many species, and a greater deposition of pollutants. It was understood that introducing such radical changes with complex natural processes can bring unpredictable effects whose ecological and economic price undermines the sense of the entire investment.

RESILIENCE

There are three main challenges of waterscapes today: ensuring security, safeguarding key natural resources and balancing the natural environment. Due to the climate crisis the existing water pressures will keep increasing to an unknown extent. Therefore, the concept of calculated control of natural systems has lost its use. That is why the change from controlled waterscape to resilient waterscape is so crucial to gain the capacity to recover quickly from various levels of difficulties. The concept of resilience is increasingly used in urban planning and in simplified terms it means that cities and their infrastructures should be fail-safe (Sharifiand & Yamagata, 2016)

NATURAL BASED SOLUTIONS

According to the European Commission (2019) natural based solutions are "inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience." Copying, adapting to or harnessing the power of nature gives effective and environmentally friendly tools to protect human habitats while at the same time be in harmony with the natural environment.

In the province, a number of projects have been already started, co-created by Wageningen University & Research at work whose natural based solutions play a major role to develop resilient waterscapes.

RETENTION

Due to the climate crisis the current flexibility and capacity of polders in the Netherlands will no longer be able to resist the rising water levels. On the other hand, the Dutch geological plate will rotate diagonally due to geological forces. The west will sink deeper below sea level, while the east will continue to rise (van Bergen Kolpa Architecten, 2005). As a result, in areas where salt water pressure increases, local drinking water resources will be at risk. To concentrate sweet water resources, one project in Integrated Planning and Design in the Delta (IPPD) plans to create an alternative channel with fresh water from the upper parts of the river, resulting in sweet water bodies in the centre of Goeree- Overflakkee (Meyer, 2015). We analysed the logic and spatial strategies of this project as a reference to gradually changing the landscape to develop a system where limited freshwater resources will be centrally protected, stored and utilized to meet the needs of urban development and agricultural production.

SPONGE CITIES

The urban form of retention was given the popular name of "sponge city" which "aims to (...) improve effective control of urban peak runoff, and to temporarily store, recycle and purify storm water; to upgrade the traditional drainage systems using more flood-resilient infrastructure and to increase current drainage protection standards to offset peak discharges and reduce excess storm water; and to integrate natural water-bodies" (Shun Chan, et, al., 2018). City development integrating this type of solution allows to improve local water safety as well as the liveability in dense urban centers, which is crucial from the perspective of the expected urban development in South Holland.

CIRCULAR FOOD INDUSTRY

One of the goals of this project is to make the food sector of South Holland circular by closing gaps in the existing economic cycle, on the one hand, and by integrating new methods and resources in the economy on the other. The following section explains methods and concepts that are used to achieve circularity in the Region. They can be applied within the resilient waterscapes that were described above. This combination can increase the productivity and sustainability of the food industry, while increasing the safety from flooding in the region.

CIRCULAR ECONOMY

Besides the challenge of protecting South Holland from the forces of nature, the province faces the need for a transition towards a circular economy in the next few years. Making the economy circular is not only a requirement on the path towards sustainability, it is also a primary objective of national and supranational policies. According to the Dutch government, the Dutch economy should be fully circular by 2050 (Ministry of Infrastructure and Environment, 2016: 7).

A circular economy is an economic model in which output of the consumption chain is turned back into input in the production or is reusable. In this way it is meant to create a just and social economy within the earth's ecological capacity (Roemers, 2018: 14-15).

SEAWEED FARMING

Our analysis of the food production process within the province of South-Holland is focussed on greenhouses, agriculture and dairy farming since these have the highest land consumption of the food production sectors. It shows that mainly the greenhouses and dairy production have a need for input that is currently not created out of the output, like the energy consumption of greenhouses to produce light, warmth and CO_2, and the production of fodder out of imported materials such as palm kittle and soya hulls.

A viable resource that can produce the needed products is seaweed. Tests show that when it is used in cow fodder, dairy production can go up by 2.5 kilograms per cow, per day (Agroflux, n.d.). With a high protein content, seaweed can potentially replace globally imported protein rich materials, such as soya. Secondly, seaweed implemented in the dietary habits of ruminant livestock reduces methane emissions that are harmful to the biota (Kinley, de Nys, Vucko, Machado & Tomkins, 2016).

Not only in dairy production can seaweed limit the need for imported goods, in greenhouses the macro-algae also have potential. Seaweed can be anaerobically digested in order to produce energy-rich methane, a biogas (Nkemka & Murto, 2010). This biogas can serve as fuel to heat the greenhouses, or produce the needed electricity for lighting. As a side effect, seaweed takes in pollutants such as heavy metals from the water and CO_2 from the air, which positively influences local biota (Nkemka & Murto, 2010).

In order to achieve a more circular food production process in the province of South-Holland, seaweed production in aquaculture has the potential to close the loop in an inter-sectoral approach.

SALINIZED SOIL

South-Holland, being a province that is located next to the sea, has had to deal with salinization of the soil for a long time. With the predicted sea-level rise and the continued subsidence of the polders, this salinization will only increase, especially on the islands of South-Holland South and around the port of Rotterdam. (Essink, van Baaren & van Vliet, 2008) As is explained later in the agri-food production analysis, high concentrations of salt in the soil cause a decrease in the yield for farmers (Blom-Zandstra, Currently, the effects of salinized soil on crops is counteracted by manually adding sweet water to the soil. This system comes at high costs and results in a great amount of extra water use. If it is possible to produce high yields of agricultural produce in soil with increased salinization this would save both money and sweet water. (Blom-Zandstra, 2017)

To ensure high agricultural yield in the new food with the addition of a higher salinization of the soil, research needs to be done on crops with a higher salt tolerance. This research has been started in the Netherlands with a test location on Texel called Zilt Proefbedrijf Texel and a laboratory at the University of Amsterdam. (Rozema, Rijsselberghe, 2010) Using the conclusion from their research, a list of possible high yield crops on salinized soil can be made to ensure high yield agricultural production in South-Holland.

AQUACULTURE

This type of cultivation is crucial in terms of maintaining production of sufficiently high amounts of protein, with the need to adapt landscape conditions to those more integrated with water. According to the Food and Agriculture Organization (FAO) aquaculture is the farming of fish, crustaceans, molluscs, aquatic plants, algae, and other organisms under controlled (salt or sweet) water conditions. The use of suitable types of water production allows the province to effectively use resilient waterscapes while purifying eutrophicated water from inland agriculture and solve one of the biggest issues on the way to a circular food production system.

LIVABLE AND COMPACT SETTLEMENTS

The final challenge that our project addresses is the regions need for additional dwellings and the negative effects of increasing density. For sustainability reasons, we propose to redensify the existing town and cities. Therefore, this section explores the concept of compact cities as well as the question how the region can become more livable in spite of the increasing density. Furthermore, it asks which steps can help to make the distribution of positive and negative effects of the aforementioned concepts more just.

HOUSING DEMAND

The immense housing demand in South Holland creates a pressure on land that stands in conflict with other land claims. To accommodate its growing population, South Holland needs to build 150,000 new dwellings until 2030 (Province Zuid Holland 2017: 7). Additionally, this housing demand is not spread equally throughout the region. Most of these new accommodations will be needed in the urban areas, while the population of more rural areas might shrink within the next ten years (ibid.). This means that a large number of dwellings will be built in areas that already have the highest pressure on land.

COMPACT TOWNS AND CITIES

Because of the immense pressure on land in the region, we propose to follow the compact city model for urban development in the region and to redensify existing towns and cities instead of building new neighbourhoods outside the city borders.

Mike Jenks (1996: 3) summarizes that compact city theories describe an urban form in which functions are concentrated and mixed which in theory should result in less traffic. But he states, there are varying opinions about the actual sustainability of compact cities. The strongest argument for compact cities is the reduced need for travelling. There is evidence that inhabitants living in compact neighbourhoods produce less emissions through every day travel since this urban form is more adequate for walking, cycling and public transport (Holden and Norland 2005, p. 2161). Another reason why compact cities are adequate for this project is that dense cities use less space. This way more space can be used for other purposes like the ones mentioned in the previous paragraphs.

Nevertheless, there are downsides to making cities more dense. Holden and Norland (2005, p. 2159) show that people living in compact neighbourhoods take more leisure travels than people from lower-density areas. This can counter weigh the positive effects on everyday travel. As the main reason for this effect they indicate the lack of private gardens. But the authors also propose planners can react to this effect by creating sufficient private or public recreation areas within or in proximity to compact neighbourhoods.

Another challenge are the effects of compact cities. on human health. Especially in the context of increasing densities in cities, healthy environments for people are of crucial importance. According to Mariëlle Beenackers, Joost Oude Groeninger, Carlijn Kamphuis and Frank Van Lenthe (2018) higher densities in Dutch cities are correlated with higher stress levels for the population. On the other hand, higher densities can increase health if combined with pedestrian and cyclist friendly public spaces (ibid.: 85). Consequently, measures to increase population density in the towns and cities of South Holland need to be combined with public spaces that encourage people to walk and cycle within the urban fabric as well as in the surrounding rural area.

HEALTHY LANDSCAPES

New regional recreation areas could help to compensate for the negative effects of denser towns and cities. According to Shih-Han Hung et al. (2019) stress levels can be reduced substantially by visiting natural environments. Some even state that mountainous and water landscapes have even more positive effects than forest areas for example (ibid. 225). Of course, these effects depend on various factors like the design of these spaces. Nevertheless, these studies show that the implementation of water landscapes, besides their productive and protective value, have positive effects on human health and are very suitable as regional recreation areas.

ACCESSIBILITY OF RECREATIONAL LANDSCAPES

An important question for the design of new recreation areas is how to make the access to these areas just. A risk is the deepening social injustice between people living in inner city neighbourhoods with a comparably low average income and wealthier neighbourhoods on the urban fringe. Our analysis shows that most of the poorest neighbourhoods of south holland are located in the central areas of the bigger cities. Therefore, they benefit less from new recreational areas on the border between city and rural areas. Furthermore, many of these neighbourhoods are next to industrial areas and could therefore suffer more from industrial emissions.

Consequently, good access to new recreation and education areas is needed. Especially low-income neighbourhoods need affordable public transport and good bicycle routes though connect them not only to destinations within the city, but also to rural areas and regional parks. Therefore, we propose to build new blue and green recreation areas close to public transport nodes and in locations that are accessible by bike from inner city locations.

ACCESS TO HEALTHY FOOD

Another question of social justice is the accessibility of healthy food. Population growth will lead to a higher food demand and the question if healthy food is available to everyone in the region will become even more important. The described changes in the food industry will ensure the supply with food for the region and the export market. But further measures need to be taken to create equal access to healthy food for everyone. Van Kreijl et al. (2006: 104) summarize three sets of actions the Dutch government can take to promote a healthy diet: information, subsidies and regulation.

One way of informing consumers about food is to bring food production closer to them. Jessica A. Diehl et al. (2019: 238) show in a case study that urban farming, for instance, can help to educate people about food and food production. Therefore, our strategy aims at the integration of agriculture in the urban fabric. This is one of the goals of our strategic "agriculture knowledgescape", which will be elaborated in the strategy section.

CONCLUSION

In our design, we aim to create a balanced landscape where the concepts of the three themes mentioned in this conceptual framework work together to create a liveable, safe and productive environment. We find that, in order to solve the possible future problems we need to combine concepts from multiple themes on one landscape. For example, taking a water based landscape and combining it with agrifood production in the form of aquaculture farming. Or creating a natural water buffer zone and using it as a recreational area close to residential areas, such as the Biesbosch. With each intervention that is applied in the vision, a minimum of two themes has to be addressed to ensure the balance.

1.4 RESEARCH QUESTION

Subquestion

What are the main challenges presented by climate change in South Hollan

How do these challenges relate to lande us

Can the effects of climate change be used to our advantage in the search for a balanced landscap

How can the province of South-Holland be protected from t and keeping the livability of the region?

Subquestions

What constitutes the livability of the region?

How does livability reflect on the province of South-Holland?

How does a shift in space claims improve the livability of South-Holl ns

d?

e?

e?

the effects of climate change while producing sufficient food

Subquestions

How does the current agri-food system of South-Holland work?

How can a circular agri-food system contribute to balancing out a space claim demand?

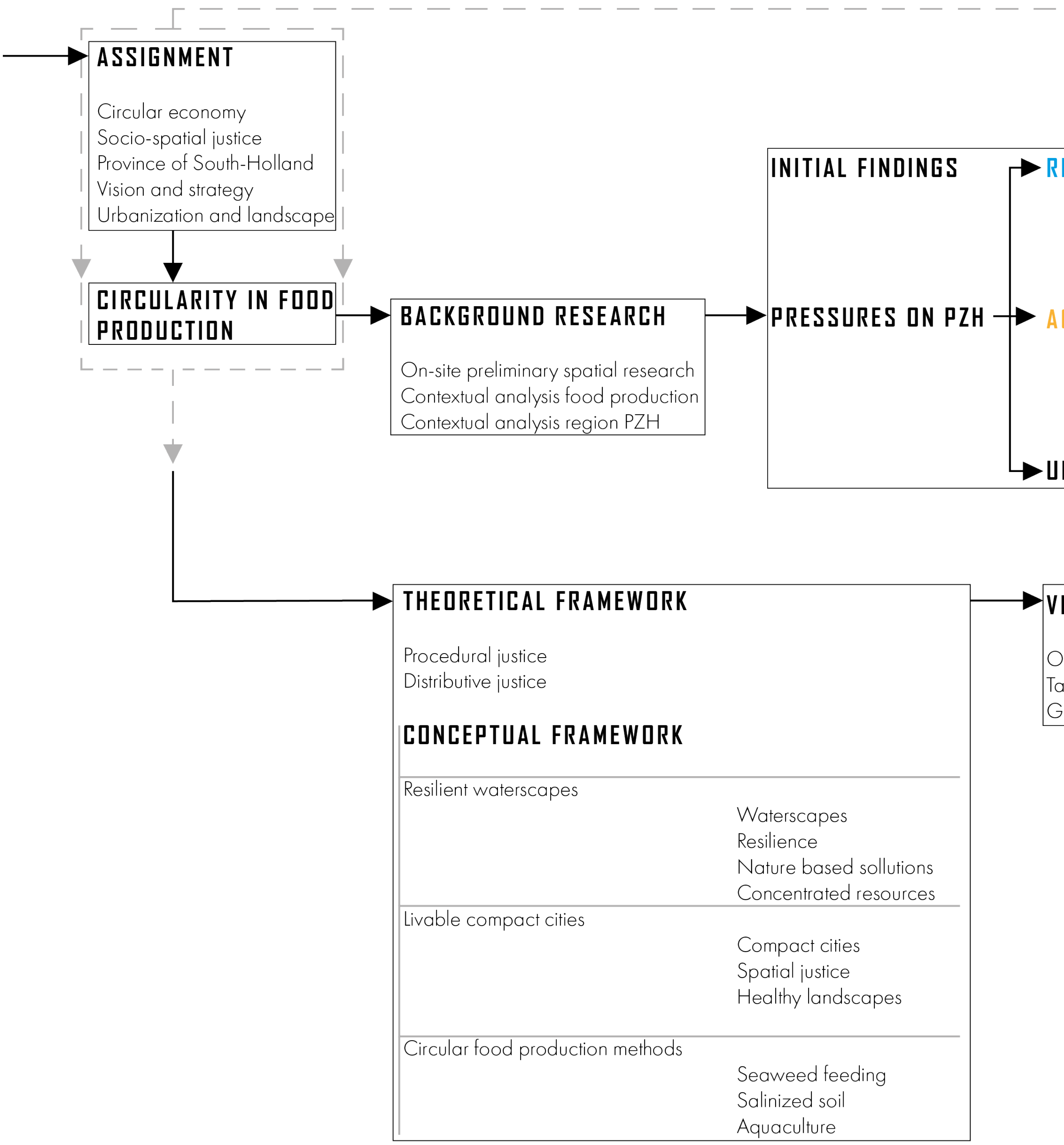
What are the spacial implications of a new agri-food system?

and?

1.5 METHODOLOGY

As shown in figure 1.5.1, the starting point of this project was the question how to make food production in South Holland circular. We used literature review and a regional metabolism analysis on the food sector of South Holland. For the analysis of the food, resource and food waste flows we used the network model since it includes interconnections within the urban metabolism and is therefore very useful for a spatial strategy (Wandl 2020). This research gave insights in the current agri-food system and from literature we found possibilities to increase the efficiency of the system.

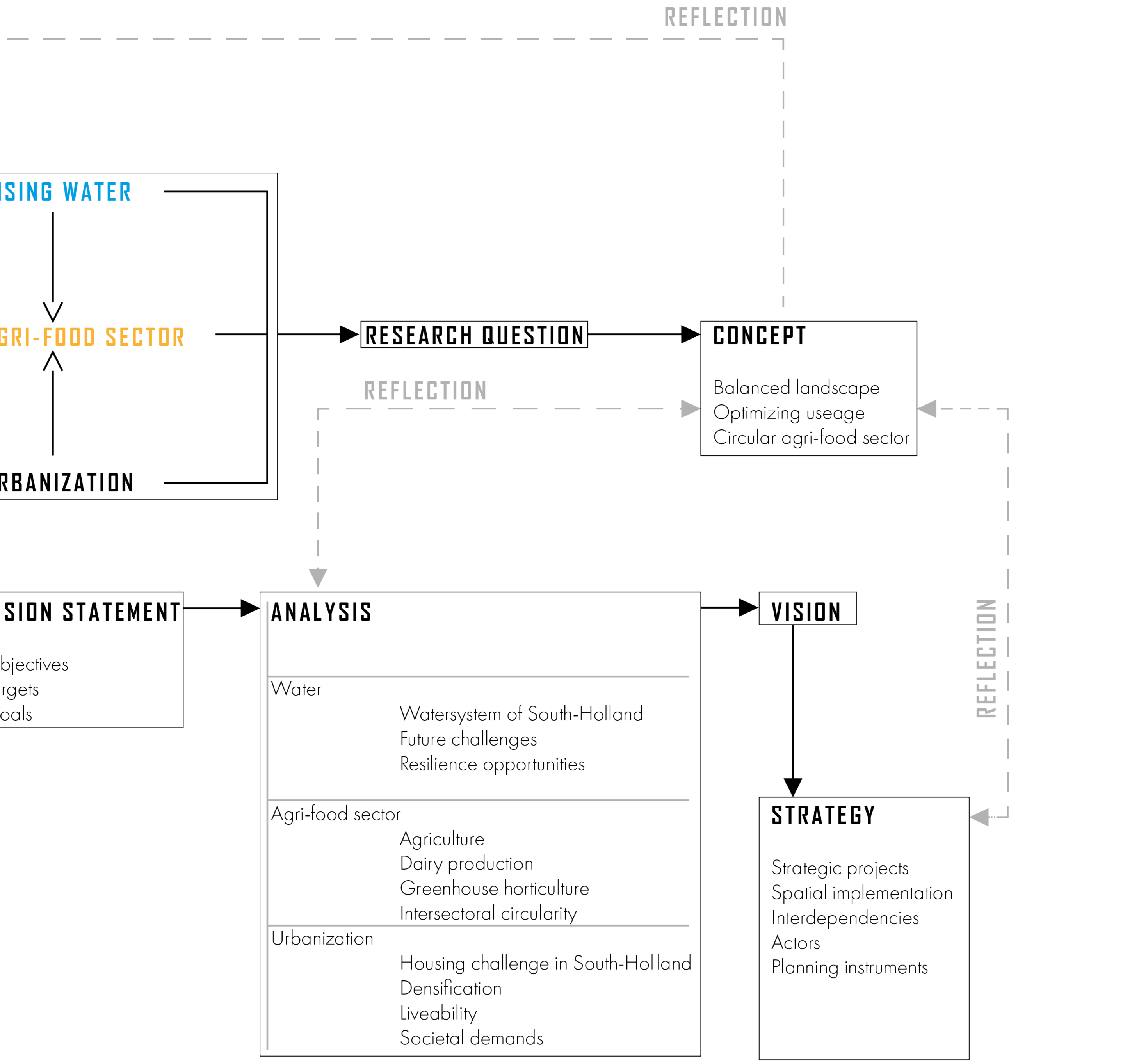
This phase of research was accompanied by an exploratory research on the challenges within the province. We found that the competition for land in the province is currently one of the most important topics and that the main pressures come from water, agriculture and urbanization.



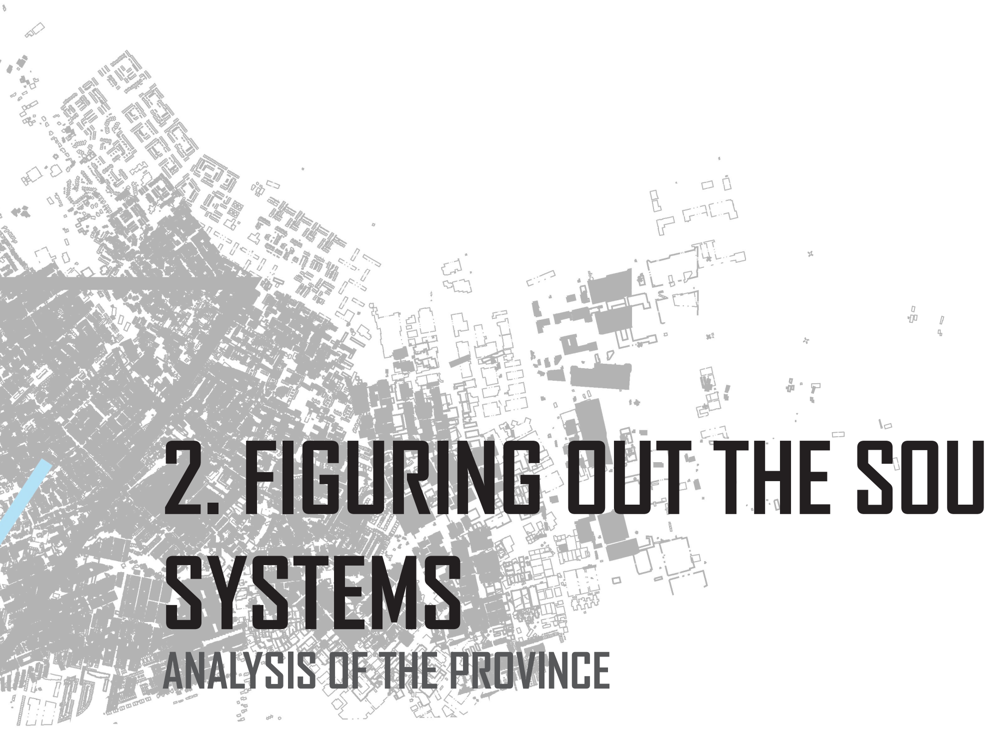
These three pressures became the core of our in-depth research. Besides literature on these topics, we used regional maps and GIS-data to learn more about the threat of flooding. We went into further detail in the analysis of the agri-food sector. Besides that we used socio-spatial data as well as regional strategy documents and scientific literature to learn where the pressure from urbanization is the highest and what are the needs of people in densely populated cities. The research of these topics led us to the conclusion that the implementation water-scapes could reduce the pressure from both, water and agriculture and could have a positive impact on liveability in the region.

From this research we build a vision that uses wa-terscapes to reduce the afore mentioned pressures. We developed a set of transitional landscapes that covey our vision and were the starting point of our strategy.

For our strategy, we used the idea of transition man-agement (Van Raak, 2020). Based on this theory we developed a strategy that starts with two strategic projects that kick off a regional transformation.




AGRI-FOOD SECTOR
WATERMANAGEMENT
CONTESTED SPACE
URBANISATION



2. FIGURING OUT THE SOUTH-HOLLAND SYSTEMS

ANALYSIS OF THE PROVINCE

As mentioned in the problem statement, South-Holland is facing increasing pressures on land which are from rising water levels, growing demand for food production and densifying cities. In order to deal with these problems, we did research on water management, agri-food production and urbanisation to understand the logic of existing systems and the potential to close circularity gaps.
The research in this chapter is a key to understanding aspects of those complex issues and to analyze potential solutions. Moreover, the knowledge collected in this chapter is the basis for our regional vision and strategy concepts. It will be reviewed and discussed along the following sub-questions:

WATER MANAGEMENT

What is the current condition of the water protection system and how does it work?

What effects will Climate change have on this system?

What are the current possibilities, plans and limits for the development of this system?

Are there any alternatives which could be used for building resilient waterscapes in the Province?
With what characteristics, potentials and consequences of the implementation of these alternatives?

AGRI-FOOD PRODUCTION

How does the current agri-food system of South-Holland work?

What are the potentials for circularity and spatial implications of a new agri-food system?

How can a circular agri-food sector contribute to balancing out a space claim demand?

URBANISATION

Where will the towns and cities of South Holland grow?

Which form of urban growth can protect rural and natural land?

Which societal groups will suffer from negative effects of increasing population density?

How can these negative effects for certain groups be mitigated?

What are the effects of redensification and how can denser cities keep their liveability?

2.1 WATER MANAGEMENT IN SOUTH-HOLLAND

2.1.1 WATER SYSTEM OF SOUTH HOLLAND

The South Holland area has undergone enormous changes in terms of the landscape and arrangement of the coastline over the last 200 years. Defined by the hydrological mechanisms of canals, dikes and windmills, in order to form a safe and productive environment. Water system control has always been as a matter of civil engineering (Saeijs, 1991).This attitude towards water management resulted in more land available for man, but drastically limited the space for water self-regulation (Fig 2.1.1.1-2). Consistent liquidation of buffer spaces for times of extreme discharge of river pressure and the sea- forced to expand the flood defences more and more. This technocratic approach began to be questioned in 1974, when creating plans for the construction plan of the Eastern Scheldt storm surge barrier. Cutting off the supply of salt water could and since be a death sentence for the Eastern Scheldt's complex natural environment awareness of those consequences increased -after which came a great social resistance and eventually the project was equipped with moveable panels that would only be closed in an emergency (Knoester et al. 1984). Since then, the good of the natural environment has become an increasingly important topic in the process of improving the water management system.

Today the main line of that complex flooding protection infrastructure length of 3 767 km (LOLA, 2014). In the system can be distinguished: primary and secondary dykes, dunes and man-made flood defences (open, permeable and closed dams) (Fig. 2.1.1.4). Dykes need regular maintenance but because of their scale it is not possible to make improvements everywhere evenly. For this reason, priority areas have been identified. Higher safety norms concern most urbanized areas with a higher economic contribution, and in the case of the Province of South Holland it is of course the Randstad area (1/10000 per year safety factor) (Kind, 2012) . On the south of the Province (and hereinafter Zealand) the core of the economy is agriculture, which results in relatively low population rate. Therefore Goere-Overflakkee have been classified by lower protection standards (1/4000 per year) and there is much less invested in protection and inbuilt security (Fig. 2.1.2.6) Despite all the complexity of the system and great dependence on its flawless, proper functioning the Netherlands is today the safest delta in the world (Baptist, 2019). However, tomorrow's challenges can definitely threaten this position.

" GOD CREATED MAN, BUT THE DUTCH CREATED THEIR OWN LAND"

Prof. Dr. H. Saeijs Head-engineer and director Rijkswaterstaat Zeeland, 1990-1999 (Saeijs, 1991)

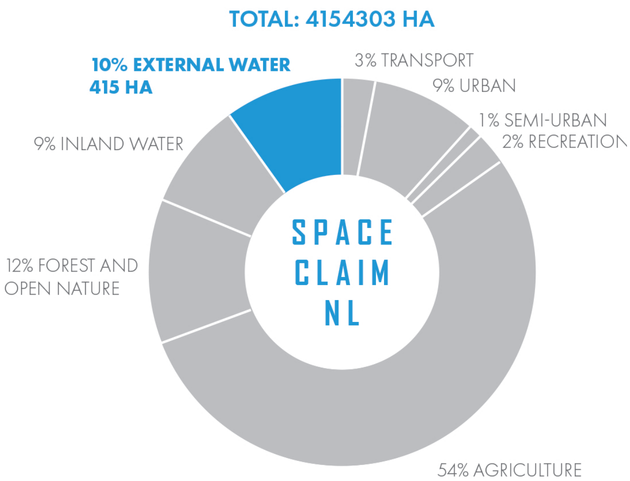


Fig. 2.1.1.1 Space claims in the Netherlands. Figure by author (CBS 2018)

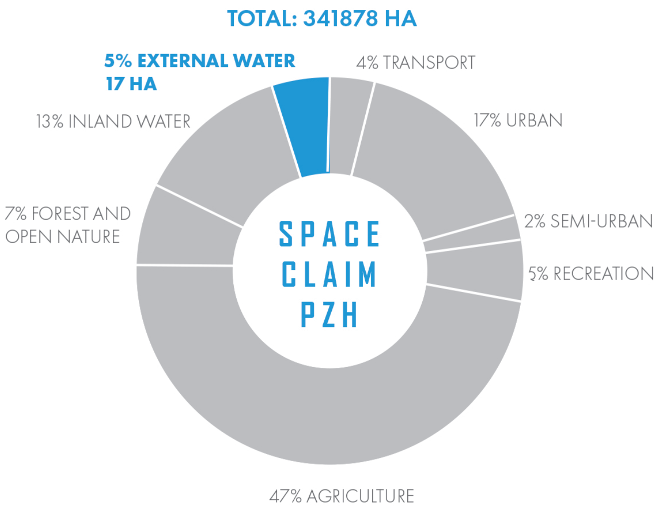


Fig. 2.1.1.2 Space claims in South Holland. Figure by author (CBS 2018)

Fig. 2.1.1.3. Water system in South Holland
Figure by author (van der Meulen, 2018)

Fig. 2.1.1.4. Main lines of the flood protection systemin South Holland. Figure by author (LOLA, 2014)

2.1.2 FUTURE CHALLENGES

The current system, despite its refinement, is in a losing position with climate change. The Royal Netherlands Meteorological Institute (KNMI) predict for sea level rise ranging between 0 and 1,5m in 2100 (Fig.2.1.2) (and even 17,.65m for 2500) due to the hard to estimate future scale of melting glaciers (Kopp, 2017). It is also projected that the frequency of river landings will increase and their extremes may increase by up to 50%. (Fig. 2.1.2.3) (Meyer, 2014). There will be more extreme situations whose scale and frequency are very difficult to predict. Preparation for the worst-case scenario (which in practice means the need to double the height of primary security line) with current technology would take 150 years (van der Meulen, 2018). Increasing the **DYKES** height means an even greater increase in the length of the cross-section (Fig. 2.1.2.1a), which is end sentence for many human settlements and monuments located in the vicinity of such a infrastructure.

An important aspect is also **SAND** suppletion. Unfortunately, the consumption of sand is already very high and it is estimated that in the light of future challenges extraction from the bottom of adjacent sea areas can reach the number of 85 million m3 per year (Noordzeeloket, 2018). Such a scale of extraction can be difficult to obtain given the large surface area rich in sand is impossible to use because under the jurisdiction of Nature 2000 or current pipelines. Improvement of 927 km of dykes and 468 km engineering structures is already planned with producing 50 kilometers of "safe dykes" per annum. (Fig.2.1.2.1b) and again the order of work sets a priority plan which focuses on the areas with the highest populations and economic contributions. This does not necessarily cover areas with the greatest exposure to water pressure. For this reason, areas such as Goere-Overflakkee need other, lighter, solutions which would still protects local development.

Another aspect of water system issues lies underground. Through years of pumping out and draining ground levels are already **SUBSIDING** (Fig. 2.1.2.4) specially in Rhine and Meuse valley. This process accelerates more severe drought. The impact on changes in groundwater flows lead to penetration of salt water into soil - and it will range from 10 to 15 km from the coast (Haasnoot et al. 2017) That is why the **FRESHWATER** supply system becomes one of the biggest challenges (Fig.2.1.2.5).

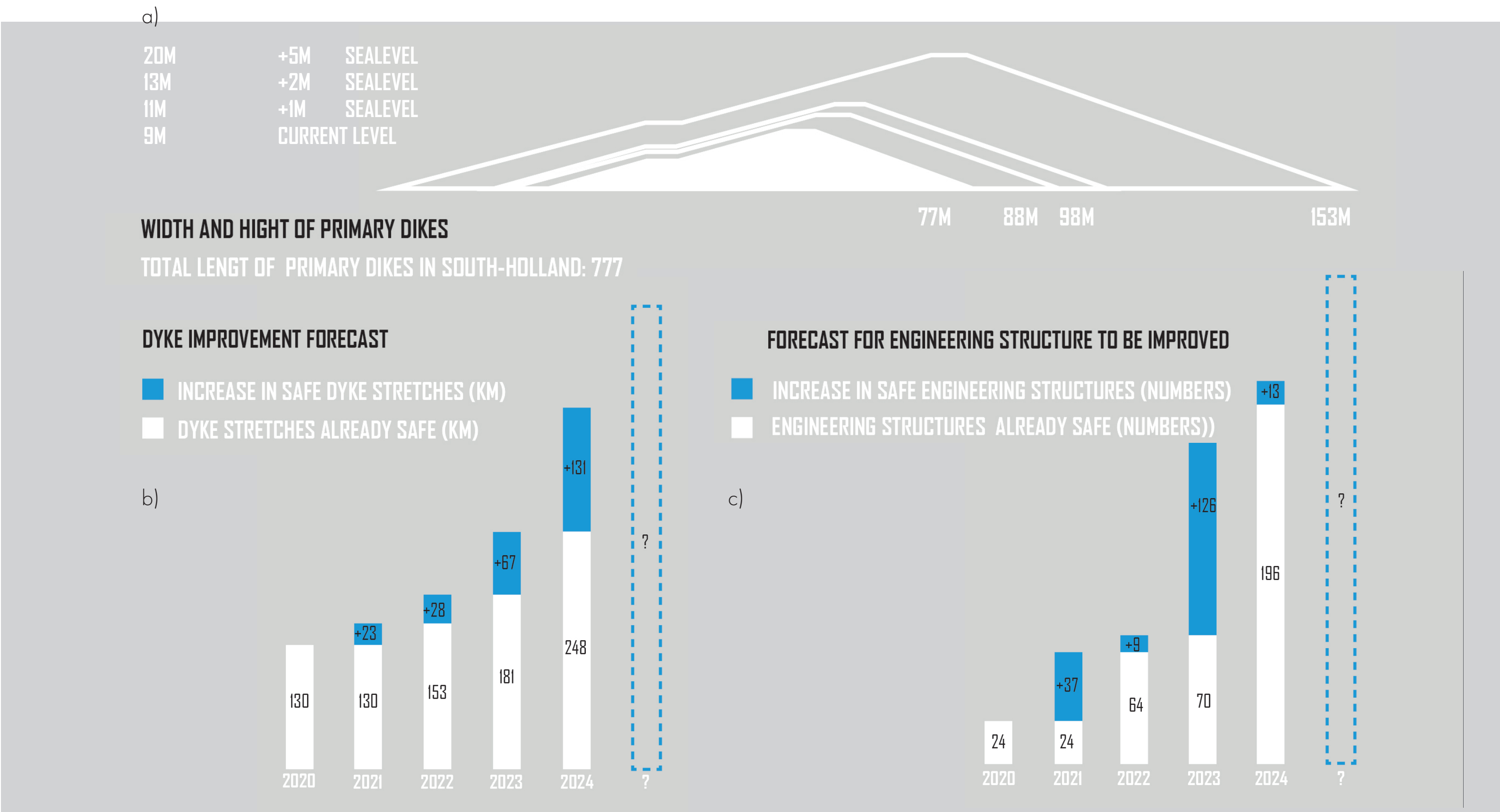


Fig. 2.1.2.1. characteristics and plan for development of water protection. Figure by author (Staff of the Delta Programme Commissioner, 2020)

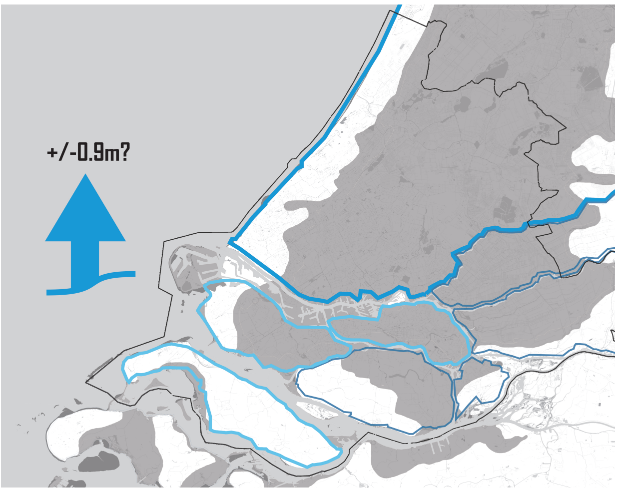


Fig. 2.1.2.2. flooding possibility with rising sea levels. Blue shades marked different water protection standards - the highest for the Randstad area. Figure by author (Kind 2012)

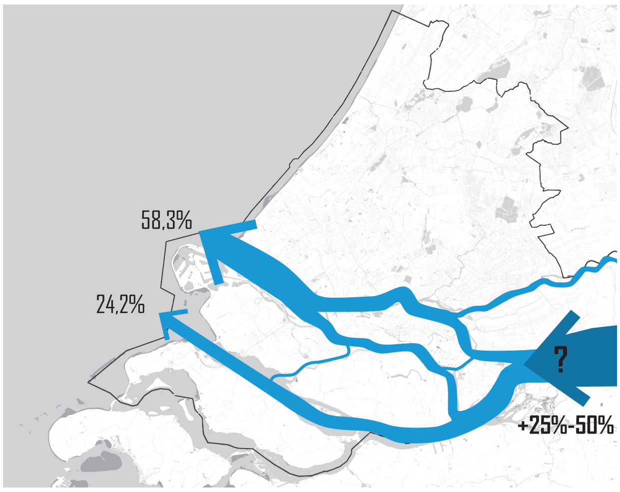


Fig. 2.1.2.3. The current share of river water intake paths and a forecasted increase in the amount and pressure of water during periods of extreme. Figure by author (Meyer 2014)

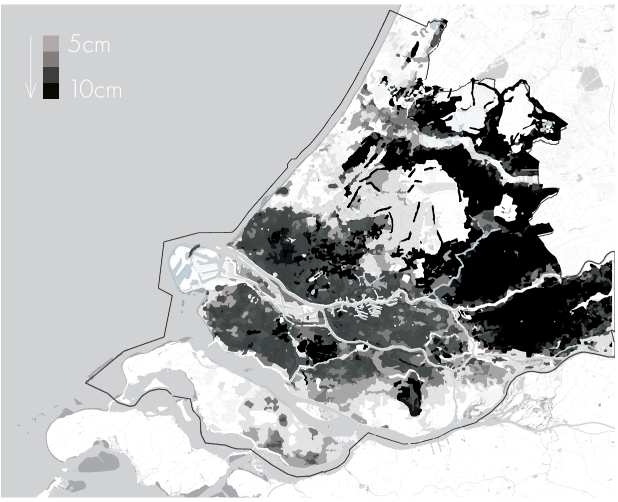


Fig. 2.1.2.4. the estimated subsidence to 2050 based on the current climate. Figure by author (Nelen, 2017)

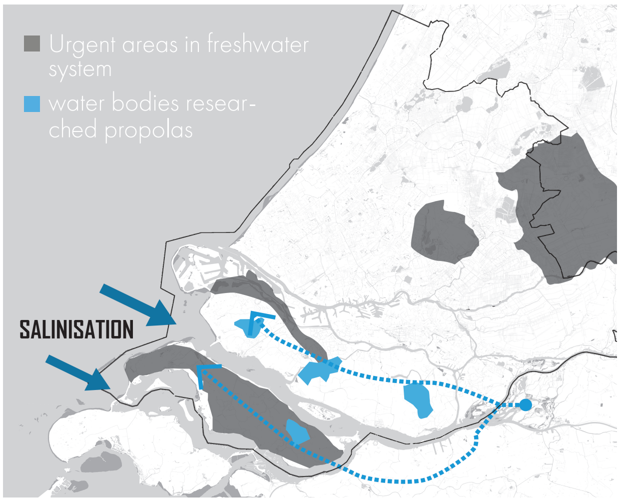


Fig. 2.1.2.5. Most vulnerable areas with regard to access to fresh water and existing proposals for new channels and water bodies. Figure by author (Meyer, 2014 and Staff of the Delta Programme Commissioner ,2020)

Heavy infrastructure, apart from its environmental costs, is a great **ECONOMIC BURDEN**. The Netherlands is already a leading country when it comes to investing in flood risk management - currently it is 1,1% of national GDP (Meyer, 2017) and the future estimated costs of annual investment in improving the safety of the Dutch water system are almost 1.3 billion EUR (Staff of the Delta Programme Commissioner, 2020).

Until now, all major water system adaptation occurred under the influence of disasters, which also always clearly defined the scope of necessary changes. Now, however, when the threat will increase at a difficult to predict pace and scale, that old top-down and accurately calculated infrastructure based solutions lose their utility due to lack of flexibility and adaptation (van der Meulen, 2018).

There is a way to make optimum use of the benefits for humans and work on ecological balance for self-regulation and resistance to extremes.

Combination of natural systems with technical solutions can provide highly **RESILIENT WATERSCAPES**. It is clear that each land use typology have to be able take responsible for the water in the area but the construction of such a resilient system is a long-term process. That is why it is so important that adaptation measures to the future consequences of climate change are already started (Baptist, 2019).

"WE ARE ON A DEAD END WITH OUR DYKES, (...) WE WILL HAVE TO CHANGE COURSE AND LOOK FOR INNOVATIONS"

Prof. Dr. H. Saeijs Head-engineer and director Rijkswaterstaat Zeeland, 1990-1999 (Saeijs, 2004))

2.1.3 RESILIENCE OPPORTUNITIES

NATURAL BASED SOLUTIONS:

According to the European Union states these solutions are "inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience" (European Commission, 2019). Copying or adapting harnessing the power of nature gives effective and environmental friendly tools, to protect human habitats while at the same time be in harmony with the natural environment. In addition to these undeniable advantages, this type of solution is very time-consuming and in the light of today's development of South Holland Province they require large landscape transformations that is why it is so important to look for the types which are feasible for implementation in that local context.

SAND MOTOR

A very interesting case is the project for coastal safety. A pilot was carried out in 2011 and applied a large amount of sand (21.5 million cubic metres) off the Dutch coast. After construction, this sand started spreading along the coast between Hoek van Holland and Scheveningen due to wind, waves and sea currents (Baltissen, 2016). This approach allows the coast to extend in a natural way to create a new type of coastal defence (Fig.2.1.3.1.).

MANY ASPECTS OF THE SAND ENGINE ARE BEING RESEARCHED, INCLUDING THE MORPHOLOGICAL PROCESSES, SWIMMING WATER SAFETY, ECOLOGICAL DEVELOPEMNT, CHANGES IN GROUND WATER AND GOVERNANCE. WE ARE PLENTY INNOVATIVE"

M. Stice- Professor of Coastal engineering at TU Delft (Baltissen, 2016)

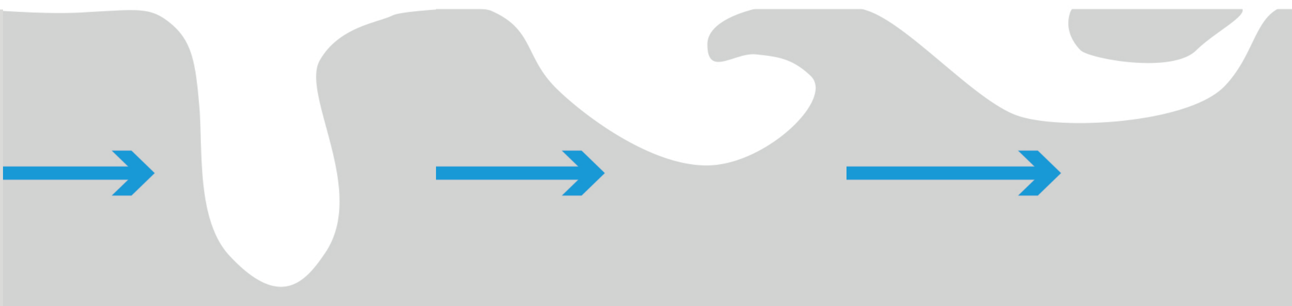


Fig. 2.1.3.1. Sand Motor concept. Figure by author (Baltissen, 2016)

ROOM FOR THE RIVER

In a similar way, it is possible to respond to the challenges from the deltas inland water pressure. River **WETLANDS** renewal support can measurably reduce disaster risk; as buffer these area type can accept and keep within its limits a significant amount of water which during extreme periods. In the Netherlands, the best known example of that approach is the Room for the River programme started in 2006 and now extended as a part of a bigger strategy; Delta Program. To improve the capacity of rivers to cope with high water levels, it gives more space to nature - especially areas between the first and second dykes so as to create wetlands that are the most effective buffer and protection from extreme water pressures. (van den Brink, 2009). Besides water safety, natural processes in wetlands can capture 10 times more CO2 than the average forest. It enables **SELF-REGULATION** of the water flow, and the increase in swamps and river areas has a positive impact on the fight against the climate crisis (10 times more CO2 absorption than ordinary forest) (Ramsar, 2018). However, what hinders the letting water in approach d is its high **POLLUTION**. Both Rhine and Meuse have considerable amounts of heavy metals like Cu, Pb and Zn (Middelkoop, 2000) and inorganic nitrogen and phosphorus which are huge issues (Metabolic, 2018). That is why Wageningen U&R carried out a series of experiments with **NATURAL FILTRATION** processes. The greatest potential seems to have Common Reed (Phragmites australis) which is capable of reducing the total amount of pollutants from 32 to 47%. In addition, the marsh fields with this plant has huge biomass a water storage potential. (Meerburg, 2010). Another important factor to improve the quality of water is restoration of sea tides that have been severely restricted by Delta Works dams. Salty tidal water brings more oxygen and ensures better conditions for the under-water biota and projects restoring this process are already underway (Tangelder, 2019).

"WE SEE SCOPE FOR THE CREATION OF NEW NATURE, MAKING OPTIMUM USE OF THE BENEFITS FOR HUMANS (ECOSYSTEM SERVICES) AND WORK ON ECOLOGICAL CONNECTIONS FLORA AND FAUNA HELP TO SHIFT THEIR DISTRIBUTION."

Martin Baptist,
Wageningen U&R (Baptist, 2019)

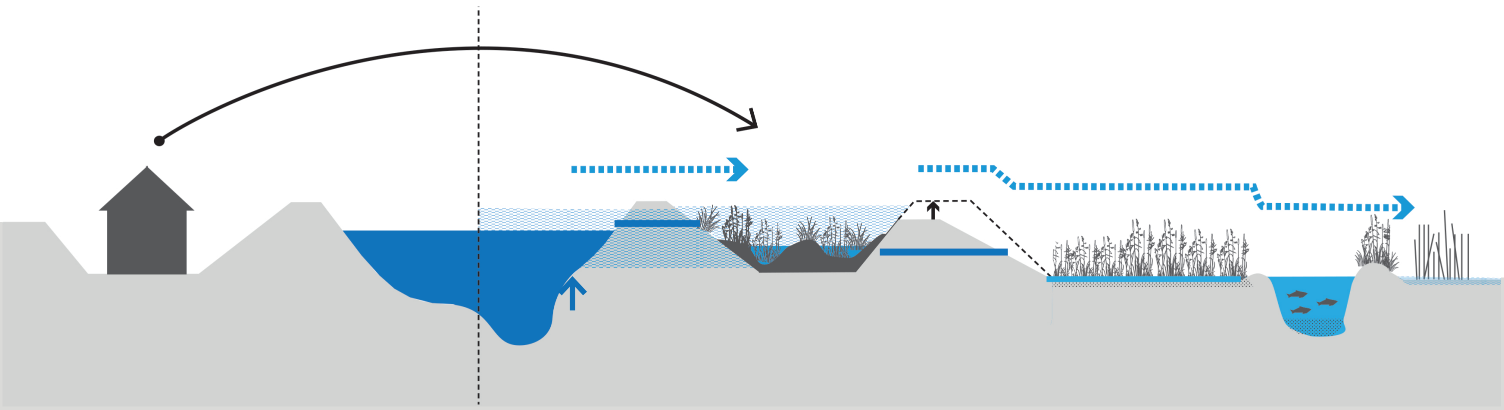


Fig. 2.1.3.2. Nature based solutions; more room for the river and natural filtration levels (Meerburg, 2010 and van den Brink M., 2009)

AQUACULTURE: or Aquatic food production is the farming of fish, crustaceans, molluscs, aquatic plants, algae, and other organisms. Aquaculture involves cultivating freshwater and salt-water populations under controlled conditions. Such "domestication" of aquatic species was already practiced in prehistoric times, and the earliest descriptions in the literature date to 475 BCE (Rabana, 1988). The decrease in utilization was associated with the development of transport technologies in the 19th century and thanks to this facilitated access to fresh wild fish. Today, this based on water food production is growing strongly - the share of these methodologies in food production has increased globally from less than 1 million tonnes in 1950 to 52.5 million tonnes in 2008 (FAO, 2011). Not every form of water cultivation is environmentally friendly. That is why it is so important to focus on the potential of aquatic plants and smaller organisms or integrated aquaponics systems. Filter-feeding bivalve molluscs are able to filter pollutants (Chopin, 2001) and Seaweed is very effective in absorbing nutrients such as inorganic nitrogen and phosphorus which are huge issues for PZH (Metabolic, 2018). In the province, a number of projects have been already started, co-created by Wageningen University, which analyse are key to developing productive waterscapes (Steins, 2020).

"INNOVATING WITH NATURE SUPPORTS ECONOMIC GROWTH, CREATES JOBS AND ENHANCE OUR WELL-BEING"

European Commission (2019)

Fig. 2.1.3.3. Aquaculture types (left-right); fish farming, mussels, algeas(Baltissen, 2016)

SPONGE CITY: Urban flooding is also a large and increasingly frequent threat to Dutch cities. Gaining popularity concept is 'sponge city' which "aims to (...) improve effective control of urban peak runoff, and to temporarily store, recycle and purify storm water; to upgrade the traditional drainage systems using more flood-resilient infrastructure and to increase current drainage protection standards to offset peak discharges and reduce excess storm water; and to integrate natural water-bodies" (Shun Chan, 2018). The most characteristic and popular elements are retention in the form of tanks on roofs, more greenery in the city, or some hybrid public space ideas like the Water Square Benthemplein design of De Urbanisten from 2016 which combines the functions of a sports field with a water reservoir. It is envisaged that related practices will enhance natural ecosystems and provide more aesthetically pleasing space for the people that live and work in urban environments. Cities are less affected by heat stress and a decrease in air quality. These types of implementations support the natural ecosystem as well; and create urban habitats for birds and other organisms.

" CITIES SHOULD FUNCTION AS POROUS AND FLEXIBLE NATURAL SYSTEMS. THEY SHOULD BE ABLE TO ABSORB, RETAIN AND RETURN WATER IN A WAY THAT CAN SOLVE DROUGHT, FLOODING AND HEAT STRESS PROBLEMS. HOW CAN NATURE INSPIRE US IN DEALING WITH THESE ISSUES? "

Florian Boer (De Urbanisten)
(Tu Delft Lecture, 2019)

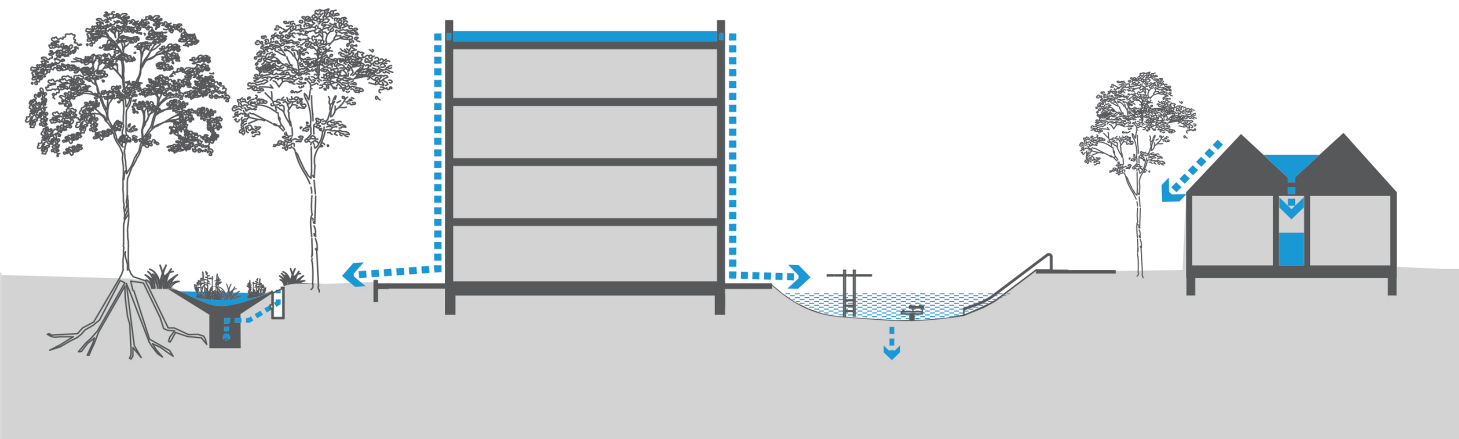


Fig. 2.1.3.4. Sand Motor concept. Figure by author (Ramsar 2018 and van den Brink, M. 2009)

2.2 AGRI-FOOD PRODUCTION SOUTH-HOLLAND

2.2.1 AGRI-FOOD IN THE NETHERLANDS

Agri-food is a large part of the Dutch culture, both in consumption and production. The Netherlands has been an important player in the worlds agri-food business for years, where it is the second largest exporter and fifth largest importer as can be seen in figure 2.2.1.2. (Jukema, Ramaekers & Berkhout, 2020) The Dutch agri-food export includes above average amounts of goods from Dutch manufacture, almost 73%, where-as the general export consists of about 55% from Dutch manufacture. (Dolman, Jukema & Ramaekers, 2019) Because of the importance of the agri-food sector, this chapter researches the workings of the current agri-food system and looks for opportunities to change the system to a circular one.

AGRI-FOOD SPACE CLAIM

The production of this high amount of agri-food for such a relatively small country results in a landscape that consists largely of agri-food. Looking at the division of surface area we actually find that for both the Netherlands and South-Holland around half (54% for the Netherlands and 48% for the Province of South-Holland) consist of agricultural land (figure 2.2.1.5 and 2.2.1.6). (CBS, 2018)

In South-Holland, the agri-food production sector can be divided into four main sectors: grassland and pastures, agriculture, horticulture and greenhouse farming (figure 2.2.1.1). With 60% of the agri-food surface area, grassland is by far the largest sector, of which around 87% is dedicated to dairy farming. The second largest sector is the agriculture, with 30% of the surface area. Both greenhouse farming and horticulture take only a small amount of surface area, both under 10%. Interestingly, when looking figure 2.2.1.1, we find that the greenhouses make up a larger part of the total agri-food companies in South-Holland. With that said, this report will focus further on the largest food production sectors: dairy production, agriculture and greenhouse farming.

AGRI-FOOD AND SOIL TYPOLOGY

As can be seen in figure 2.2.1.7 on page 34, the agricultural sectors are mostly oriented towards a certain area of the province. The agricultural land is oriented towards South-Holland South, the dairy is located mostly in the East and greenhouses are located mainly in the West of the province. These locations are related to the soil typology in the province, which can be seen in figure 2.2.1.8 on page 36. Usually, a distinction is made between agriculture and grassland, since agriculture has more and higher demands for the soil. The most suitable soil for food production is light and heavy wind-blown sand, which is found mainly towards the South of the province. The third best soil type for food-production is light clay. Peat is the least favourable soil type for food production and is found to be mainly used as grassland. In South-Holland this soil is found more to the east of the province. (Silvis, Voskuilen, Kuiper & van Essen, 2016).

"THE NETHERLANDS IS PART OF THE WORLD TOP IN SECTORS AS GLASSHOUSES, SEAD DISTRIBUTION, PIGFARMS, FLORICULTURE AND DAIRY. ALMOST ALL LARGE FOOD COMPANIES IN THE WORLD, FROM UNILEVER TO NESTLÉ, HAVE OFFICES IN THE NETHERLANDS. THAT IS FENOMINAL FOR SUCH A SMALL COUNTRY"

A. Anders
Australian agriculture expert
(van Dinther, 2017)

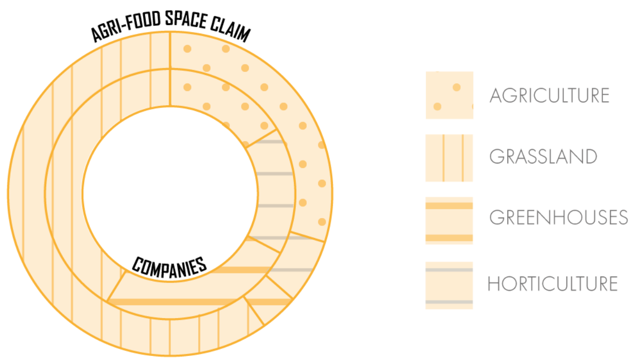


Figure 2.2.1.1: Agri-food space claim in South Holland
Figure by author, based on (CBS, 2020c)

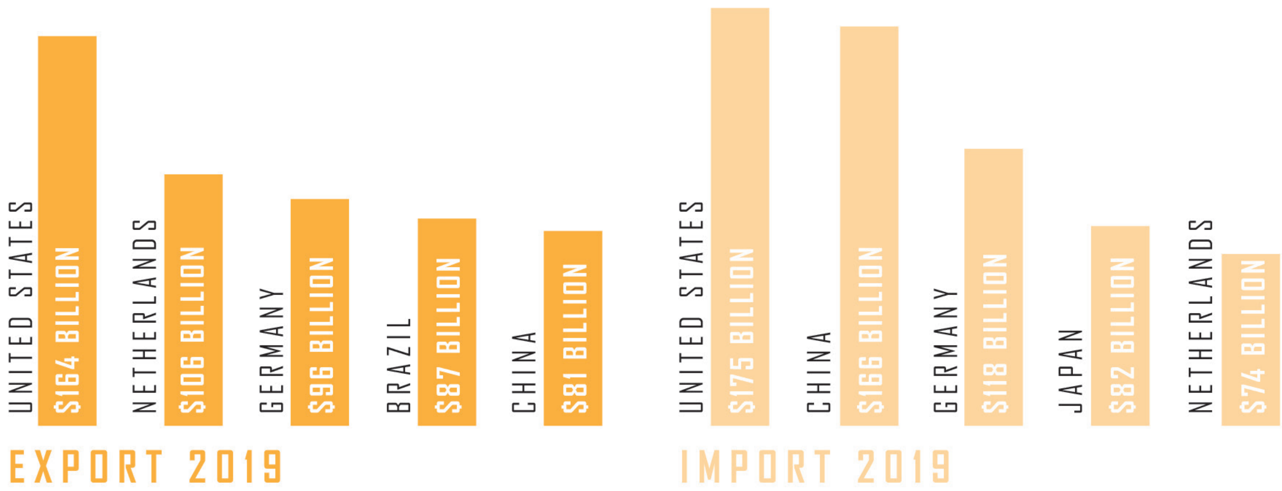


Figure 2.2.1.2: Countries with the worlds highest export and import numbers
Figure by author, based on (Jukema, et al., 2020)

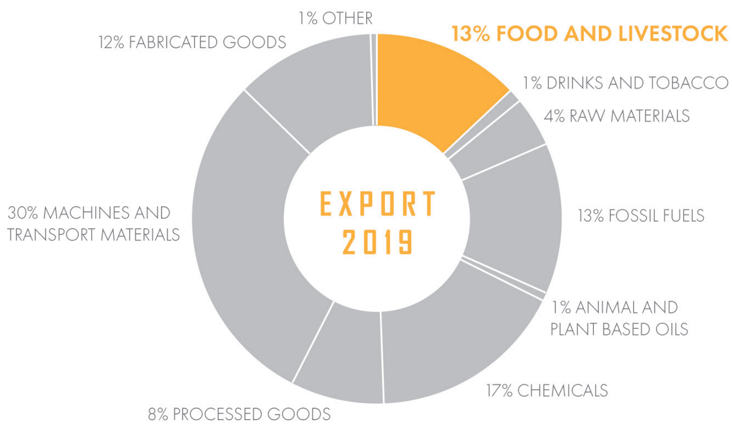


Figure 2.2.1.3: Export per sector in the Netherlands
Figure by author, based on (Dolman, et al., 2019)

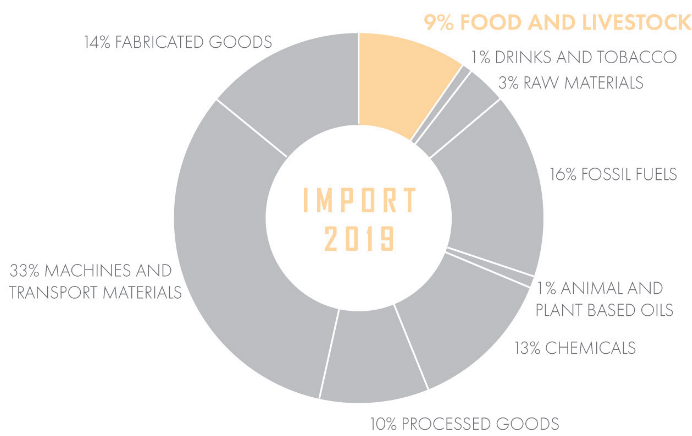


Figure 2.2.1.4: Import per sector in the Netherlands
Figure by author, based on (Dolman, et al., 2019)

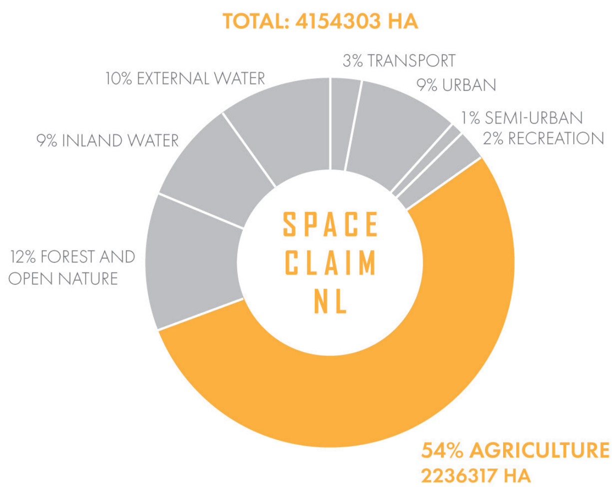


Figure 2.2.1.5: Space claim in the Netherlands
Figure by author, based on (CBS, 2018)

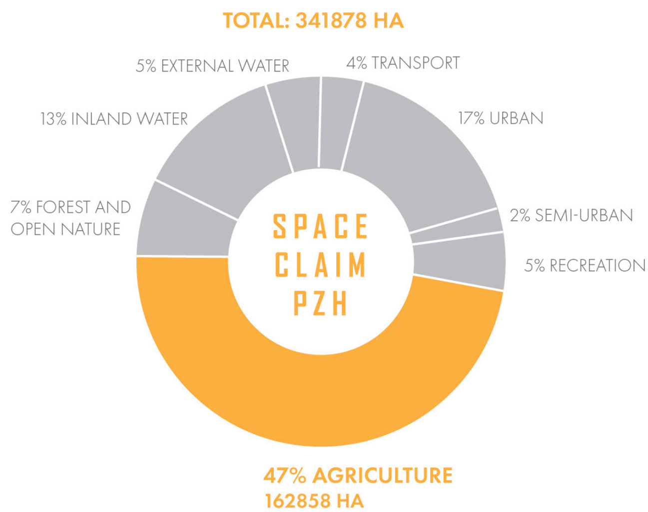


Figure 2.2.1.6: Space claim in South-Holland
Figure by author, based on (CBS, 2018)

AGRI-FOOD SECTOR DISTRIBUTION IN SOUTH-HOLLAND

AGRICULTURE

GREENHOUSES

DAIRY FARMS

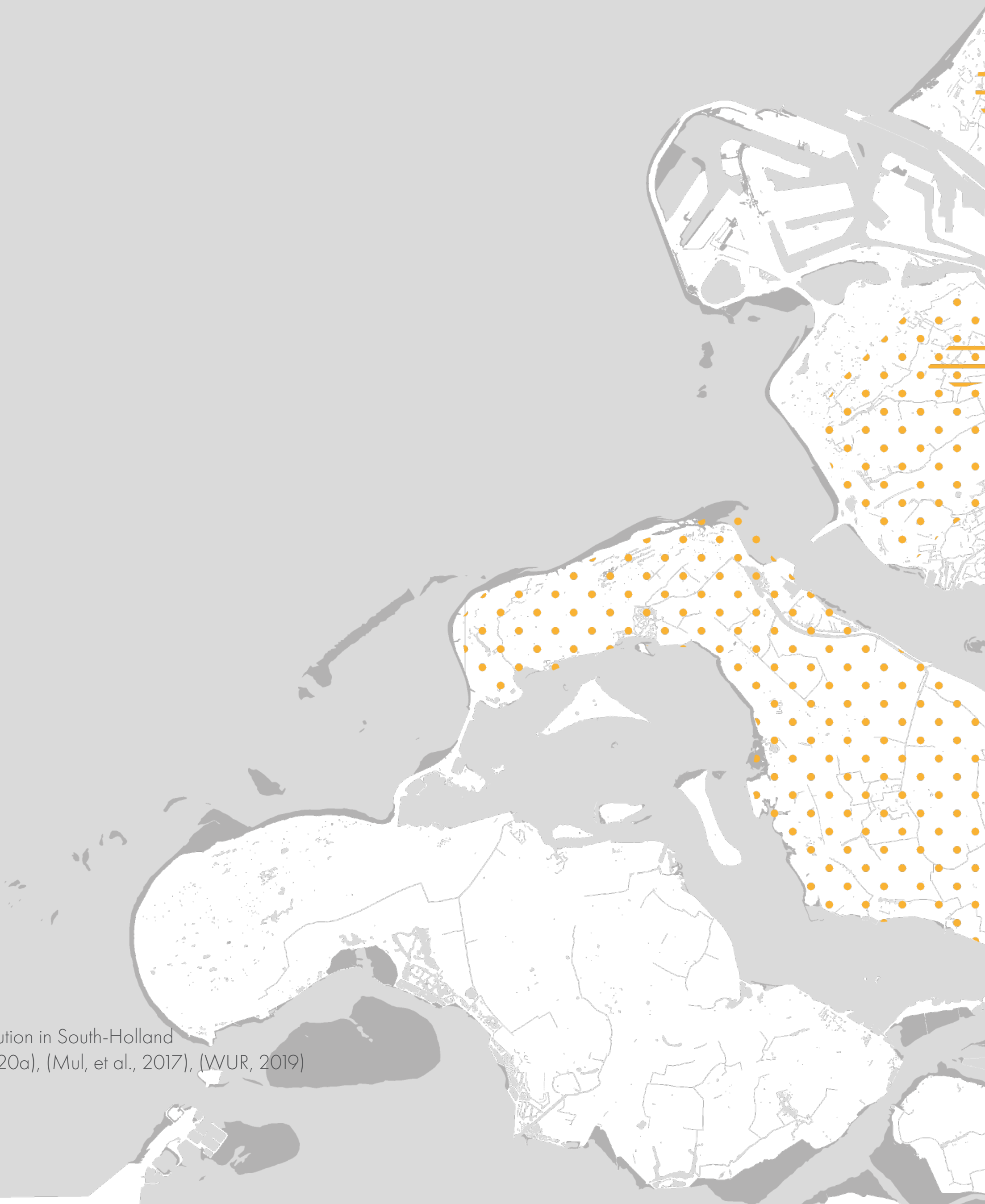
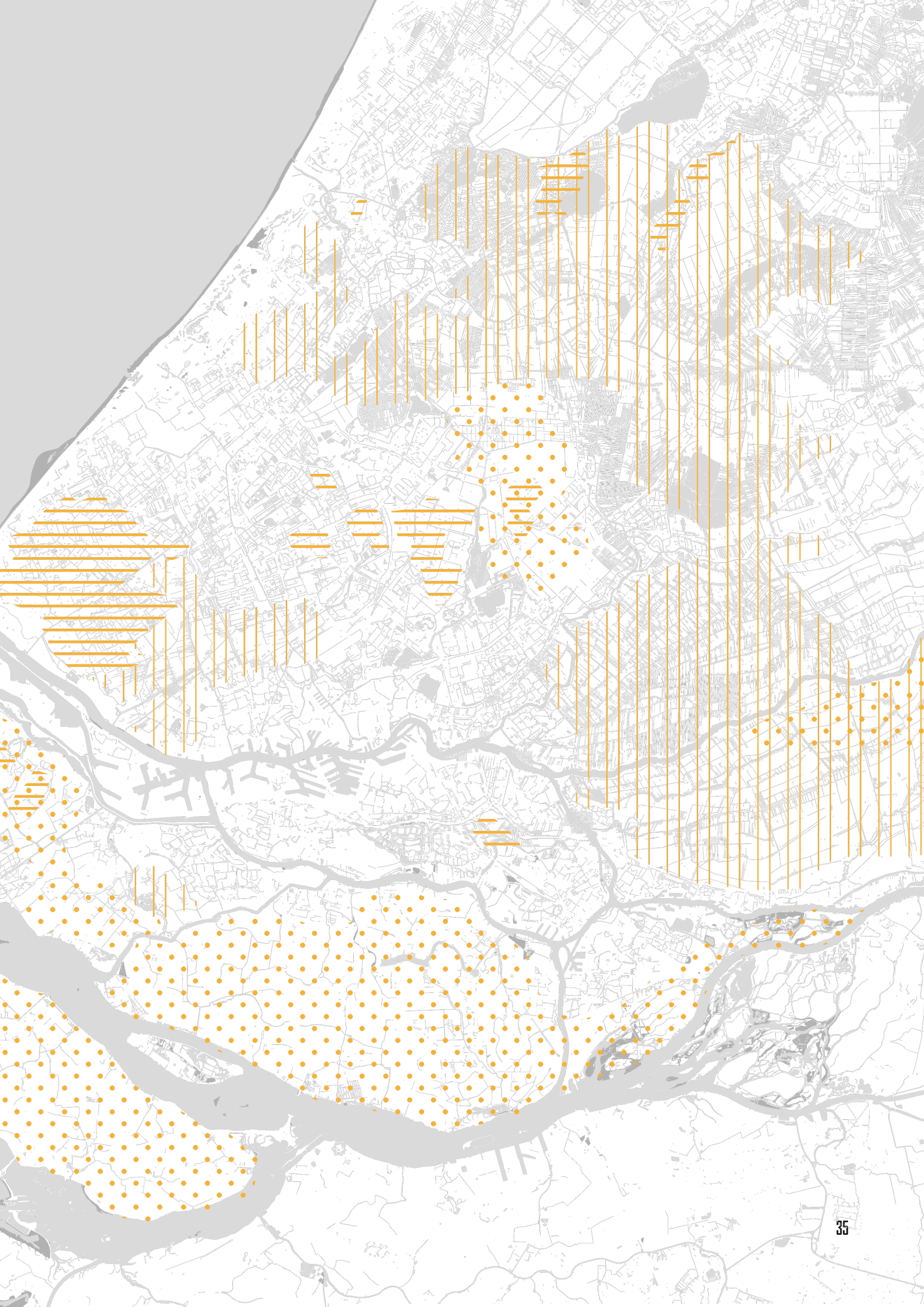


Figure 2.2.1.7: Afri-food sector distribution in South-Holland
Figure by author, based on (CBS, 2020a), (Mul, et al., 2017), (WUR, 2019)



SOIL TYPOLOGY IN SOUTH HOLLAND

- SAND
- LIGHT WIND-BLOWN SAND
- HEAVY WIND-BLOWN SAND
- LIGHT CLAY
- HEAVY CLAY
- PEAT
- URBAN AREA

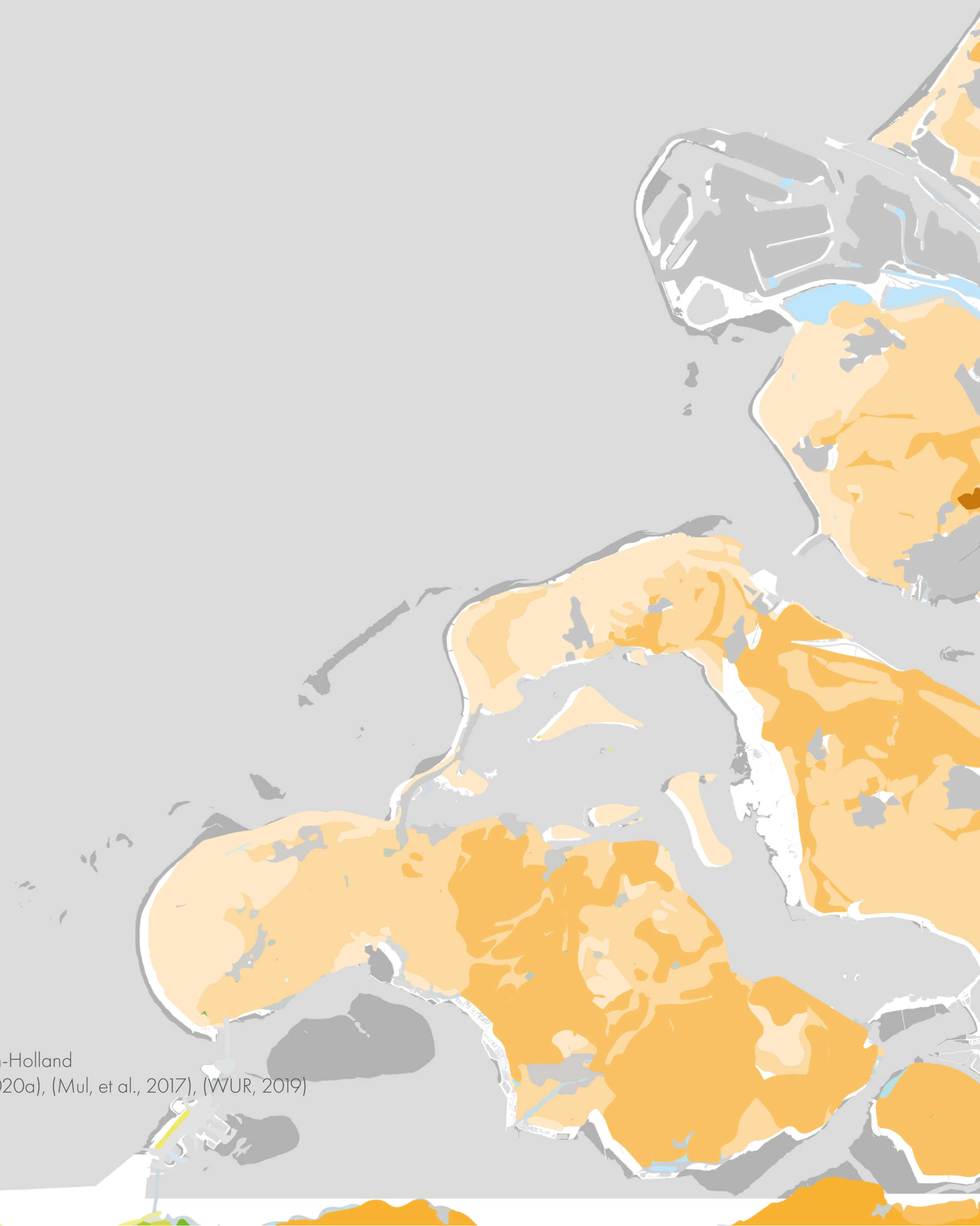
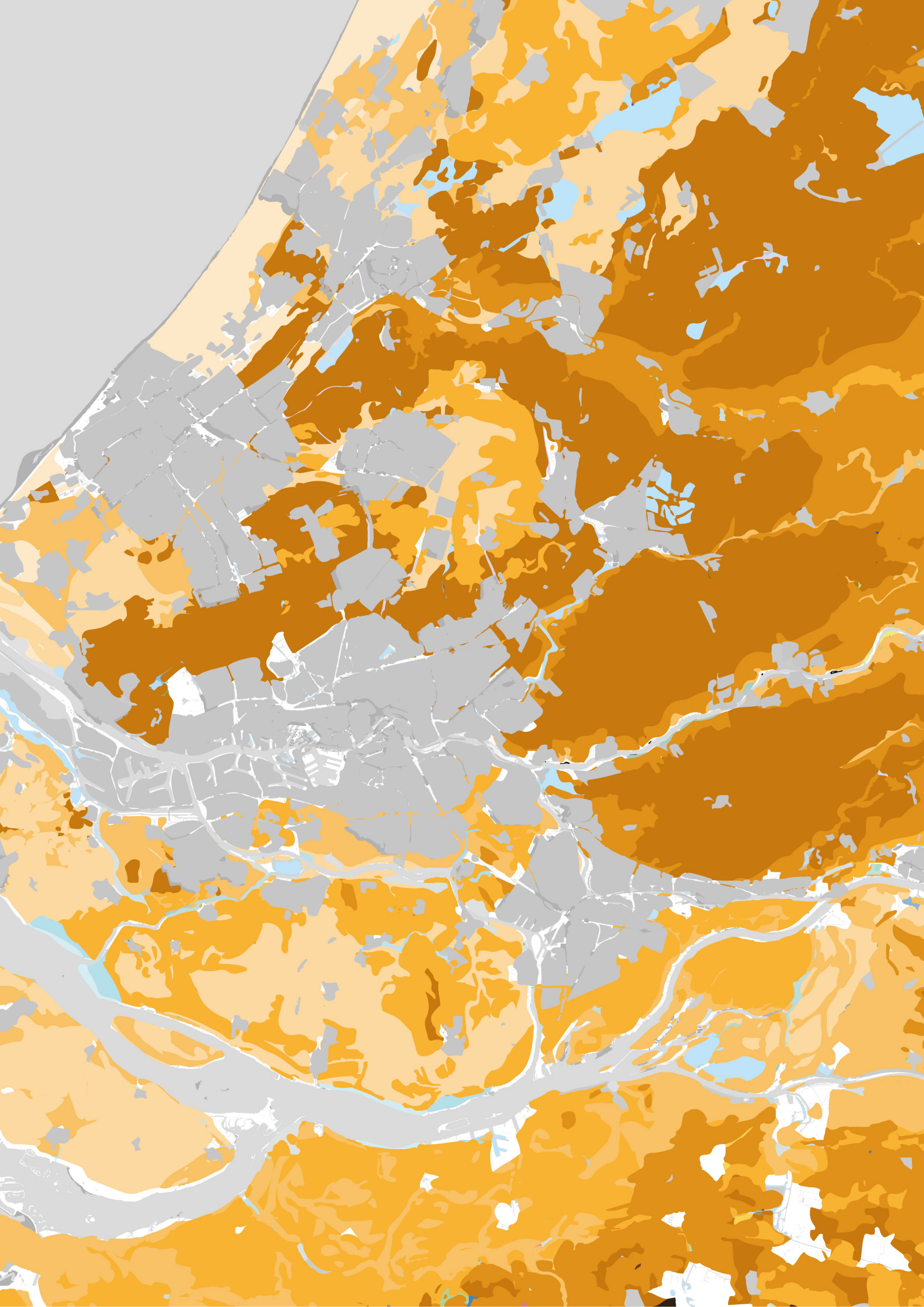


Figure 2.2.1.8: Soil typology in South-Holland
Figure by author, based on (CBS, 2020a), (Mul, et al., 2017), (WUR, 2019)



2.2.2 AGRICULTURE

The agricultural production in South-Holland is mainly located in the South of the province due to the presence of wind-blown sand in the area. In comparison to all of the Netherlands, South-Holland has a relatively low area of agriculture, namely 35027,13 hectares (CBS, 2020b), which accounts for 6% of the Dutch agricultural area (Mul, et al. 2017). In total, this land is worked by 965 agricultural farms (CBS,2020b). These farms produce 6 main types of agricultural products: potatoes, wheat, corn, sugar beets, onions and starch potatoes, which results in a total production of 1,6 million tons of agricultural products yearly. As can be seen in figure 2.2.2.1, these products mainly consist of potatoes (35%), sugar beets (33%) and corn (18%) (CBS, 2020a).

Figure 2.2.2.2 shows the general agriculture system, where we can see there are only a few products needed to start the production process: there is the seed, water and soil nutrients. To help the growing process, either fertilizer or manure is added, and when needed herbicides will be added too. The output can be used for different sectors: each product will form seeds which will re-enter this production chain, corn and wheat are mainly used as fodder for kettle, other products will produce raw products that either go to the consumer as is or are first processed before they reach the consumer. Each type of produce will also include rejected produce, which will become fodder for kettle or be processed. Residual products, like the potato plant or sugar beet leaves, will be re-entered in the production chain to make use of the leftover nutrients. (WUR, 2020)

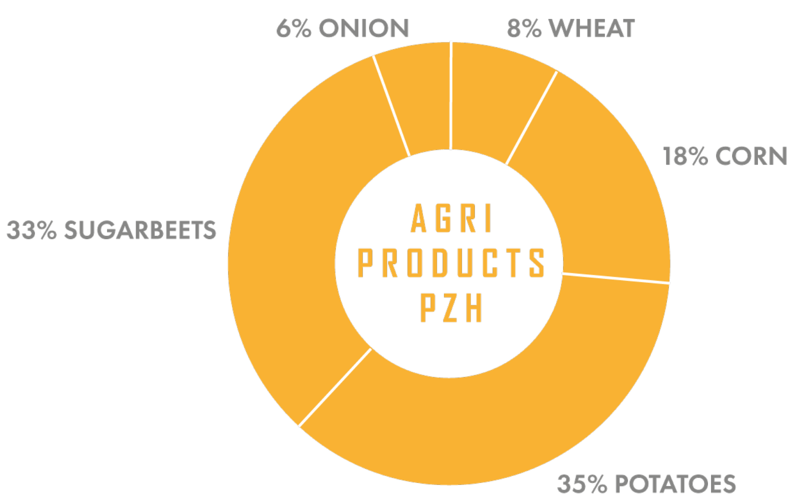


Figure 2.2.2.1: Agricultural crops production South-Holland (CBS, 2020a)

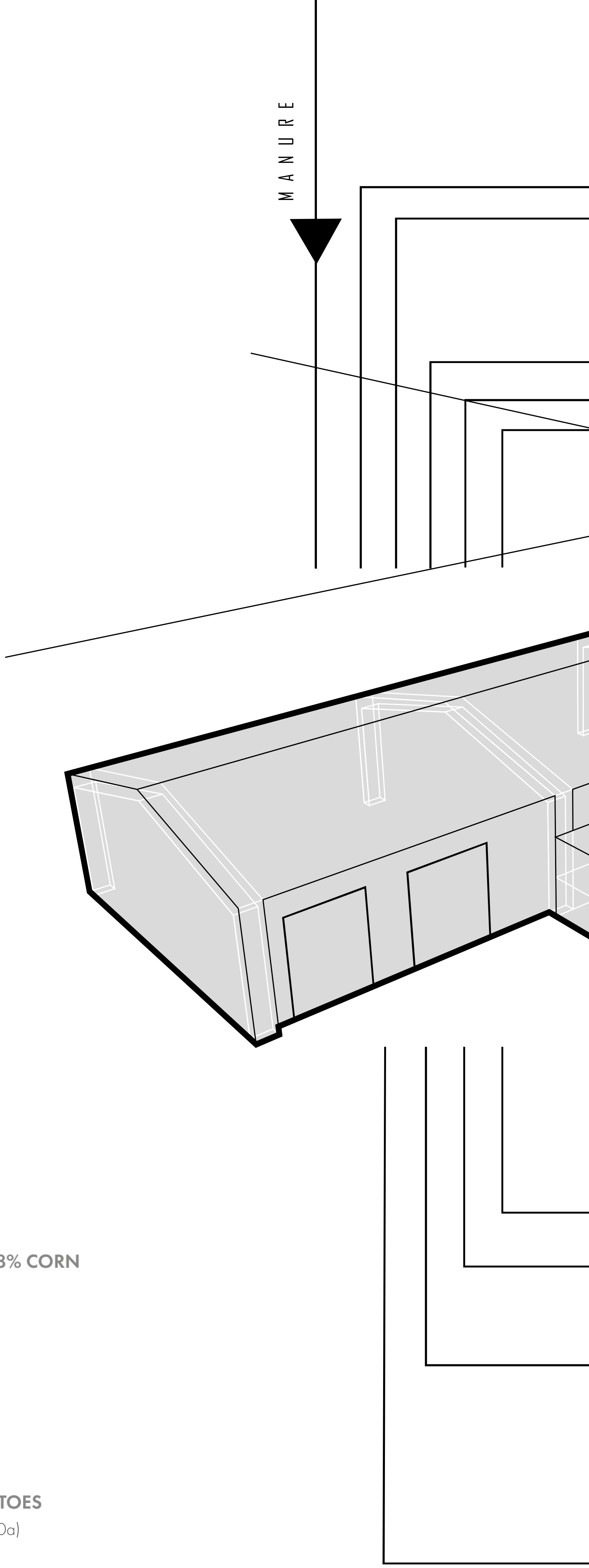
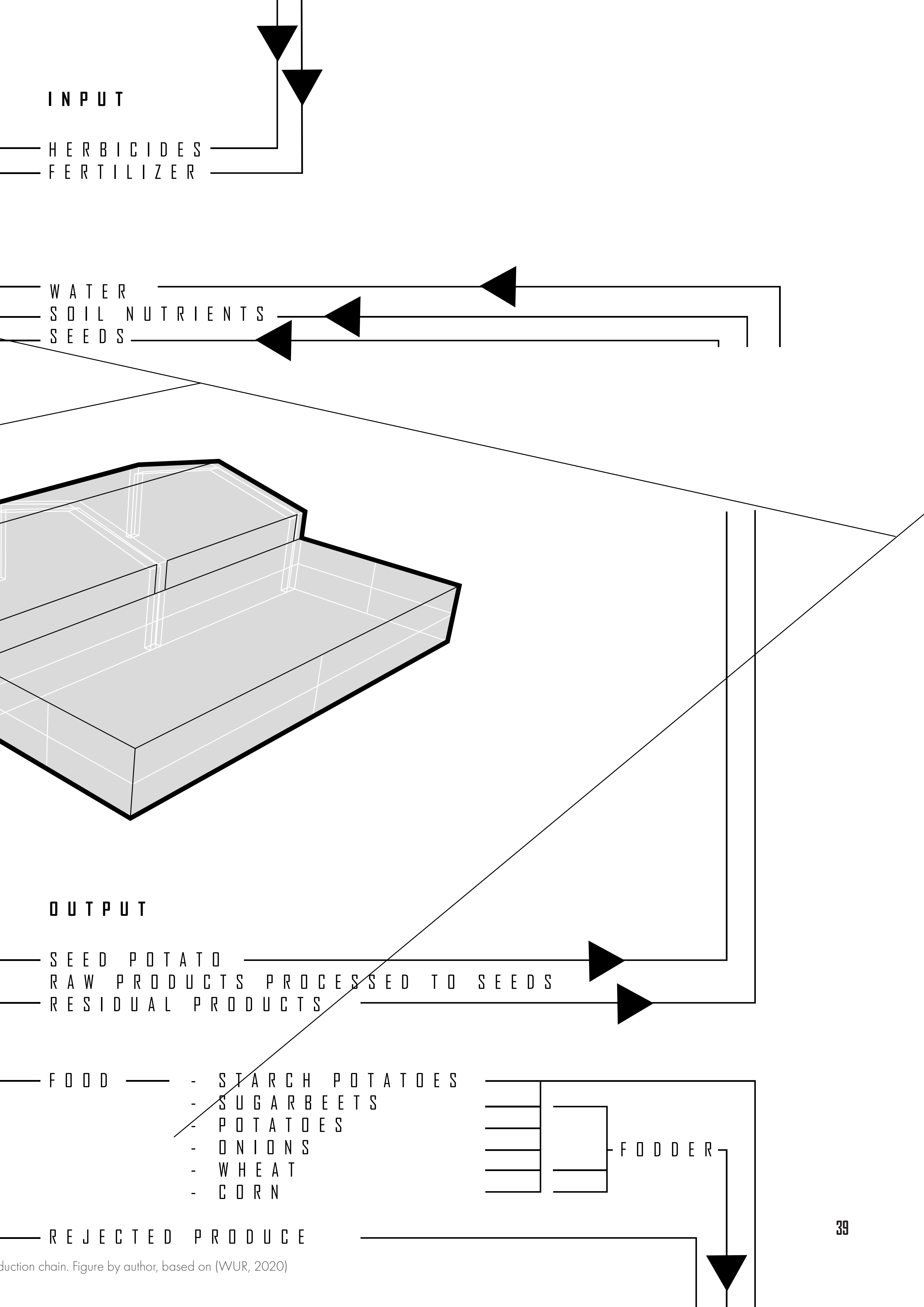


Figure 2.2.2.2: Agricultural pro



duction chain. Figure by author, based on (WUR, 2020)

AGRICULTURE ON SALINIZED SOIL

Salinized soil as a term known in most countries located in a delta area. Due to the rising sea-water levels, pressure from the delta, change in rainfall patterns and extreme weather conditions, the salt in ground- and surface water in the coastal region of the Netherlands will continue to increase, like it has been doing many years (de Kempenaer, Brandenburg & van Hoof, 2007). In the current water management system we aim for a minimal salinity, but this also has a high price tag. A better option would be to find a way to work with the salinity and find possibilities in agriculture to do so (Blom-Zandstra, 2017).

EFFECT OF SALT ON CROPS:

Salt in the soil causes two types of stress on the agricultural crops (and other plants). The first is osmotic stress, where the salt lowers the osmotic potential of the soil causing the plant to have to work harder to get the right amount of water from the soil (comparable to draught). The second stress is caused by the sodium that is present in salt, which has a toxic effect on the plant. It causes the roots to reduce their potassium intake and the photosynthesis and enzyme activity of the leaves will slow causing a reduction in growth of the crop. Both the water shortage and toxicity can lead to a decrease in the yield of the crops (Blom-Zandstra, 2017).

CURRENT RESEARCH AND POSSIBILITIES:

There are already certain types of plants that have started developing towards being more tolerant to salt. The so called 'excluders' crops have roots that stop the sodium from getting in the plant. Other plants can store the sodium in the leaves reaches a toxic level. Plants like beans, tomatoes and sugar beets can adjust their osmotic level and extract more active ions from the water in the soil (Blom-Zandstra, 2017).

The research into possibilities for growing on salinized soil and the implementation of this is still in its starting shoes in the Netherlands. This is a result mostly coming from the lack of urgency for the farmers due to the still easy access to fresh water provided by the high effort of water management. (De Kempenaer, et al., 2007). Currently, the topic of salinized agriculture seems to consist of mainly research.

There is one project that has been working with salt tolerant crops for about ten years now and is located on Texel: 'Zilt Proefbedrijf Texel' (figure 2.2.2.3). They test different crops for their salt tolerance and works together with different organisation to realise agricultural projects in different countries around the world where there is a need for salt tolerant crops and have started larger scale potato production on the Waddeneilenden (Zilt Proefbedrijf, 2019).

The Netherlands already knows multiple crops that are tolerant to the increase of salt in its growing environment. If this arsenal of crops is included into the current salinized agriculture 'niche' (consisting of seaweed, fish and shellfish), there could be a very interesting assortment of Dutch salinized agriculture. The list below shows some of the possible crops (de Kempenaer, et al., 2007).

AGRICULTURAL CROPS:	VEGETABLES:
Barley	Celery
Flax	Green asparagus
Quinoa	Sea aster
Spelt	Scurvy-grass
Multiple potato types	Fennel
	Glasswort

Figure 2.2.2.3: Zilt Proefbedrijf Texel (by D. van Mill, 2017)

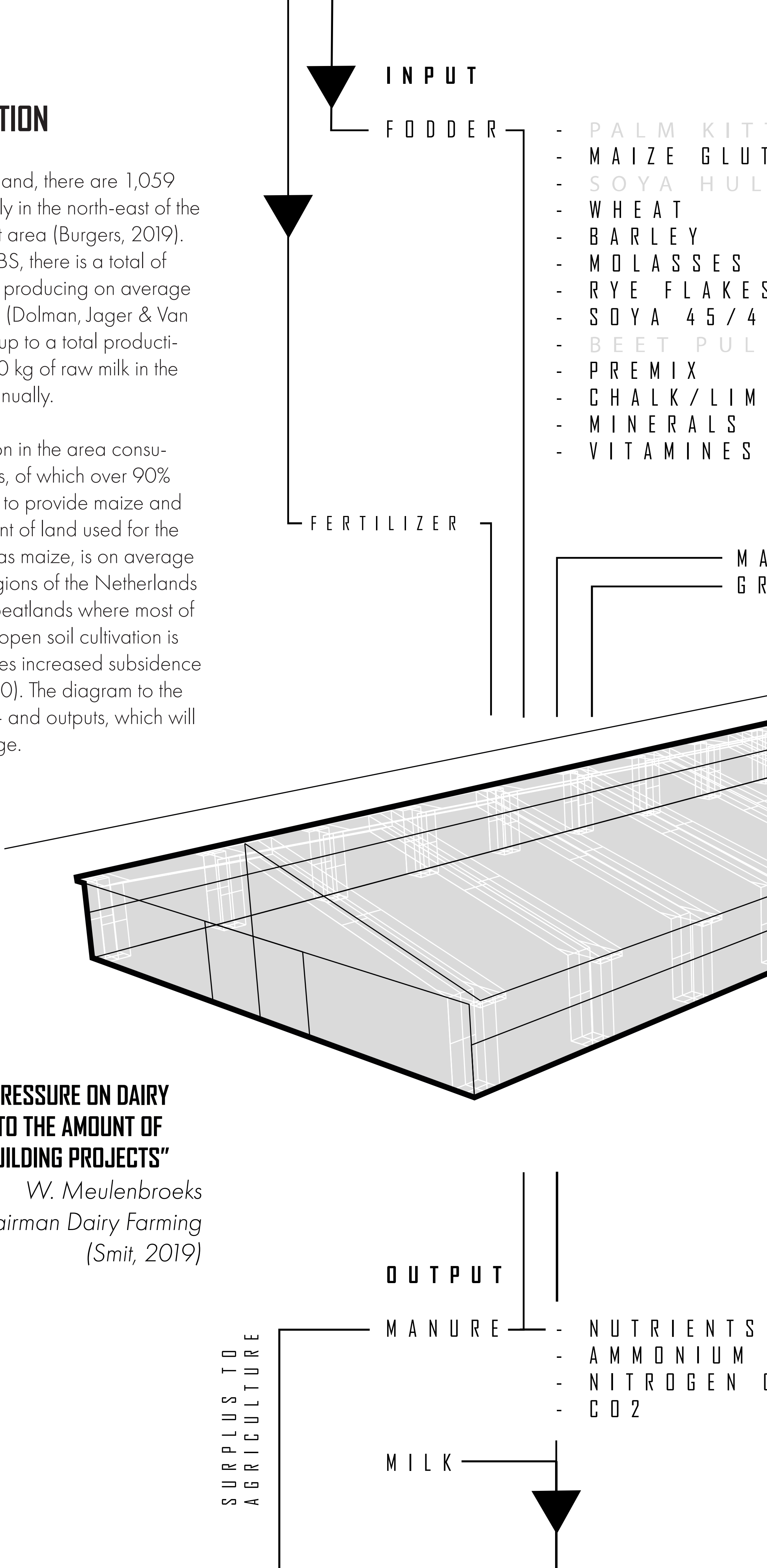
CIRCULARITY IN AGRICULTURE

Looking at the agriculture sector production chain on page (FIXME) we find that this sector is for a large part already circular within the food production system. There are, however, a few changes that can be made. Most residual products, both from the farmer as well as the processer, go back into the food chain, either on the agricultural land to enhance soil nutrients or in fodder. Any surplus can be used in other sectors for the production of bio-based products (Mul, et al., 2017). An external input in the agricultural sector is the fertilizer. The province is, however, coping with and excess of manure. When only 10% (380.000 tons) of this manure is upgraded it can, next to producing biogas, produce enough phosphate (2.440 ton) and nitrogen (1.090 ton) to replace fertilizer. (Metabolic & Drift, 2018)

2.2.3 DAIRY PRODUCTION

In the province of South-Holland, there are 1,059 dairy farms, located primarely in the north-east of the province, in the Groene Hart area (Burgers, 2019). According to research by CBS, there is a total of 90,715 dairy cows in 2020, producing on average 7,500 kg of raw milk anually (Dolman, Jager & Van der Meer, 2017). This leads up to a total production capacity of 680,362,500 kg of raw milk in the province of South-Holland anually.

Spatially, the dairy production in the area consumes around 69,727 hectares, of which over 90% is used as grassland, the rest to provide maize and hay (CBS, 2020). The amount of land used for the types of green fodder, such as maize, is on average lower (10%) than in other regions of the Netherlands (20%). Due to the lowlying peatlands where most of the dairy farms are located, open soil cultivation is problematic because it causes increased subsidence (Provincie Zuid-Holland, 2010). The diagram to the right contains all in-, through- and outputs, which will be discussed on the next page.



"IN SOUTH-HOLLAND THE PRESSURE ON DAIRY FARMS IS ENORMOUS DUE TO THE AMOUNT OF URBAN AND INDUSTRIAL BUILDING PROJECTS"

W. Meulenbroeks
LTO Chairman Dairy Farming
(Smit, 2019)

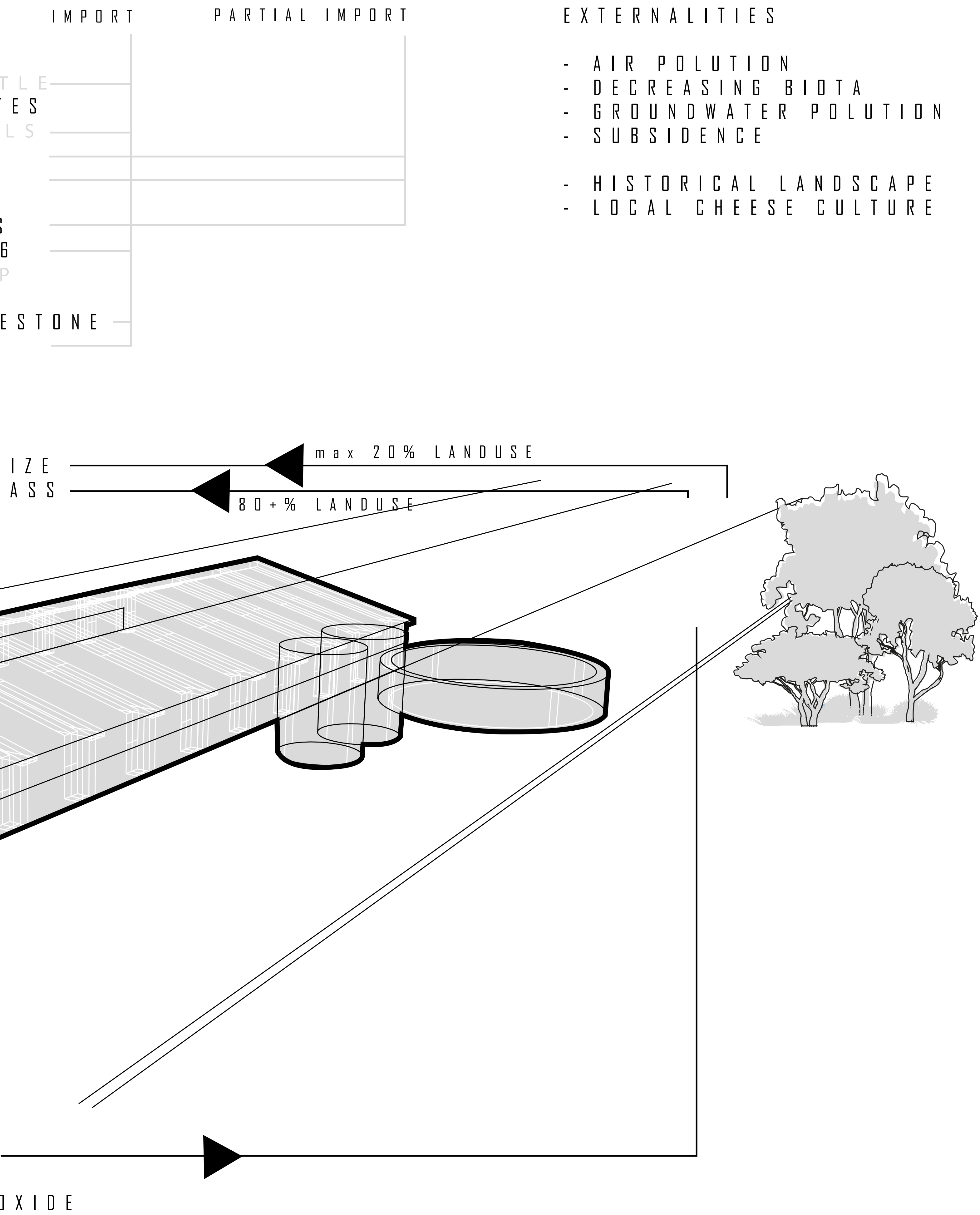


Figure 2.2.3.1: Dairy production chain.
Figure by author. Based on: Agrimatie (s.d.), CBS (2020), Junai (2020), Provincie Zuid-Holland (2010)

CIRCULARITY IN DAIRY PRODUCTION

The farmers are mostly selfsufficient in providing feed for their cattle. Grass and green fodder are produced on their own lands, in some cases supplemented with surplus produce bought from other farmers. The main external input is the fodder, which supplements the diet with proteïnes, fibers, minerals and vitamines that can not be extracted from own produce (Junai, 2020). Of this fodder, it is the palm kittle, soya hulls and soya 45/46 that are imported from countries all over the globe, which will create difficulties in trying to make the process completely circular. Also, there is not enough production of maize, wheat, barley and rye flakes within the Netherlands to close the loop on these materials (Agrimatie.nl, s.d.).

The dairy production has, next to the direct in-, through- and outputs, many external effects. It causes airpollution due to the excretion of methane, ammonia and phosphates to the air, fom both the manure produced and during the digestion. This, combined with the output of phosphates and nitrogen oxides, settles on the land which makes it nutrient rich. Although beneficial for high production per hectare, it leaks into surface water which leads to a decrease of plant species that live on poor soils. Also, as said before, causes the open soil cultivation and agriculture in the lowlying peatlands a more rapide subsidence. (Provincie Zuid Holland, 2010)

Next to these negative effects on the environment, there are also beneficial externalities of a more cultural nature. The dairy production in the classic Dutch polder landscape is highly appreciated, with its complementary cheeseculture.

BY INTRODUCING SEAWEED INTO THE DIET OF DAIRY COWS, PRODUCTION CAN BE INCREASED. WITH PRODUCING THE SAME AMOUNT OF MILK IN LOWER LANDUSE, PRESSURES BY WATER AND URBANIZATION CAN BE RELIEVED.

Figure 2.2.3.2: Possible lower landuse in dairy production. Figure by author.

In order to close the loop as much as possible, we propose the implementation of seaweedproduction. Seaweed is a produce that can be cultivated in the province of South-Holland, with its large amount of territory in the Northsea and salt water in the southern part of the province. Seaweed is high in proteïnes, so it can potentially replace raw materials like soya, that are imported for fodder.

Research, conducted by Agroflux and De Eendracht U.A., has shown that the daily addition of 70 grams of seaweed per cow can stimulate dairy production, increasing the production by 2.5 kg of raw milk per day (Eendrachtrouveen.nl, s.d.). In total, this leads to an increase of 912.5 kg per year, now yielding 8,412.5 kg of raw milk per cow. For the entire province, this leads to an increased total of 763 million kilograms of raw milk per year.

In order to gain space and relieve the competeing pressures on land, we can produce the current amount of raw milk in the new system with only 89.1 percent of the current amount of livestock, reducing the amount of land needed by 11%, to 7,565.4 hectares. This is an area of 8.7x8.7 kilometers of space relieved from pressure, which can be seen in the map below.

In the research, a mixture of six specific types of red, green and brown seaweeds have been added, all with their own specific types of bio-active materials. Next to the boost in milk production, the cattle showed higher furtility and better health and immunity. Additionally, seaweed has positive effects on the digestion process of dairy cows, in which less methane is produced than during digestion of regular fodder due to the amount of Bromine (van den Biggelaar,2019).

For the farmers, the introduction of seaweed will be very beneficial. According to the research by Agroflux and De Eendracht, the addition will have a 'return on investment' of 2.5, for every euro spent, the farmers will earn 2.5 euros (Eendrachtrouveen.nl, s.d.). The cost of seaweed per cow is 0.18 euros per day. This will help the implementation of the project a great deal, due to the fact that when we are able to produce enough seaweed and process it, the farmers will not have to take financial risks.

MORE PRODUCTION PER DAIRY COW
RETURN ON INVESTEMENT 2.5
LESS METHANE DURING DIGESTION

NO IMPORT OF SOYA HULLS
NO IMPORT OF SOYA 45/46
NO IMPORT OF PALM KITTLE

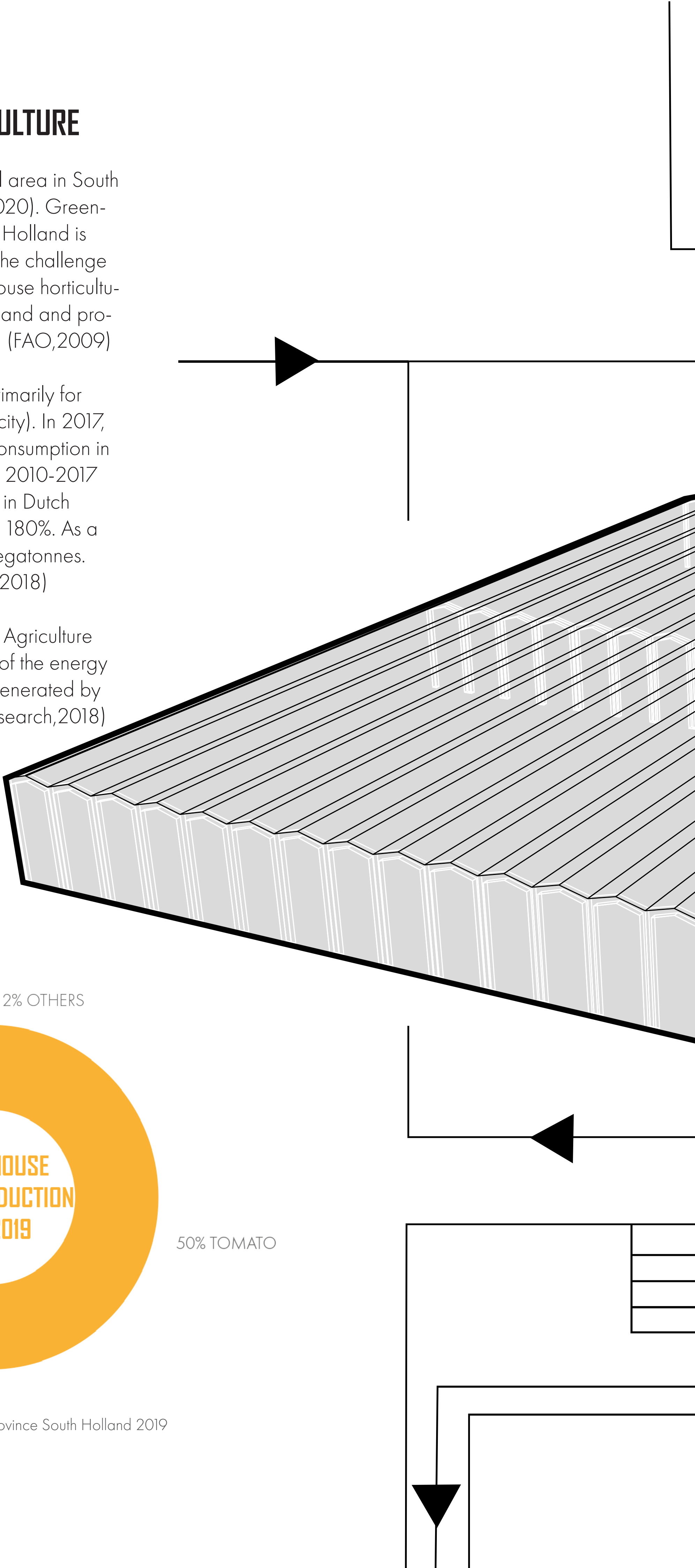
SAVING UP TO 7,564.4 HECTARES
10.9% LESS COWS

2.2.4 GREENHOUSE HORTICULTURE

In 2019, greenhouse horticultural total area in South Holland is 4627.88 hactares(CBS,2020). Greenhouse vegetable gross yield in South Holland is 919.86 mln kg (CBS,2020). To face the challenge of global population growth, greenhouse horticulture in South Holland need to use less land and produce 70 percent more food in 2050. (FAO,2009)

In greenhouses, energy is required primarily for heating (warmth) and lighting (electricity). In 2017, the average of greenhouse energy consumption in the Netherlands is 1.16 GJ/ ㎡. In the 2010-2017 period, the use of sustainable energy in Dutch greenhouse horticulture increased by 180%. As a result, CO_2 emissions fell by 0.26 megatonnes. (Wageningen University & Research,2018)

According to the Dutch Federation of Agriculture and Horticulture (LTO),47.8 per cent of the energy in greenhouses must be sustainably generated by 2030. (Wageningen University & Research,2018)



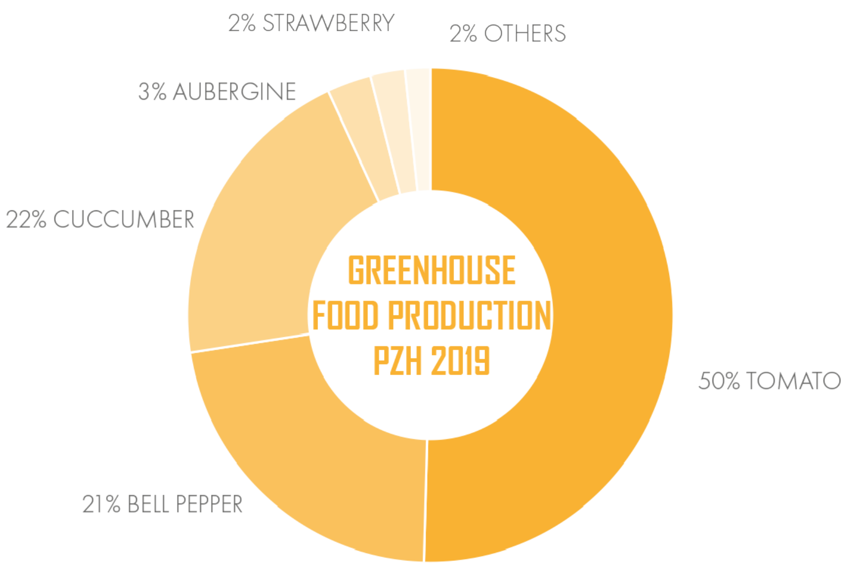


Figure 2.2.4.1: Greenhouse Vegetable Yield in Province South Holland 2019
Figure by author. Based on: (CBS,2020)

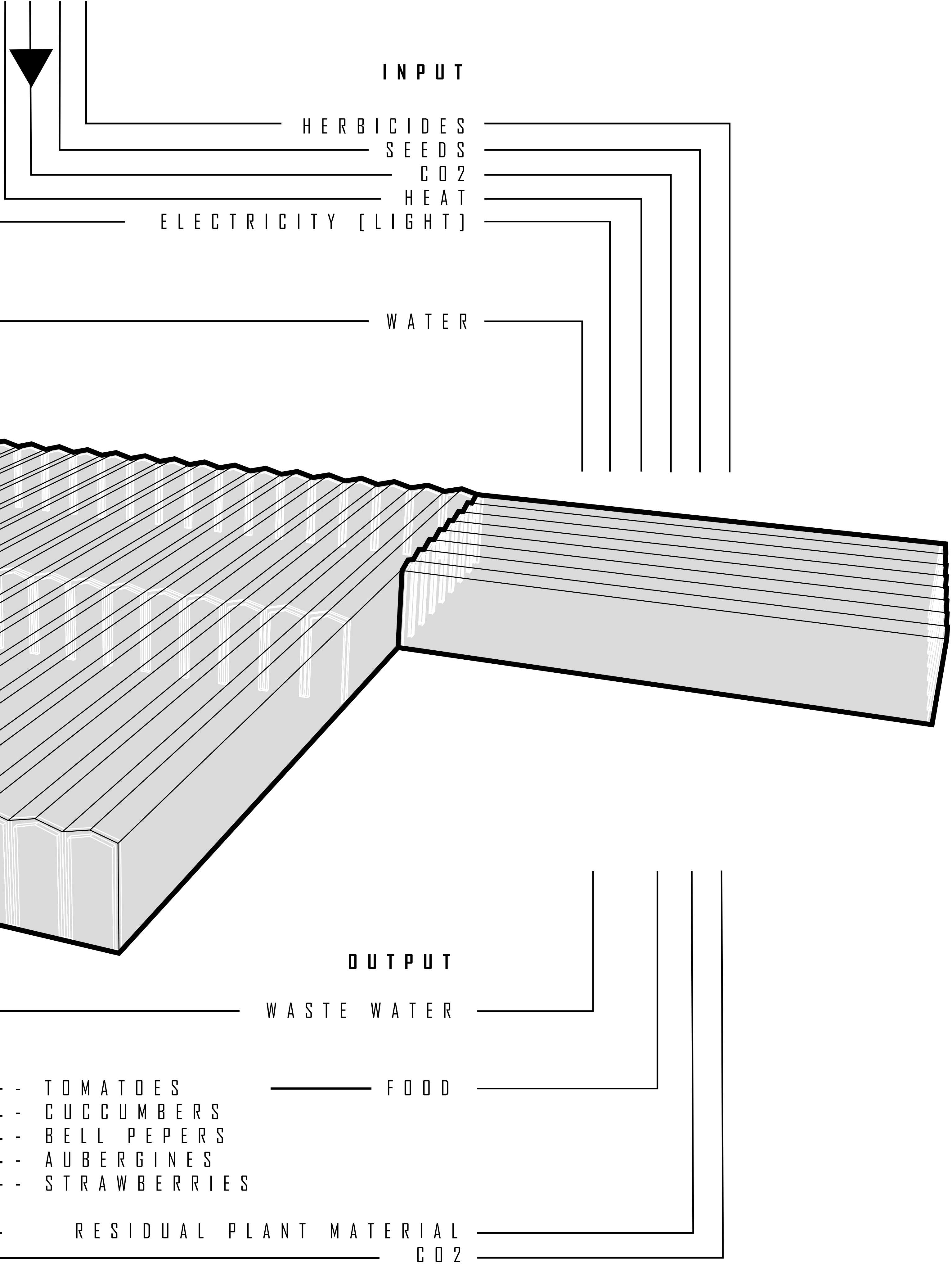


Figure 2.2.4.2: Greenhouse production chain.
Figure by author. Based on: (CBS,2020), (Wageningen University & Research,2018)

CIRCULARITY IN GREENHOUSE HORTICULTURE

In the horticulture sector, research institutions in the Netherlands have been developing knowledge, methods and innovations to achieve circularity for many years now. In terms of production method, energy consumption and waste treatment, greenhouse horticulture in South Holland has some proven technology andl applications that can be studied.

TO CLOSE WATER CYCLE BY ALGEA FARMING

LTO Glaskracht Nederland (2018) set a goal that in 2027, all greenhouse horticulture companies in South Holland have closed their water cycle. One planned project is algea farming in greenhouse wastewater.

Tomatoes, cucumbers, flowers or other products grown in greenhouses need adequate fertilizers for their growth. But these crops cannot fully absorb the nutrients in the fertilizer. Some nutrients and salts will remain in greenhouse wastewater. Under normal circumstances, growers recycle the wastewater once to reduce the nutrients in it. After this process, the remaining waste water is usually discharged directly into the soil. In the long run, the salts in the soil will be too high.

A study by Wageningen University & Research (2017) shows that algae can gross well in greenhouse waste water and may then be used as fodder in oyster culture. In order to cultivate algae, the wastewater will be filtered again to remove residual pesticides. Nutrients and salts in wastewater will be absorbed by algae. Wastewater from algae production can be reused in the production process of greenhouse gardening after treatment to realize closed water circulation.

CIRCULARITY OF CO2 IN GREENHOUSE

CO2 emissions from greenhouse horticulture mainly come from fossil fuels consumption to maintain light and temperature during the proces of producing. Green House Horticulture in South Holland is increasingly replacing fossil energy with sustainable energy to reduce CO2 emissions. By increasing the proportion of solar power in the energy structuret, greenhouse sector in the Netherlands currently reduces 3,000 tonnes of CO2 a year (Top Sector Horticulture & Starting Materials, 2019).

Meanwhile, CO2 is also used as a growth promoter for crops in horticulture. For example, through CHP (Combined Heat and Power) technology, the generated heat and CO2 enter the greenhouse. In this way there are virtually no residual flows(Wageningen University & Research,2018).

CIRCULARITY IN STONE WOOL HORTICULTURE

Stone wool was first used as a substrate for crop growth in greenhouse horticulture in the Netherlands 50 years ago. Since then, stone wool has become an indispensable part of high-tech horticulture.

The superiority of growing plants in substrate in circularity is reflected in saving land resources. The saved land can provide space for the introduction of synergetic agriculture sectors (e.g., algae cultivation). 175,000 kg of peppers, 350,000 kg of tomatoes or a million kg of cucumbers can be growed in 50 cubic metres of stone wool (Top Sector Horticulture & Starting Materials, 2019). According to the estimation, 33% of horticulture area in South Holland can be reduced by growing plants in substrate in 2050.

Figure 2.2.4.3: Circular Production on Stone Wool Substrates (By Top Sector Horticulture & Starting Materials, 2019) and the SDGs: practical examples

The advantages of stone wool substrate horticulture in promoting circularity are also reflected in resource conservation and emission reduction. According to the research, growing plants in substrate requires 20-25% less fertiliser due to circulation and reuse. Also, because the yield is higher,10-15% CO_2 emissions per kilo produced can be reduced. And because water can be collected in drainage channels and recycled, growing plants in substrate only requires 4 litres of water per kilo of tomatoes compared with 60 litres outdoors(Top Sector Horticulture & Starting Materials, 2019).

2.2.5 SEAWEED AND ALGAE PRODUCTION

Already, several initiatives and pilot projects on seaweed production have started, both in the Netherlands and in South-Holland specifically. Initiatives on the small scale have, amongst others, been started in the Oosterschelde, at Scheveningen and on Texel (Rubio, 2019). Seaweed can be used in products like thee, herbs, proteines and medicine. The leftover produce can be used to produce biofuels, such as methane gas.

Already, the company Seaweed Harvest Nordsea has plans to create a 4000 hectare seaweedfarm in the Northsea (Rubio, 2019). The potentials in seaweedfarming have also been picked up by the national government, who also see that feeding the population with just land-based produce is getting increasingly harder, whereas the Netherlands have a large amount of available space in the Northsea. Several million euros have been prescribed to research and development of seaweedfarming and processing.

Next to the potential of the algae in food production, seaweed has external beneficies to the environment. Seaweed can absorb heavy metals, toxic chemicals and other pollutants from the water (Nkongndem Nkemka & Murto, 2010). Also, the algae absorb CO2 from the air, and create a habitat for sealife underneath their canape, sheltering several species and thereby increasing local biota (Rubio, 2019).

The diagram on the right shows the in- and output model for seaweedfarming. Seaweed grows in seawater, which contains all nutrients the algae needs. Except for the seeds, which after the first harvest can be produced by the farm itself, no further input is needed. The output can, as mentioned above, be used for several different products.

"WE, THE DUTCH, ARE GREAT AT EVERYTHING THAT HAS TO DO WITH WATER. WITH INNOVATIVE TECHNIQUES, PRODUCTION CAN BECOME HIGHLY EFFICIENT"

M. Soetman
Initiator seaweed farming
(Rubio, 2019)

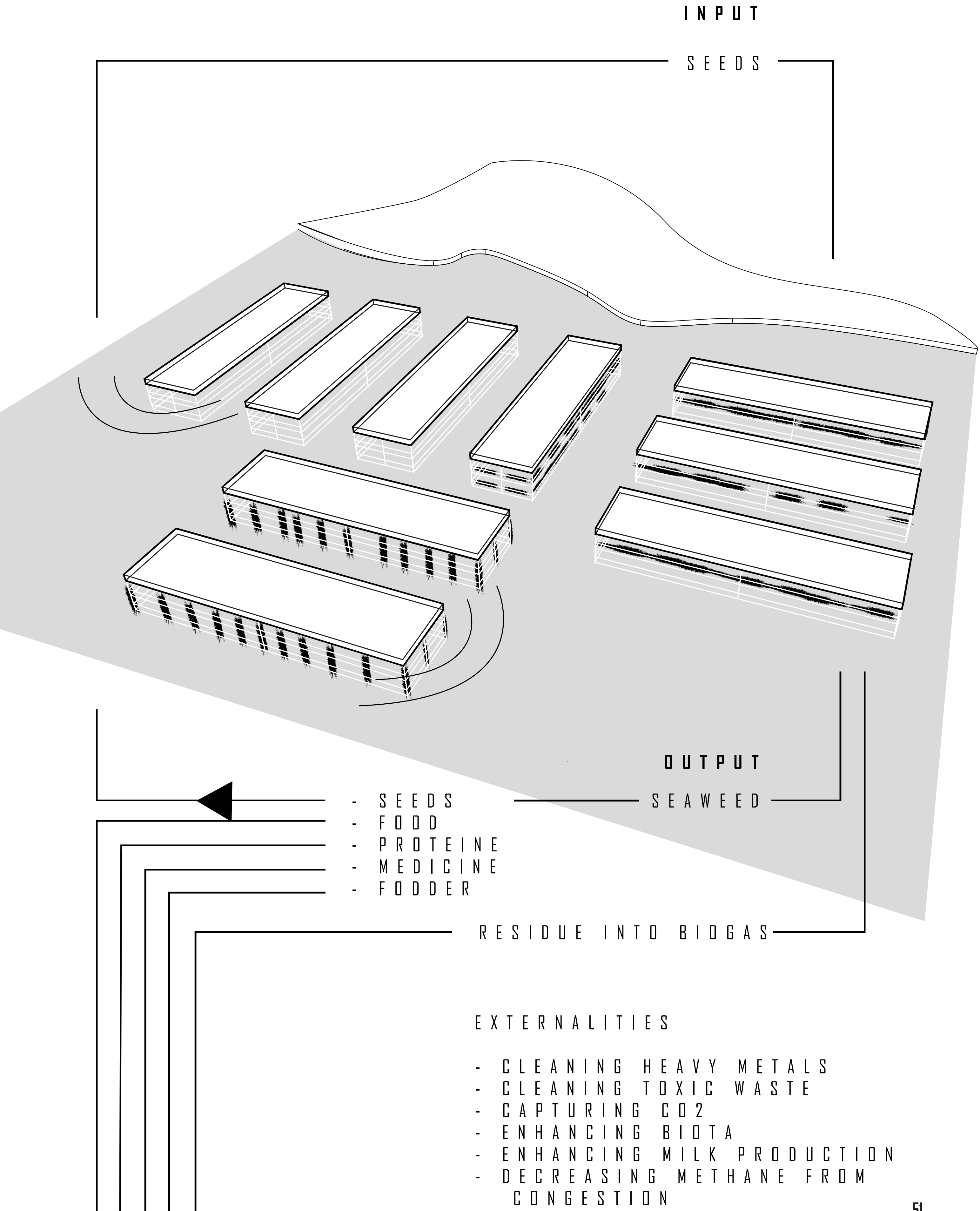


Figure 2.2.5.1: Seaweed production chain.
Figure by author. Based on: Nkongndem Nkemka & Murto (2010), Rubio (2019)

In order to boost the production of dairy farms, the cows have to have 70 grams of seaweed added to their diet every day. We propose to even up this amount, so that we can additionally produce our own substitutes for imported proteïne rich materials. This introduces circularity into these linked sectors.

The new amount of cows that should be fed with the seaweed, 89.1% of the current amount of cattle, is 80,827 dairy cows. The amount of seaweed to both add and replace raw materials, could be estimated around 140 grams per cow, every day. This would lead to a need for 11,315.8 kilograms of seaweed each day.

According to the Scottish Association for Marine Science, per hectare of seaweed farm, 25 tons of produce can be harvested anually (Thijssen, 2015). Per day, this adds up to 68.5 kilograms. In order to provide the dairy farms with the needed amount of seaweed, this would lead to an initial production across 165.2 hectares, or 1.3 x 1.3 kilometers.

The residue, left over after extracting the material for medicine and proteines, can be used as input for biogas. The high methane content within the seaweed makes this a commercially viable option. This gas can then be implemented in the greenhouse horticulture in order to (partially) produce the needed heat, electricity and CO_2.

The map below shows again the 7,565.4 hectares that can be withdrawn from the dairy production sector. This will be replaced with the 165.2 hectares of initial production for fodder, with later addition of producing area for medicine, proteines and biogas.

ABSORPTION OF CO2
ABSORPTION OF HEAVY METALS
ABSORPTION OF CHEMICAL POLLUTANTS

INCREASING BIOTA

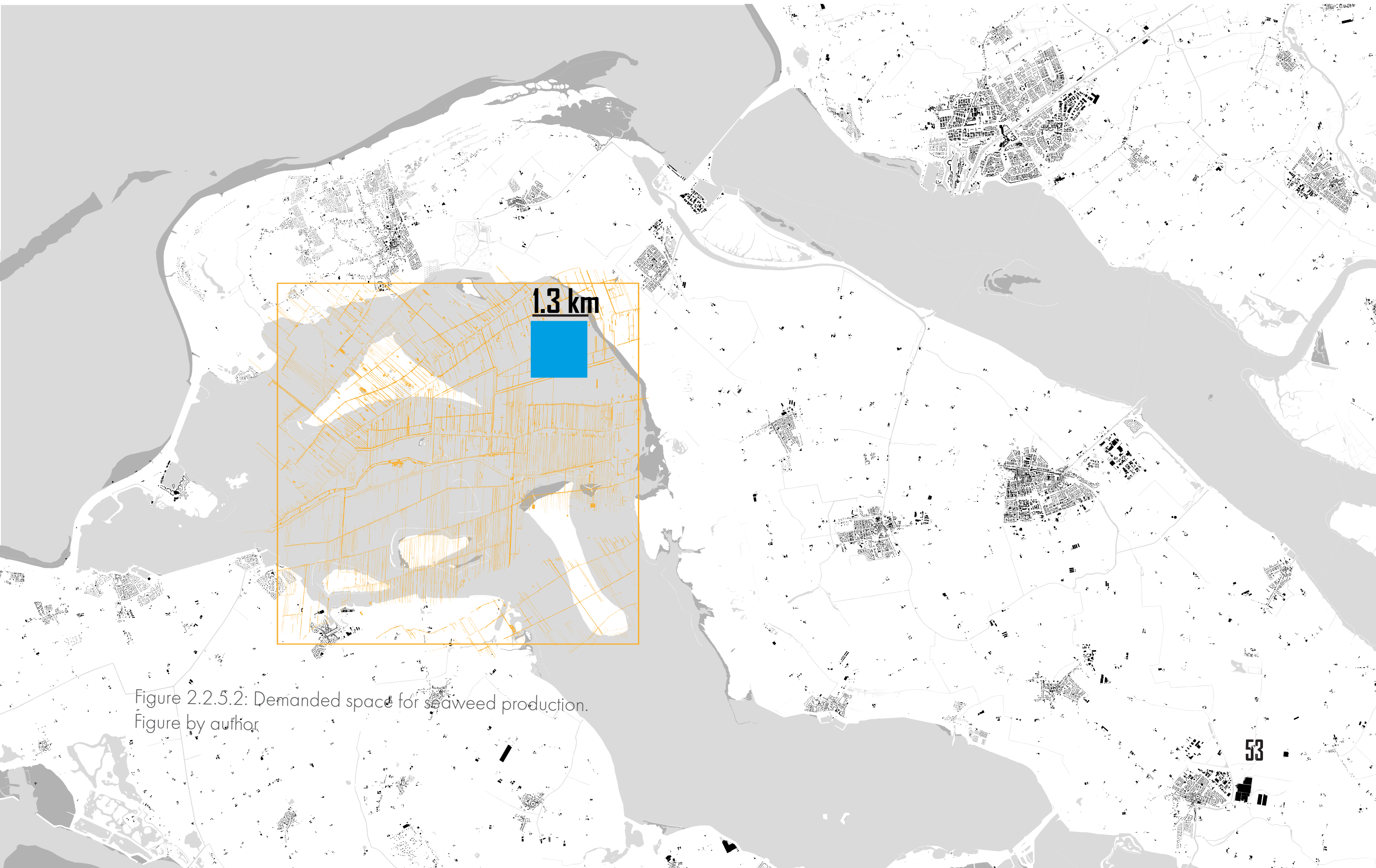


Figure 2.2.5.2: Demanded space for seaweed production.
Figure by author

2.2.6 TOWARDS INTERSECTORAL CIRCULARITY

WHAT IS LEFT...

The following products have to be *inserted* into the production process from *outer sources*:

SEEDS
HERBICIDES

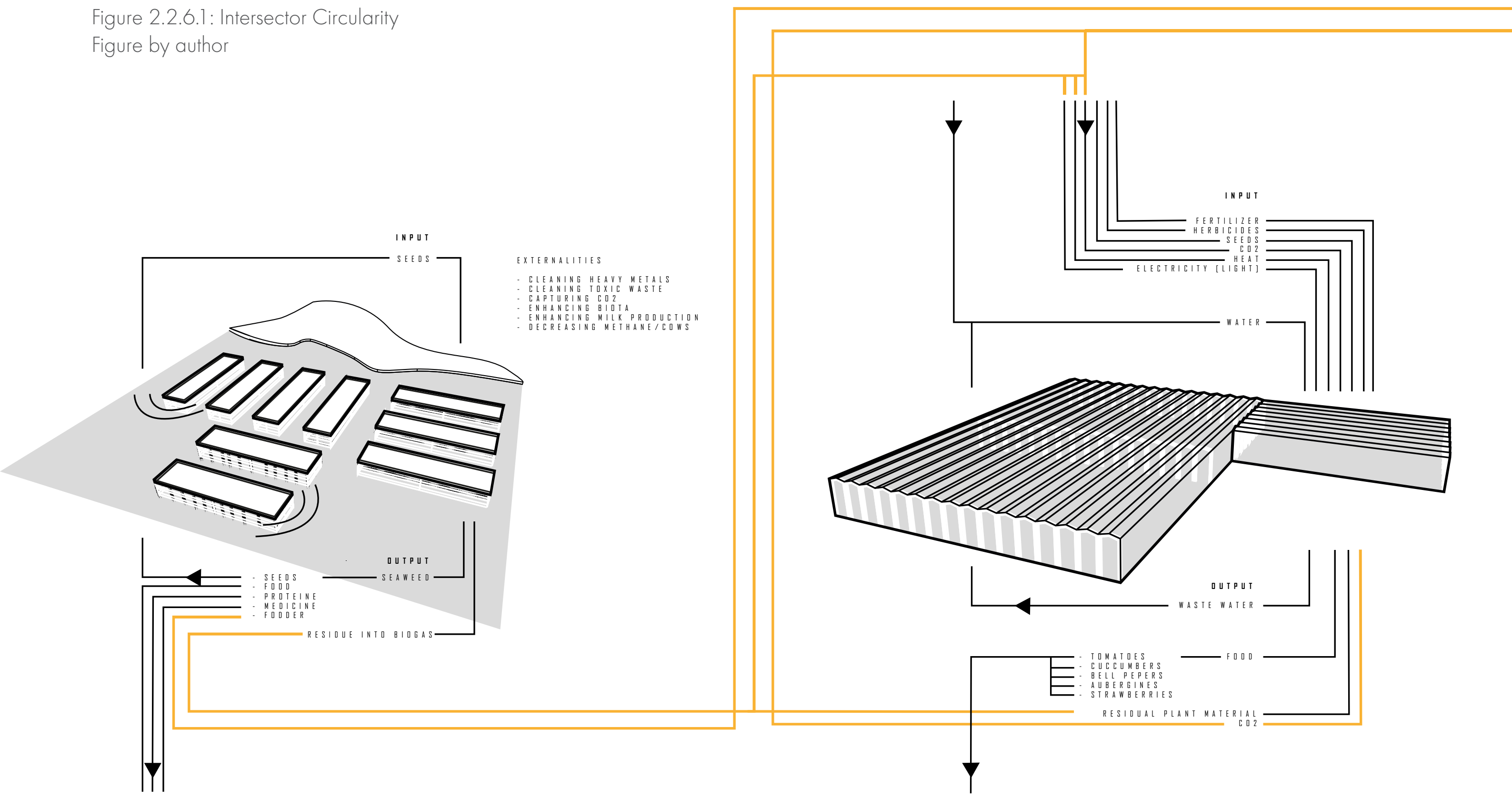


Figure 2.2.6.1: Intersector Circularity
Figure by author

The following products are produced as output of the production process:

PROTEINE
MEDICINE

TOMATOES
CUCCUMBERS
BELL PEPERS
AUBERGINES
STRAWBERRIES

The following products are replaced, circular within the sector (selfsufficient) or come from intersectoral sources, and are therefore no longer needed as input from *external sources*:

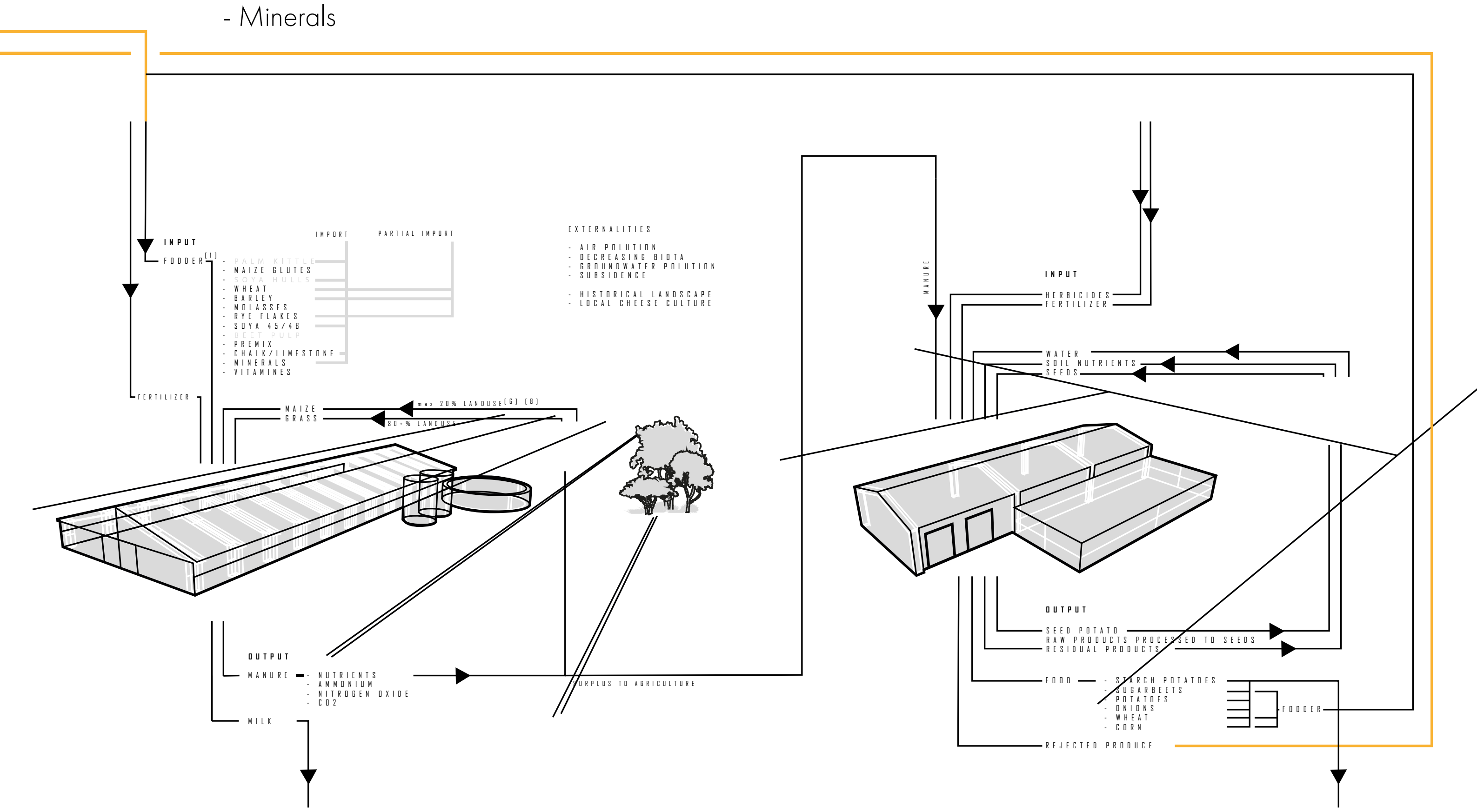
CO2
Heat
Electricity
Water

FERTILIZER

FODDER *(partial*)*

- Wheat*
- Barley*
- Rye flakes*
- Chalk/Limestone
- Minerals

FERTILIZER
HERBICIDES



MILK

STARCH POTATOES
POTATOES
SUGARBEETS
ONIONS
WHEAT
CORN

Palm kittle
Soya hulls
Soya 45/46
Vitamines

COMPACT LIVEABLE CITIES IN SOUTH HOLLAND

As mentioned in the problem statement, South Holland needs to build 150,000 new homes until 2030 and additional 60,000 until 2040 (Provincie Zuid-Holland [PZH], 2017: 12). If the new homes have a similar house hold size as the existing ones, of 2.15 people per household (statista, 2020), the new homes will accommodate more than 450,000 people. Hence, population growth will have an immense impact on the province in the next two decades.

Although the focus of this project lies on transformations in the rural parts of South Holland, urban growth is an important topic to take into consideration. The first reason is that more than 90% of the Dutch population live in urban areas (Statista, 2018). Consequently, the majority of the food that is produced in the region, is consumed by people living in towns and cities. Therefore, the effects of this project for them need to be taken into account. Related to this is the question of distributive spatial justice, how the positive and negative effects are distributed within the population.

The second reason are the effects of urbanisation on the rural land. With nearly 25%, the urban areas of South Holland have the highest share in land consumption in all provinces of the Netherlands (CBS, 2012). Since this land consumption will probably grow in the future, urbanisation is one of the biggest threats to the agriculture sector and maybe also to natural areas. Therefore, one of the main questions of this chapter is: Which form of urban growth can protect rural and natural land?

In our project we propose to keep urban growth within the boundaries of existing cities. This raises further questions of the chapter: What are the effects of redensification and how can denser cities keep their liveability? Which societal groups will suffer from negative effects of increasing population density?

2.3 URBANISATION

2.3.1 THE HOUSING CHALLENGE IN SOUTH HOLLAND

WHERE WILL THE TOWNS AND CITIES OF SOUTH HOLLAND GROW?

WHICH FORM OF URBAN GROWTH CAN PROTECT RURAL AND NATURAL LAND?

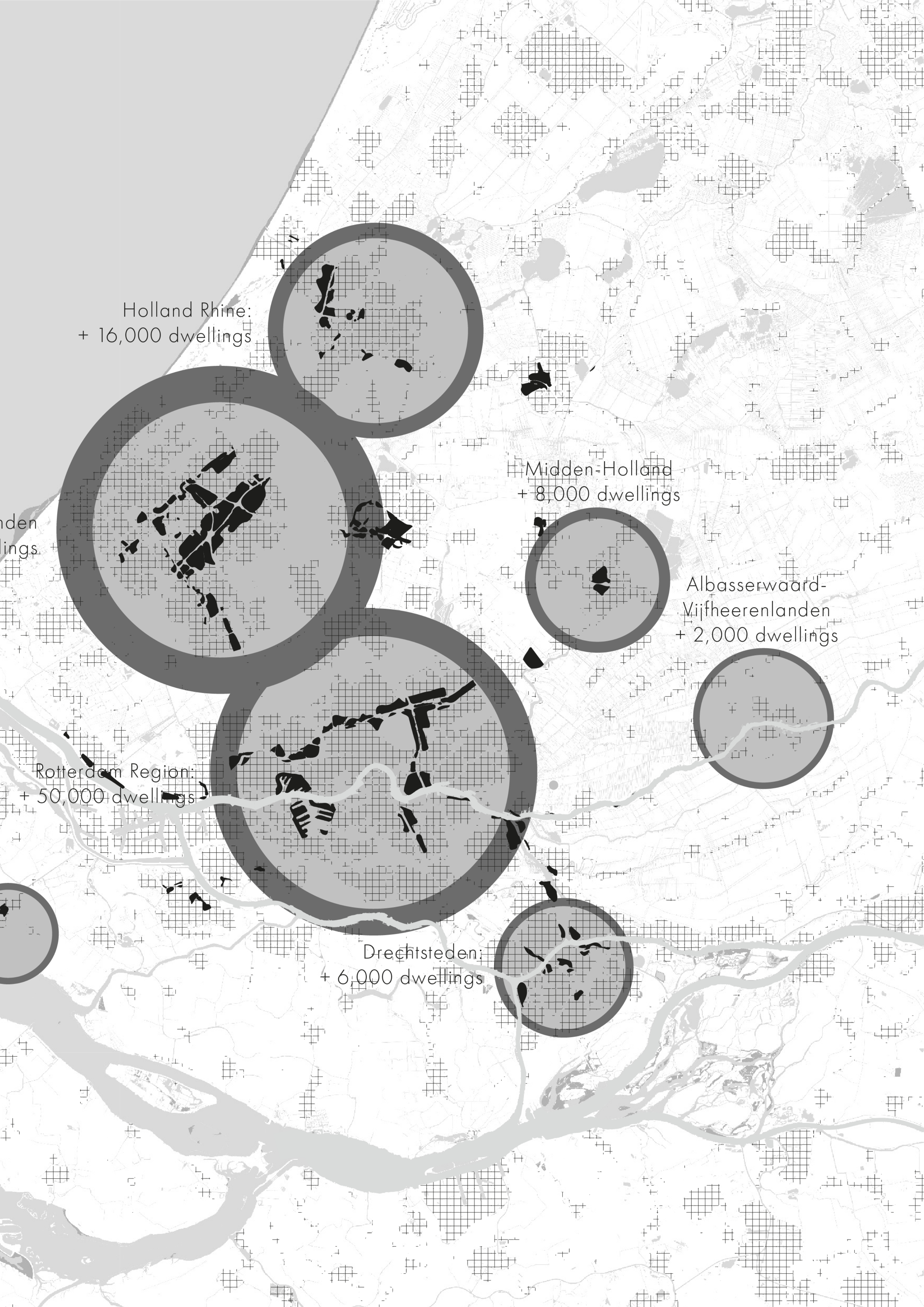
WHICH SOCIETAL GROUPS WILL SUFFER FROM NEGATIVE EFFECTS OF INCRESING POPULATION DENSITY?

HOW CAN THESE NEGATIVE EFFECTS FOR CERTAIN GROUPS BE MITIGATED?

WHAT ARE THE EFFECTS OF REDENSIFICATION AND HOW CAN DENSER CITIES KEEP THEIR LIVEABILITY?

During the next 20 years South Holland's population will grow drastically. But this trend is spread unequally throughout the province. The first map shows how the urban growth is distributed over the regions of the province. This shows that the biggest part of the growth will take place in proximity of big cities, especially around The Hague and Rotterdam. The map also indicates areas where the province of South Holland sees the potential of urban growth. This shows that the areas of population growth will be even further concentrated. Even in the rural regions like, South-Holland South, growth will mainly take place within the bigger towns like Hellevoetsluis, while the population in other parts of the region will even shrink.

Figure 2.3.1.1 Urban growth in parts of South Holland. Figure by the author, based on Provincie Zuid-Holland (PZH) 2017: 13


Holland Rhine:
+ 16,000 dwellings
nden
lings
Midden-Holland
+ 8,000 dwellings
Albasserwaard-
Vijfheerenlanden
+ 2,000 dwellings
Rotterdam Region:
+ 50,000 dwellings
Drechtsteden:
+ 6,000 dwellings

2.3.2 URBAN GROWTH WITHIN THE EXISTING CITIES

On this map, the potential growth areas are indicated in further detail. Most of them are located within former industrial area, along public transport connections and along infrastructure boundaries, like railway lines or highways.

Another type of potential areas for urban redensification are post-war neighbourhoods that need to be renovated. The Province of South Holland (2017: 12) also states that a large part of the buildings in South Holland need to be renovated or replaced.

To sum up, there are potentials for inner-city growth. This indicates that the growing population can be accommodated within the urban areas. Hence, it is not necessary built up large amounts of rural land. Nevertheless, the diversity of urban development areas shown in the map, might make the housing challenge in South Holland even more complex.

Figure 2.3.2.1 Potential urban development areas in South Holland Figure by the author, based on Provincie Zuid-Holland (PZH) 2017: 54-59

2.3.3 COMPACT CITIES AND LIVABILITY

LIVABILITY AND DENSITY

But making the existing cities more dense raises the question, who would suffer from the effects of density? According to Mariëlle Beenackers et al. (2018) higher densities in Dutch cities are correlated with higher stress levels for the population.

The map to the right shows where the currently densest neighbourhoods are located within the cities. The comparison of their location with the projected development areas shows that most of urban growth would take place within or in close proximity already dense neighbourhoods. This means that people who already lives in dense urban areas, could suffer from the effects of further densification.

Nevertheless, higher densities can increase health if combined with pedestrian and cyclist friendly public spaces (ibid.: 85). Hence, due to the walk-ability and the good cycling infrastructure, Dutch Cities could have very good preconditions to create healthy living environments with higher population densities.

While our project cannot change the design of public spaces within the cities, it can take other measures to mitigate the effects of density on a regional level. As Holden and Norland (2005, p. 2161) put forward, local and regional recreation areas can reduce the need to take longer leisure trips. Consequently, attractive large scape recreation areas that are accessible by bike or public transport could enhance the liveability of the densest neighbourhoods of the province.

DENSIFICATION AND LOW INCOME NEIGHBOURHOODS

Another group that might suffer from further densification, are people with lower incomes. As the map on the right shows, neighbourhoods with the lowest average income are often located in very dense areas. Furthermore, many potential areas for redensification are located in close proximity to those with a lower average income.

Since most of these neighbourhoods are in the hearts of big cities and many of their inhabitants might not own a car, inhabitants of these neighbourhoods would benefit less from projects on the urban fringe. Also, future urban development projects might lead to conflicts of interest between new inhabitants and more established ones. For these inhabitants it is even more important to have a good transport connection to regional green spaces.

Another possible measure is to increase the liveability of low-income neighbourhoods during the development the surrounding brown field areas. One approach to increasing liveability within the scope of this project is to integrate food production into urban areas. As mentioned in the Conceptual framework (Chapter 1.5.), food production can be combined with leisure activities. Getting active in urban farming could not only strengthen social bonds and increase the knowledge of the population about healthy food. It could also reduce stress levels (Hung et al. 2019) and therefore increase the population's health in dense and low-income areas.

Figure 2.3.3.1 Population density in neighbourhoods and potential urban development areas in South Holland Figure by the author, based on Publieke Dienstverlening Op de Kaart [PDOK](2018)

Figure 2.3.3.2 Average Income in neighbourhoods and potential urban development areas in South Holland Figure by the author, based on (CBS 2018)

2.3.4 LIVABLE ENVIRONMENT - PARKS AND GREEN SPACES

As mentioned, green spaces an important measure to mitigate negative effects of urban density. Figure 2.3.4.1 shows current public parks and Natura 2000 areas that function as regional green spaces. It shows that there are many bigger green spaces in the region. Also, they are quite well distributed. Most urban areas have bigger parks in close proximity. But Holden and Norland (2005, p. 2161) indicate that people who do not have a garden travel significantly further distances for leisure. From this result we can assume that local parks within cities are not a sufficient countermeasure to the downsides of urban density. More natural large scale recreation areas like the indicated Natura 2000 areas could be an important complementation to urban parks. Therefore, the province of South-Holland suggests additional and to make them accessible for the urban population.

To give a first impression of the accessibility of green spaces, figure 2.3.4.1 depicts the main routes of the regional public transport network. It shows that most of the bigger urban parks are quite accessible by public transport, so even people without access to a car can use these space. The regional natural landscapes, on the other hand, are not as well connected to the urban areas. Most of these areas are mainly accessible by car. An exception is the dune landscape close to Scheveningen. These are part of the The Hague region and well connected by the tram network. For a detailed green space strategy, an in-depth analysis for the accessibility of individual recreation areas would be necessary. But we can conclude that there is a regional green space network that is in part well accessible. Nevertheless, the connection between green spaces and urban areas can be enhanced.

Improving the connectivity of green and blue spaces to the cities is also an objective of the Province of South Holland (2017: p. 60). Figure 2.3.4.2 shows a green space vision by the Province of South Holland. On the one hand, this vision shows that there are plans to improve the availability recreation areas in the province. On the other hand, the map shows how the expansion of green spaces puts the agricultural sector under pressure. Many of the depicted areas are currently agricultural land. If the amount of green spaces should be expanded, a reorganisation of the agriculture industry and the regional land-uses system is necessary.

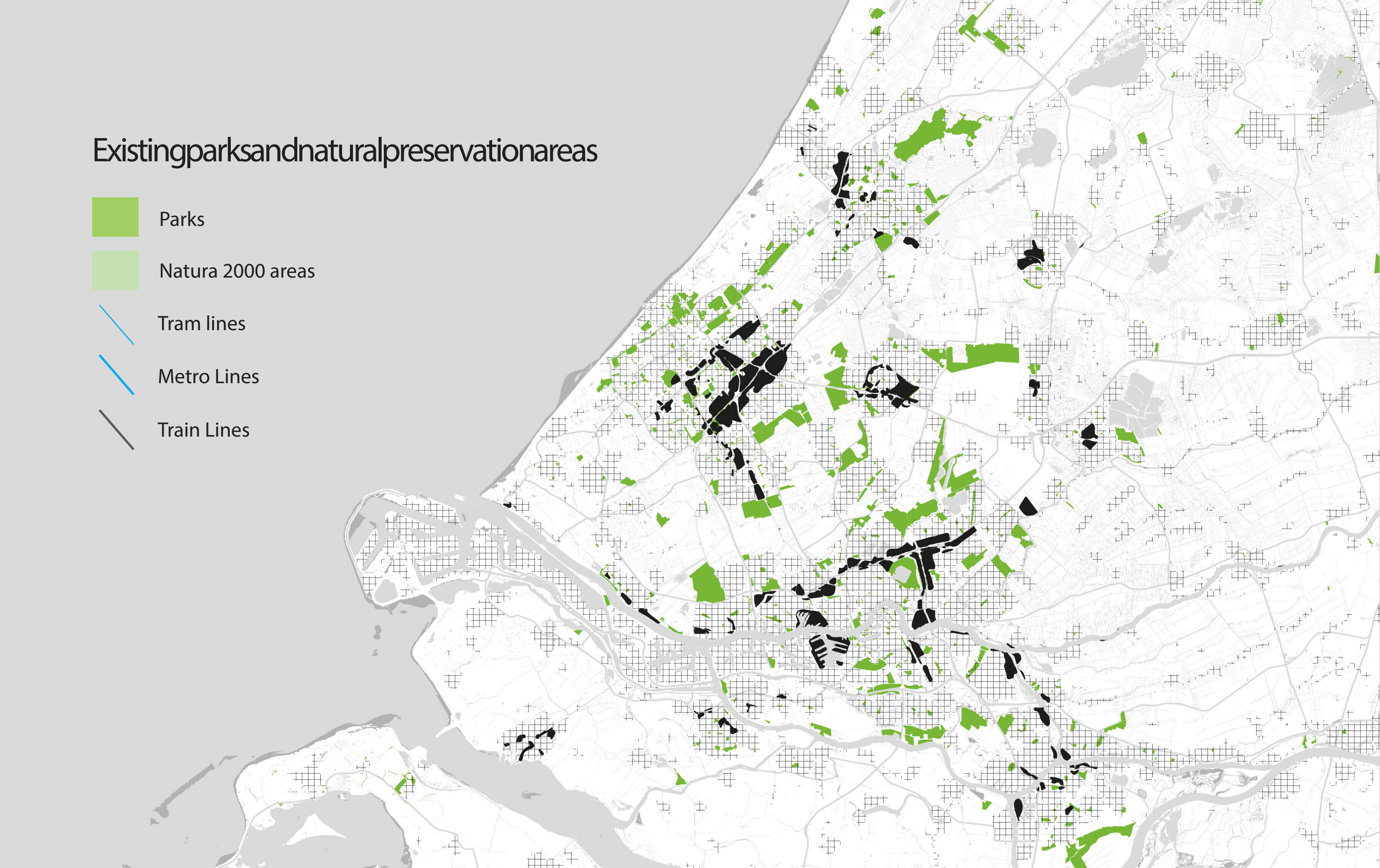


Figure 2.3.4.1 Existing green spaces, public transport lineas and potential urban development areas in South Holland Figure by the author, based on (Open Street Map)

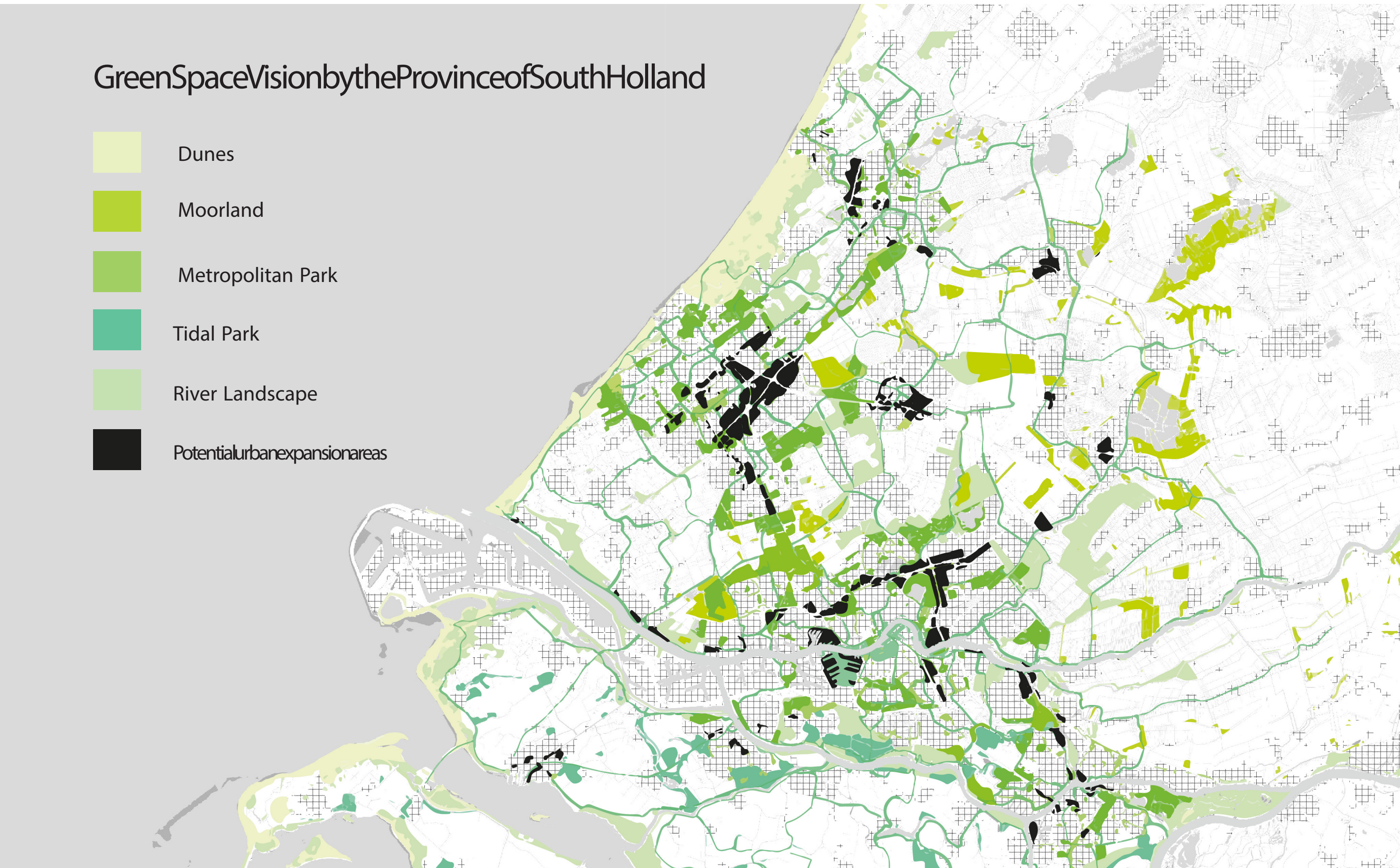


Figure 2.3.4.2 Green space vision and potential urban development areas in South Holland Figure by the author, based on (PZH, 2017: p. 61)

2.4 CONCLUSIONS

WATER

The Netherlands, including South Holland, can no longer afford using old water management by methods. A tool and approach is needed to develop a safe waterscape - using its natural processes, tendencies and phenomenon - to look for opportunities.

Natural based systems and solutions give effective and environmentally friendly tools, to protect human habitats while at the same time being in harmony with the natural environment. Concepts that have particular potential for the South Holland development, and which should be developed and used for creating future vision include:
Sand motor- using sand and natural sea currents, it is possible to create a second dunes line and effectively protect Westlands, The Hague, Leiden and other cities in the coastal area.

Room for the river From the perspective of South Holland's forecasted challenges the best method is to protect river banks and freshwater resources is widening the riverbed and giving the nature possibilities for self-regulation.

Aquaculture- as sustainable water production allows The Province to effectively use resilient waterscapes while purifying Eutrophicated water from inland agriculture and solve one of the biggest issues on the way to a circular food production system.

Sponge city; cities such as The Hague or Rotterdam must be able to store water in their own grants - This is required by the condition of the overloaded system, the system and their own situation with the threat of increased drought and flood frequency.

Protecting "old nature" and developing with natural processes, in combination with technical solutions Is the best direction to protect from effects of climate change without destroying the production and liveability capacity.

AGRI-FOOD SECTORS

AGRICULTURE

The agricultural sector is, in its current system, for the most part circular. Changes can be made in the input of fertilizer, by substituting them for more natural fertilizer from upgraded manure. For this sector, it is more important to focus on possible problems presented by climate change, mainly the increasing salinity of the soil in the province of South-Holland, and using innovative systems that will ensure high productivity even with these changes.

DAIRY FARMING

In conclusion, the production process of dairy farming is already quite circular, most striking is the import of the raw materials to produce the fodder. Seaweed can be the key to creating a circular process as much as possible, so the imported protein rich materials can be replaced by 'home-grown' seaweed. Moreover, the addition of extra seaweed to the dietary of dairy cows will increase production, with which almost 11% (7,564.4 hectares) of current land-use and livestock can be reduced while producing the same amount of dairy products.

GREENHOUSE HORTICULTURE

The circularity of greenhouse horticulture in South Holland is in the leading position all over the world. Advanced technology in horticulture has been widely tested and applied. The potentials for improving circularity, on the one hand, lies in enhancing the capacity of resource conservation, waste reduction and recycling within the horticulture sector. On the other hand, the potential solution is to introduce synergetic sectors (such as algea farming) to promote the transition to a more closed cycle.

SEAWEED FARMING

Farming seaweed in the province of South-Holland has positive effects on the natural environment, and is the key to intersectoral circularity between agriculture, dairy farming and greenhouse horticulture.

URBANIZATION

Redensification within the borders of existing towns and cities is possible and has various benefits. It helps protecting agricultural land and developing new water retention areas as well as recreation areas. Furthermore, density can encourage inhabitants to use more sustainable modes of transport.

But redensifying cities also comes with challenges. For instance denser cities effect peoples stress levels and increases the distances they travel for leisure activities.

Anyway, if accompanied by the right measures, dense urban areas can be beneficial for the health of the population.

This chapter shows that two tasks need to be taken into account in our strategy, to create benefits for the inhabitants of redensified towns and cities. Firstly, people from urban areas should be able to participate the processes of food production. Secondly, they should have access recreation areas outside the cities. Both is especially the case for inhabitants of the neighbourhoods with the highest densities and lowest average income. Therefore, regional green spaces need to be accessible by walking, cycling or using public transport. Furthermore, food production should be integrated into urban areas for its recreational and educational effects.


AGRI-FOOD SECTOR
WATERMANAGEMENT
CONTESTED SPACE
URBANISATION

3. GROWING SMALLER

A VISION FOR SOUTH-HOLLAND IN 2100

3.1 WHAT GROWING SMALLER ENTAILS

IN 2050, THE PROVINCE OF SOUTH HOLLAND IS A RESILIENT LANDSCAPE WHERE WATER, AGRICULTURE AND URBANISATION WORK IN UNISON TO CREATE SAFE AND HEALTHY CONDITIONS FOR BOTH SOCIETY AND ENVIRONMENT.

Wetland ecosystems provide safety from rising water levels and contribute to biodiversity. The agricultural sector is uses methods that can be more integrated in the natural environment and reduces its land demand and therefore creates space for water protection measures while keeping a sustainable production for local food due to the large presence of aquaculture within the local food culture. A network of green and blue spaces is integrated in the urban landscape and makes compact cities more livable and inclusive. Agriculture hubs and open air supermarkets close to dense urban areas ensure the region's innovative power in the food sector, create new jobs and bridge the gap between producer and consumer.

3.1.1 THE GOALS OF A BALANCED LANDSCAPE

The 'Growing Smaller' vision has three main goals, which will create a synergy in order to achieve the final goal of a balanced landscape in South-Holland. The analysis and frameworks have lead to an understanding of the current and future challenges that will spatially reform the province. Our main goal is to incorporate measures to achieve a productive, liveable and safe environment, in a balanced landscape.

PRODUCTIVE ENVIRONMENT

As one of the worlds largest exporters of food, we have the moral obligation towards other areas of the world which will become less suitable for food production due to climate change. We need to keep producing and exporting our high-quality products to try and help sustaining the world's growing population.

LIVABLE ENVIRONMENT

Already, cities expand their housing stock with densification projects within their current boundaries. In this process of densification of urban systems, a clean, healthy and desirable living environment is increasingly important, as the circumstances within the dense urban areas will have negative effects on urban climates and local bio-diversity.

SAFE ENVIRONMENT

With the building pressures from fluctuating rivers and rising sealevels, watersafety for all inhabitants throughout the territory of the riverdelta in South-Holland, is threatened. Crucial interventions that will change the way we relate to the water have to be implemented in the agricultural and urban areas, in order to guarantee watersafety in the coming age.

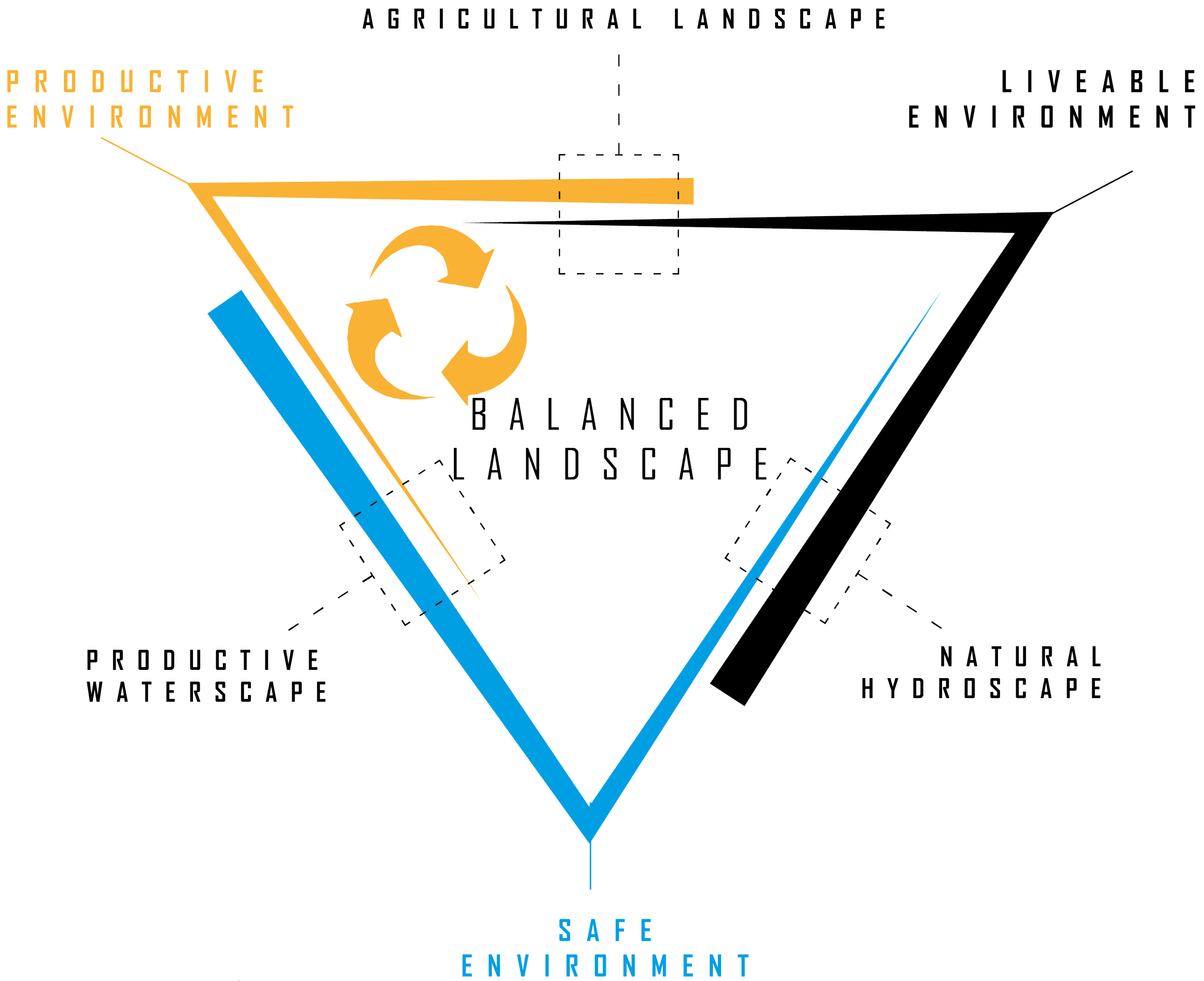


Figure 3.1.1.1: Vision concept diagram.
Figure by author

TRANSITIONAL SPACES

Due to the building pressures on the land of South-Holland, by water, agricultural productivity and urbanization, a utalitarian approach to the available space is needed. By focussing not on the homogeneous but the heterogeneous spaces, an integrative approach to the implementation of competing demands can be achieved. In order to balance the landscape, productivity, safety and liveability have to coexist, and preferably strengthen eachother.

AGRICULTURAL LANDSCAPE

This landscape is defined by the newest agri-food production methods, engineered to enforce a maximalization of productivity. At the same time, the circular system and densification of production capacities, will create a more open landscape that supports the systems of production, where inhabitants can recreate and get in touch with food production.

NATURAL HYDROSCAPE

The natural hydroscape, comprised out of systems of wetlands with a controlled water intake, creates a buffercapacity to filter and store surplus water when needed. The landscape is engineered on the bases of hydrology and watermanagement, utilizing natural systems to benefit the area. These wetlands have extremely beneficial effects on local bio-diversity, and provide next to watersafety a healthy living environment in which air, soil and water are filtered.

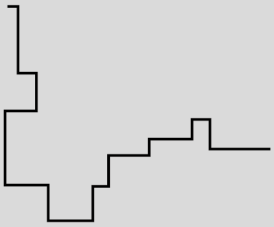
PRODUCTIVE WATERSCAPE

This water based landscape will be close to- or in-between urban areas. Here, it will capture, filter and store runoff and surplus water from the urban system. These landscapes comprised out of ponds are very suitable for several types of aquaculture, so that the waterscape will aid in ensuring a safe environment, while still maximizing potential agricultural value.

3.1.2 VISION MAP

G R O W I N G   S M A L L E

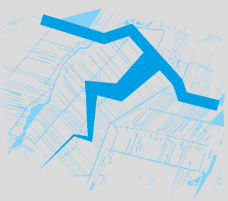
D E N S E   U R B A N   C E N T E R S



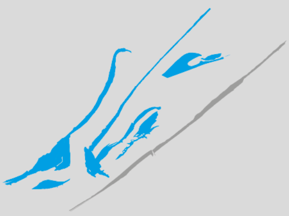
S H A R P   U R B A N   E D G E S

A G R I C U L T U R E
P R O D U C T I O N S C A P E

A Q U A C U L T U R E

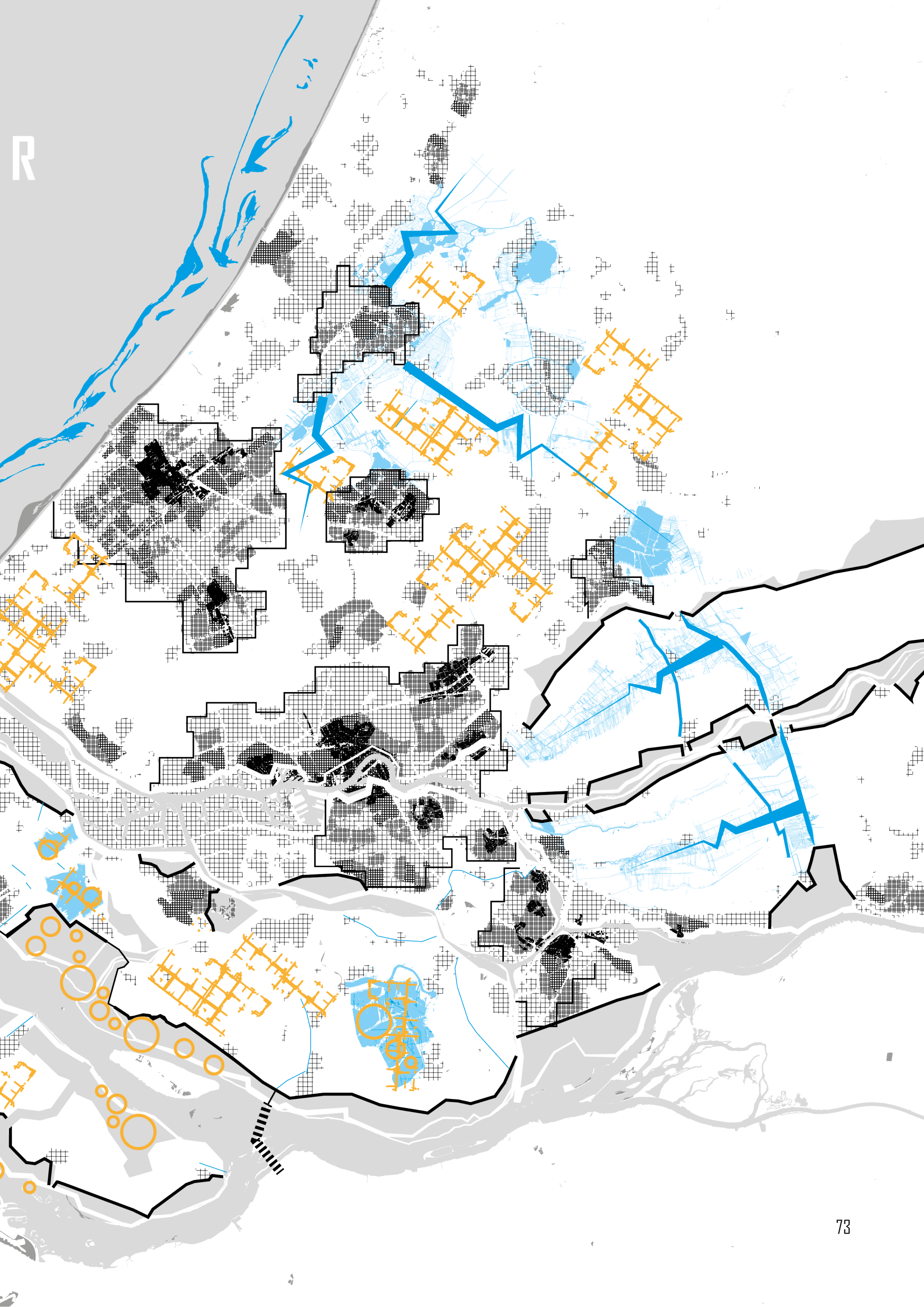


I N F I L T R A T I O N   A N D
B U F F E R



S H O R E
P R O T E C T I O N

Figure 3.1.2.1: Growing Smaller, vision map. Figure by author


R

3.2 THE NEW SOCIO-SPATIAL AND TECHNICAL SPATIAL SYSTEMS

3.2.1 THE WATER SYSTEM

Vision of water system balance based on current predictions to create safe and balanced south Holland landscape resilient towards future challenges. Since improvements in the primary dyke line is a long-term and expensive solution (Noordzeeloket, 2018) this type of investment in water protection is limited to Haringvliet inlet line. South part of Province (Goere-Overflakkee and further Zelland) would be changed into a resilient waterscape in which water pressure fluctuations would be mitigated by sponge qualities of aquaculture between first and secondary dykes. The Room for the River program is extended and the riverbed doubled in size along the entire length- so that the river areas are safe even in extreme situations (Baptist, 2019). It is also building an adequate composition for beneficial natural processes - water purification, gas absorption and increasing the biodiversity of areas belonging to Natura 2000 (Ramsar Convention on Wetlands, 2018).

The Biesbosh is extended to the west and east, which has increased the water carrying capacity of the area. The way this protected area operates, in terms of water absorption and purification, will be implemented in an analogous manner based on manmade existing kanal systems between the Hollandsche Ijssel, Lek and Beneden Merdewe channels. Due to subsidence tendencies fighting water in this area makes no sense anymore (Stouthamer, 2017). By using water system (LOLA, 2014) the river water will be let into former agricultural land and cleaned by natural filtration levels (Ramsar Convention on Wetlands, 2018). The fresh water resources will be secured within use of closed polders or channel units (Meyer, 2014).

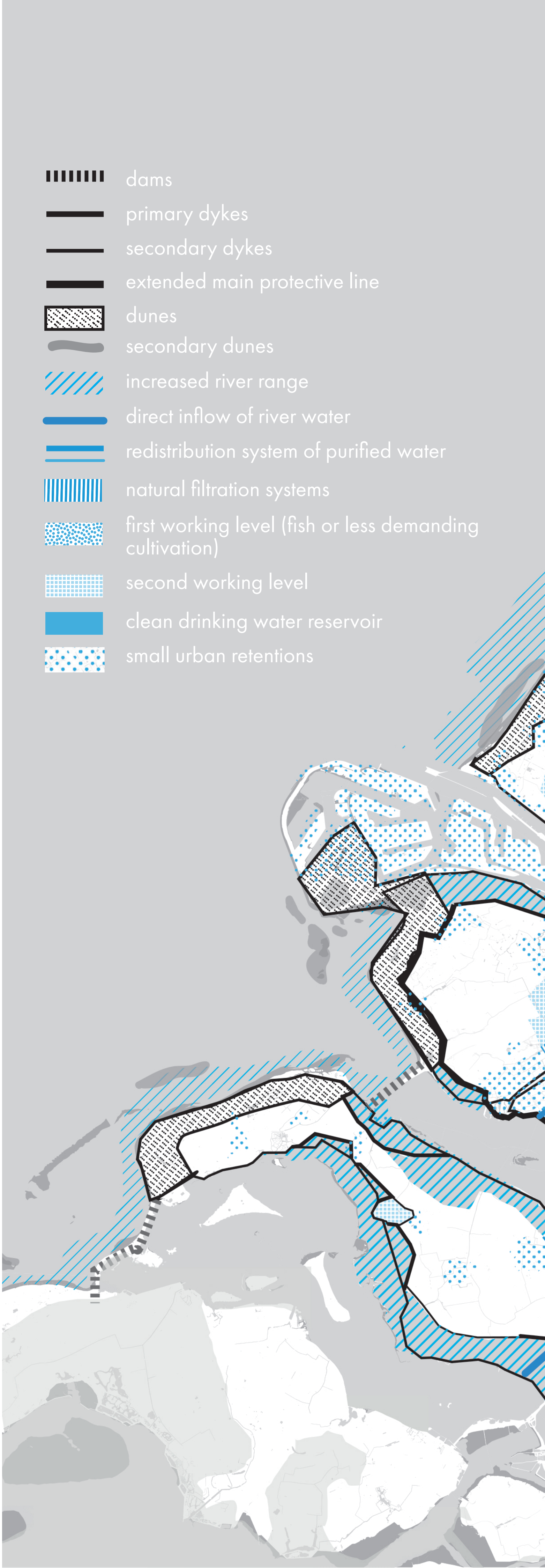
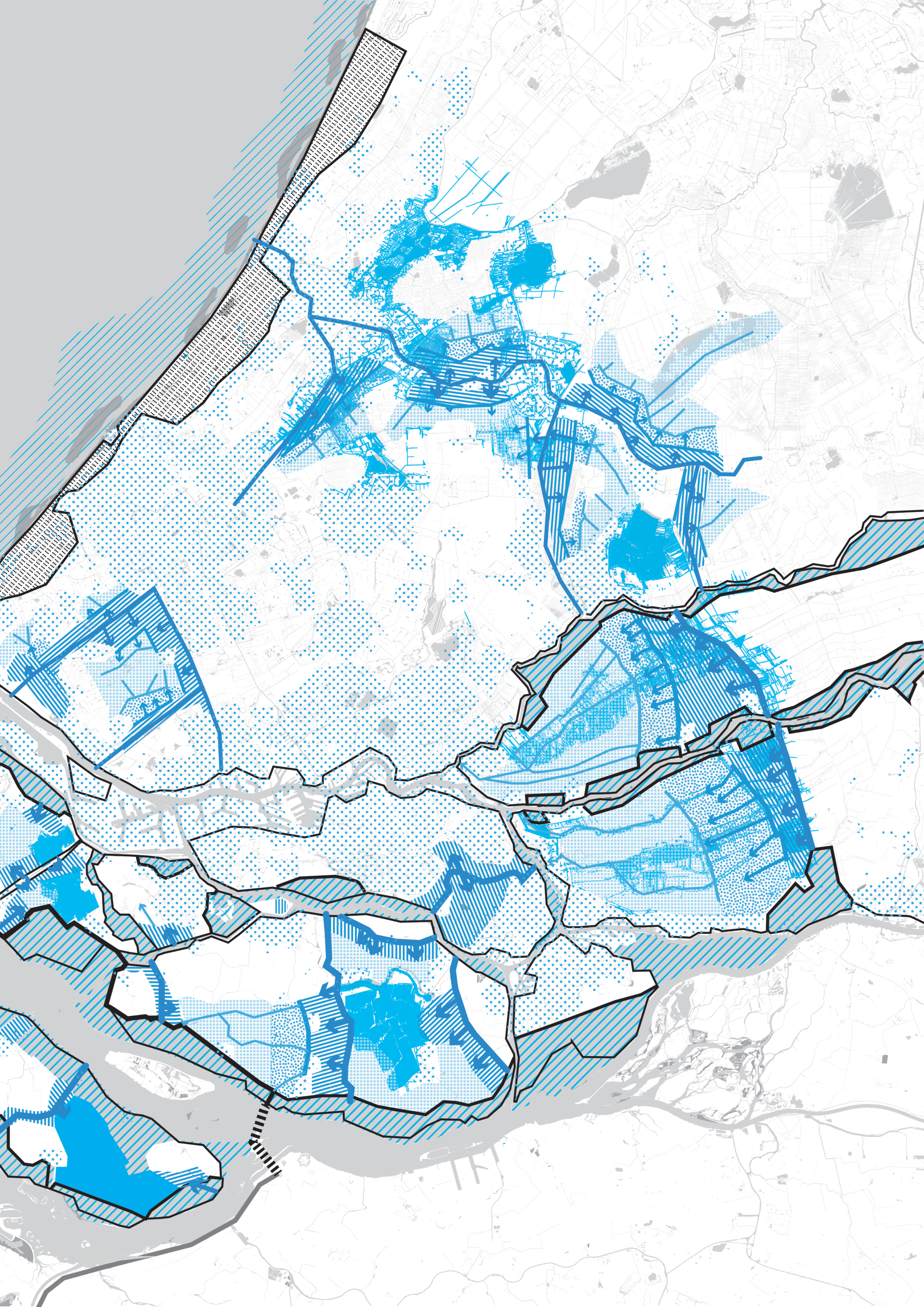


Figure 3.2.1.1: Water space claim in South Holland 2100 >
Figure by author



3.2.2 THE AGRI-FOOD SYSTEM

The agri-food system in 2100 will be one that evolves around the integration of water-based food production. In the map (figure 3.2.2.1) we can see that a more segregated system is created compared to the clustered system we saw in the map on page (34). This is a result to the adjustment of the clusters areas to the new, more natural soil and water conditions.

The Northern part of South Holland is based on sweet water wetlands, indicated by the light orange textures on the map. Each area works with a natural water purification system that works in three levels. Each level has different water conditions, causing a difference in food production preference. The first level is for the actual purification of the water using plants. The second level will have a landscape of fishponds. The third level has a high water level in the soil, making it available to certain produce such as watercress and mint or dairy production.

The South of the province works with saltwater based food production. Agriculture farmers have switched to crops with a high salt tolerance. Saltwater aquaculture products are produced in saltwater reservoirs on land and in more natural lakes.

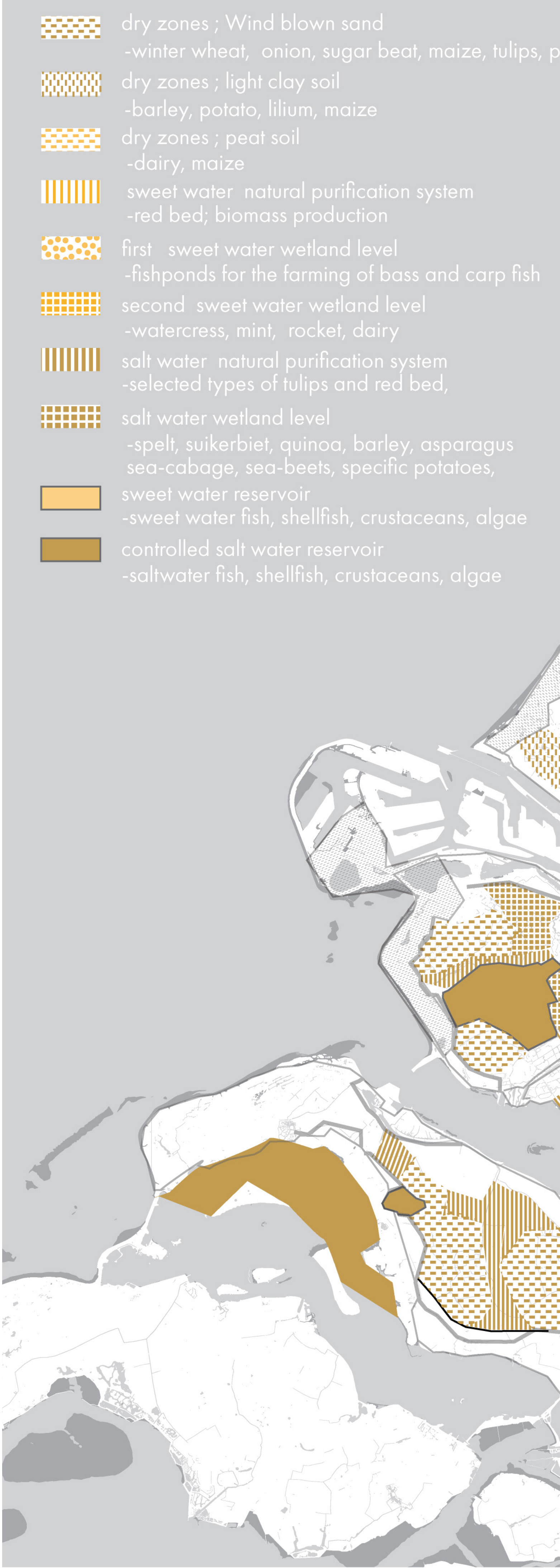
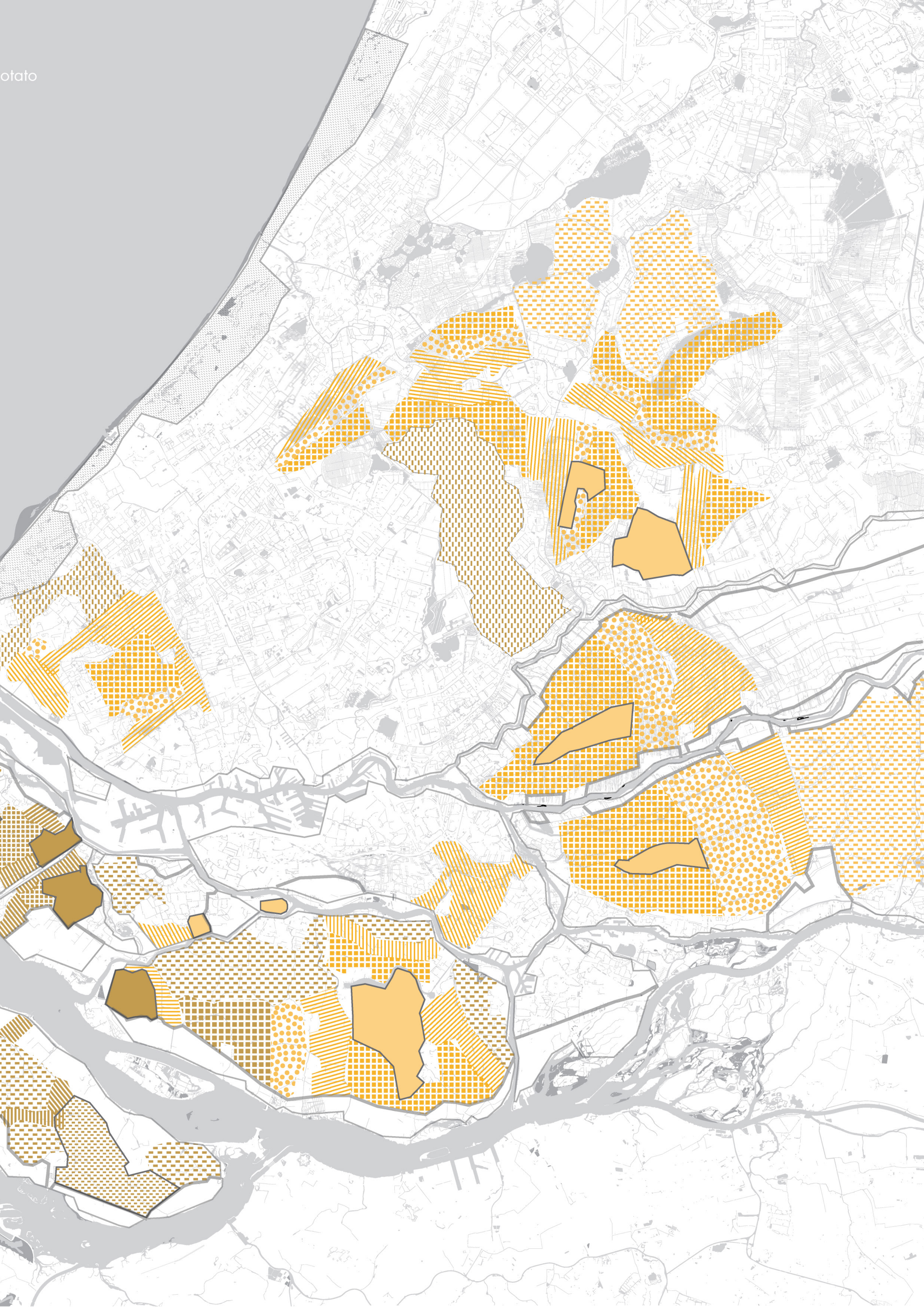


Figure 3.2.2.1: Agri-food space claim in South Holland 2100 >
Figure by author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3.2.3 THE URBAN SYSTEM

The urban areas of South Holland will be denser but even more liveable for today. Existing neighbourhoods will be further densified, but keep their open and green characters. Together with the renovation and construction of new buildings, new urban green spaces are developed and integrated in new as well as old neighbourhoods.

The liveability in the region is further enhanced though a wide range of new recreation areas. As depicted on the map to the right, a interconnected network of green spaces will be integrated into the rural and natural land. This green and blue system connects habitats of plants and animals and give a large part of land back to nature.

But also the population benefits from the healthy biosphere. The green and blue infrastructure creates pleasant routes through the whole province for pedestrians and cyclists. An expanded public transport network, connects cities with each other as well as to the regional green spaces.

Though the good connections within the province and the further integration of green in the cities, sufficient recreation areas are accessible for everyone, especially for the inhabitants of the densest neighbourhoods. Furthermore, green infrastructure mitigates the effects of climate change, like increasing urban heat islands.

Finally, healthy and tasty food will be available to everyone. Since more food can produced on a smaller amount of land, the supply with local food is ensured. These production processes are brought closer to the consumers in urban and rural agriculture landscapes.

Finally, food production and spatial development democratic processes. Inhabitants and other stakeholders are integrated in decision making on a local and regional level. Through the integration of education and leisure in the productive rural landscapes, consumers can participate in the food production.

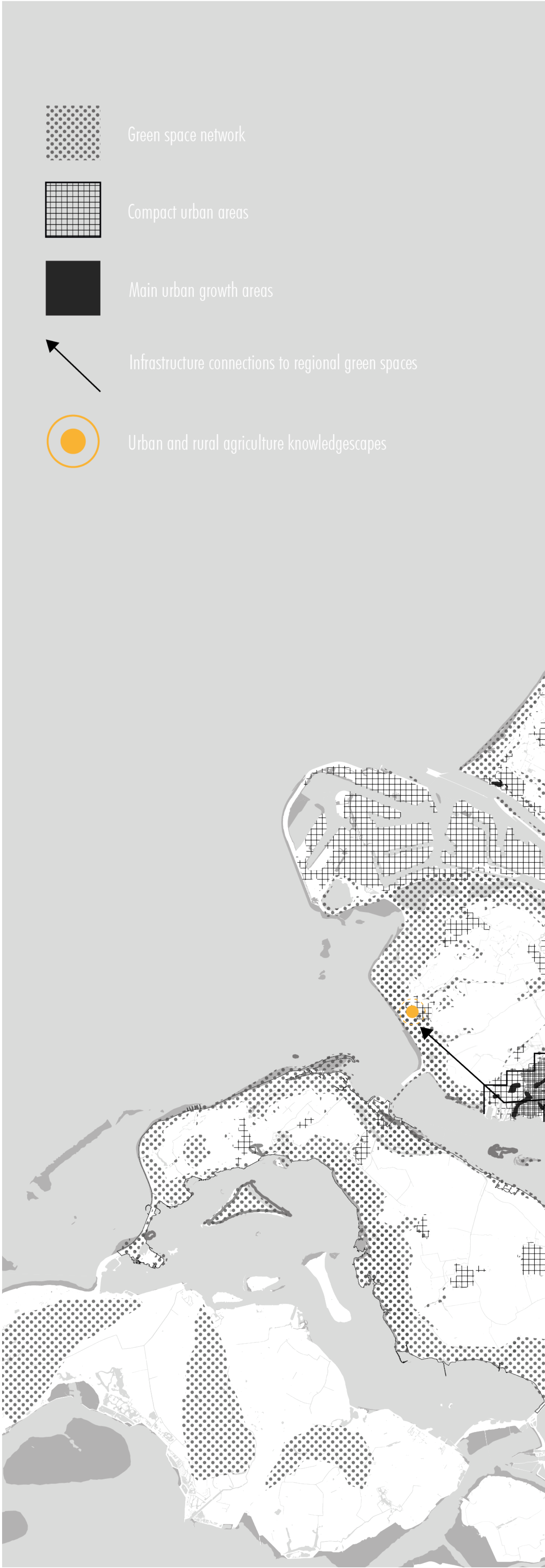

Figure 3.2.3.1 Socio-spatia urban system of South Holland 2100. >
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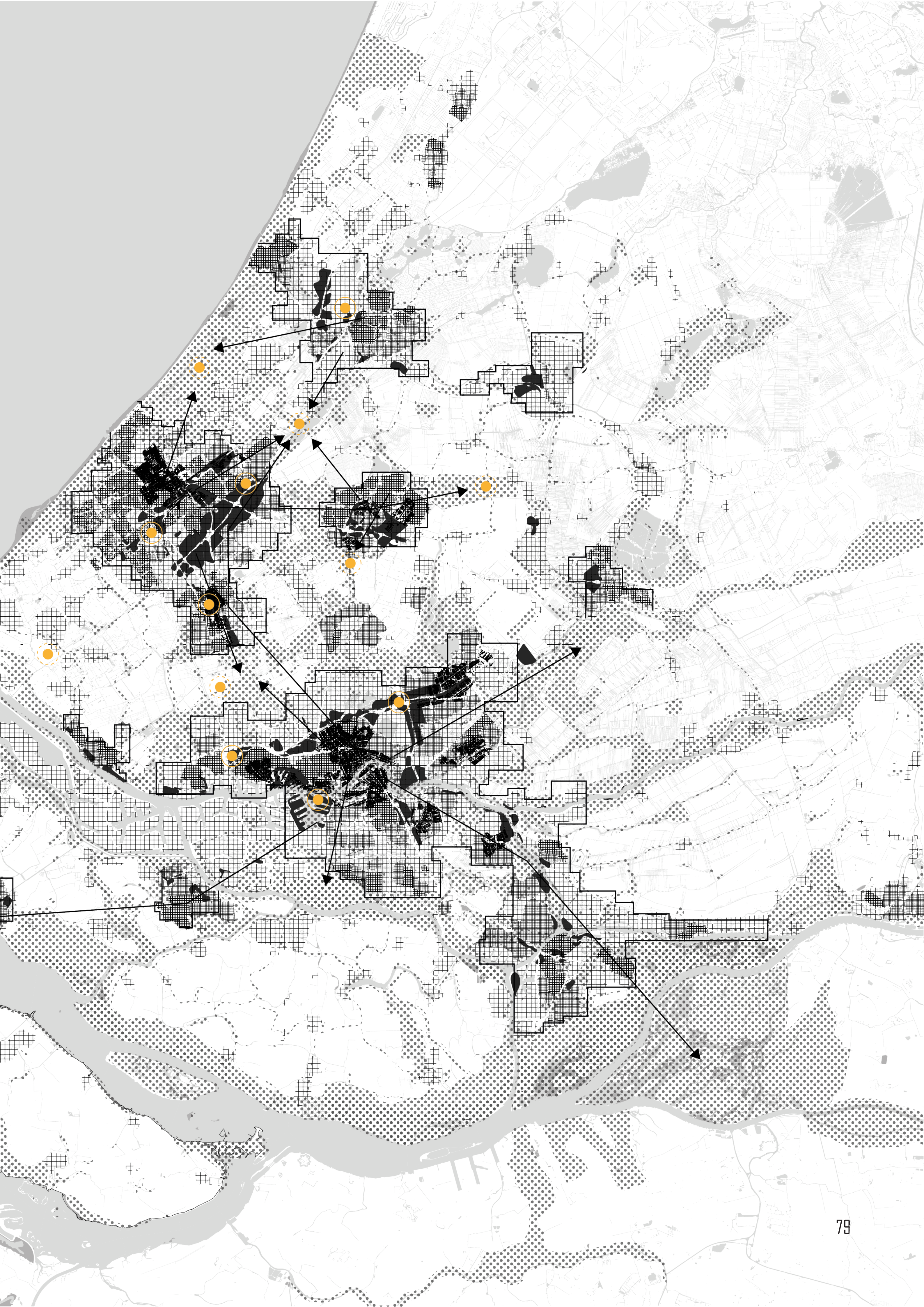


3.3 TRANSITIONAL LANDSCAPE TYPOLOGIES

3.3.1 PRODUCTIVE WATERSCAPES

SEASIDE ACQUACULTURE

The seaside aquaculture transitional landscape is a productive waterscape, meaning it is a water based landscape with a focus on the production of both sustainable food and energy. This is also shown in the diagram in figure 3.3.1.3. Fisheries, aquatic plants, algae and other biota are found in both natural and controlled salt water systems as part of the food production chain, and the typology is therefore a key landscape in creating a circular agricultural system. Hydrological engineering systems such as dikes and dams are very present in the landscape to provide safety from altering water conditions due to climate change and windmills are found in multiple seaside aquaculture waterscapes.

While for a large part being a productive landscape, the seaside aquaculture is also an interesting landscape for recreation. In some parts people can enjoy parks with tidal nature, some parts of the water open for surfing, sailing or swimming, or one can learn about this new productive system where the Netherlands learns to work together with the water.

LOCATION CRITERIA

These transitional spaces are located in coastal areas where it is possible to start big scale saltwater aquaculture production. The most important factors are possible protection from sudden weather deviations and rising water levels. A properly developed agricultural environment and the possibility for a good logistics connection with urban centers are important.

Figure 3.3.1.1: Possible seaside aquaculture locations
Figure by author

 Figure 3.3.1.2: Seaside aquaculture in space. Figure by author

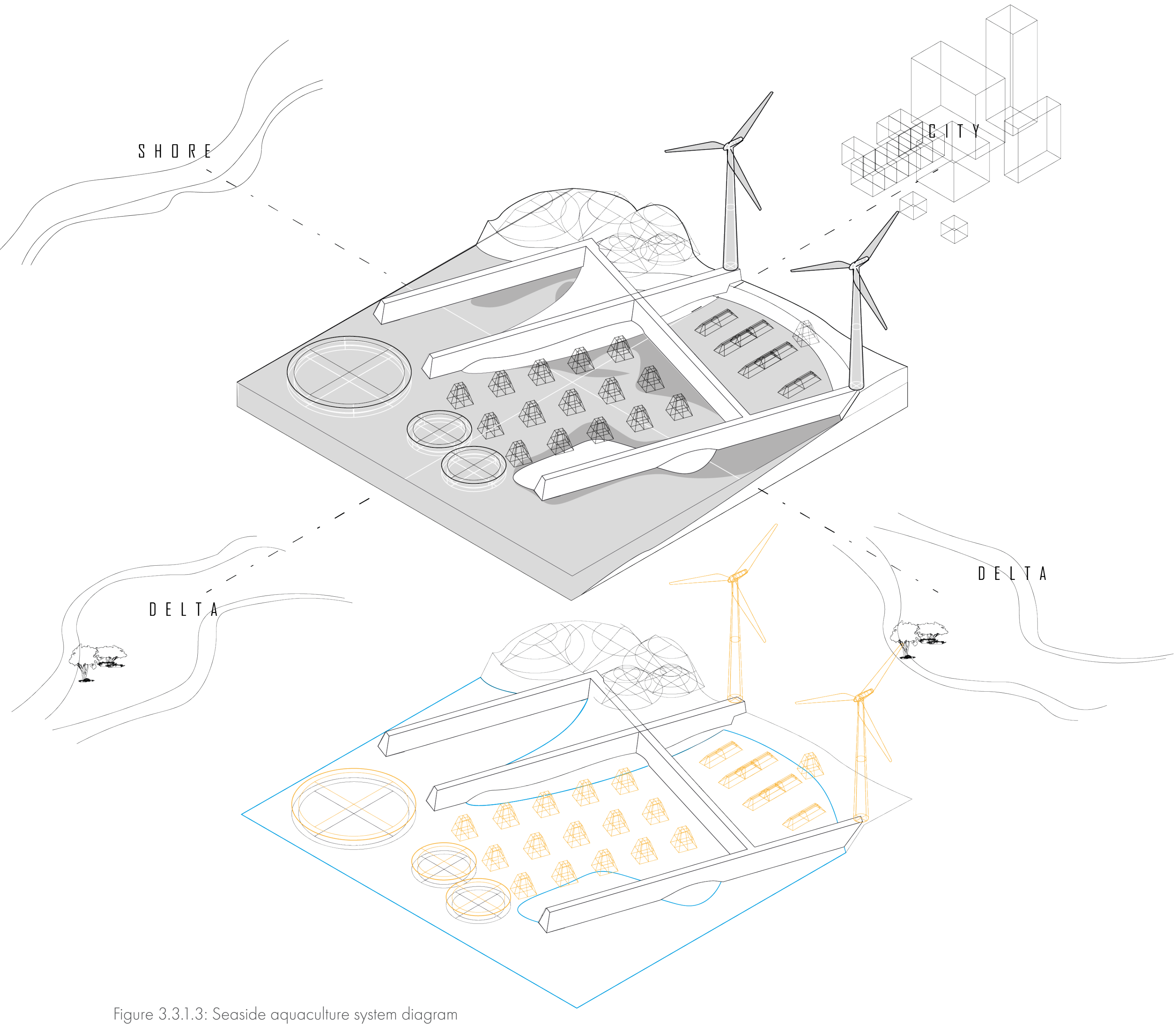
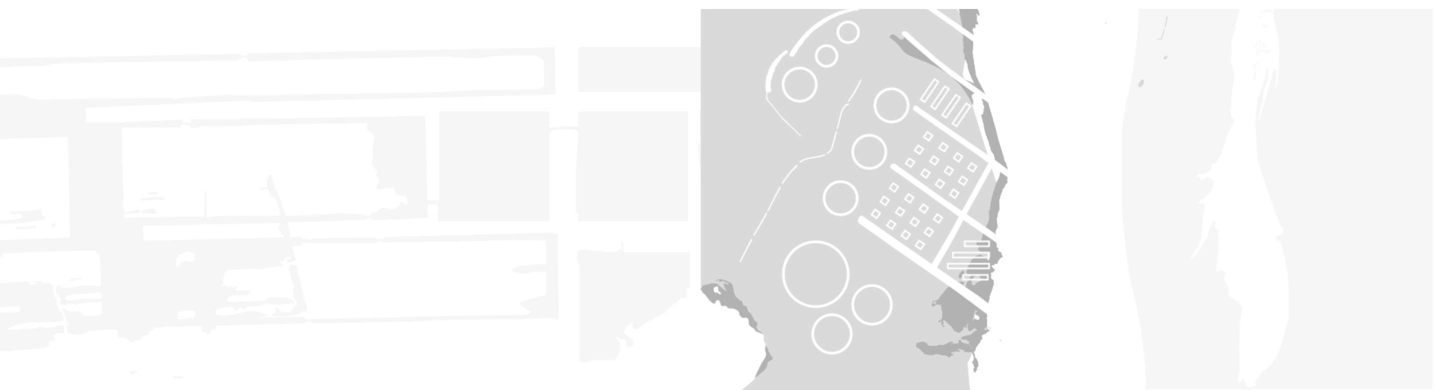


Figure 3.3.1.3: Seaside aquaculture system diagram
Figure by author



INLAND ACQUACULTURE

Inland aquaculture waterscapes are located in the sweet water regions in the East and North of the province of South-Holland. The landscape is made up of different areas with varying water levels. Located near urban areas, specific types of plants can naturally purify surplus and runoff water from both agricultural areas and the built environment. This water is then let into the water basins, which have been formed in the current polder landscape to farm sweetwater aquaculture products. These water basins are combined with (vertical) glasshouses to be able to use waste water from greenhouses, which contains important nutrients, in the water basins. The third level contains fields with wetland agricultural produce and grasslands with dairy farms. The current dike system will define the road network throughout these ponds and lakes.

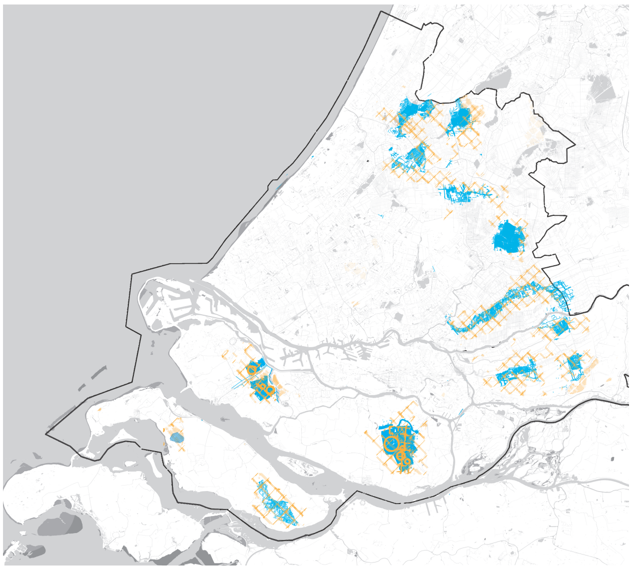


Figure 3.3.1.4: Possible inland aquaculture locations
Figure by author

LOCATION CRITERIA

These landscapes are located next to urban areas, to capture and store runoff and surplus water. These are usually polder landscapes that are subsiding due to the pumping out of the water, which will be stopped when changing the landscape into an inland aquaculture waterscape.

Figure 3.3.1.5: Inland aquaculture in space. Figure by author

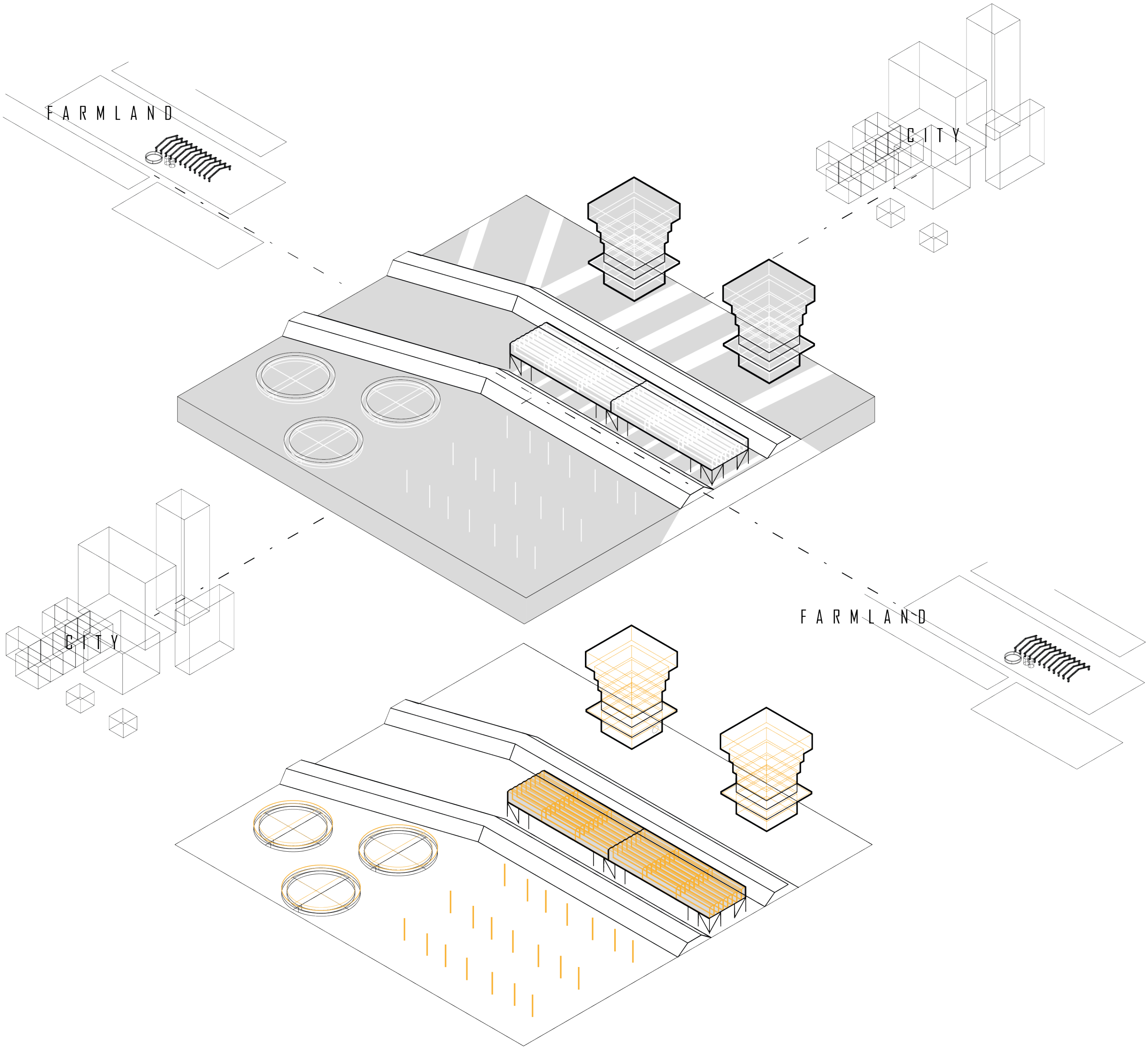


Figure 3.3.1.6: Inland aquaculture system diagram
Figure by author

3.3.2 AGRICULTURAL LANDSCAPE

AGRICULTURAL PRODUCTIONSCAPE

Agricultural productionscapes are landscapes formed to maximize potential production capacity, which can include different types of agricultural production. Some transitional spaces are based on one agricultural sector, others on combining multiple agricultural sectors and connecting them to reach a higher productivity level. The farmers introduce innovative agri-food production systems, such as vertical glasshouses and floating farms, and test them on a larger scale. A proper infrastructure connecting the production area to storage and distribution locations is of high importance to make this landscape work properly. The landscape most important in the areas with many greenhouses, by building them up several levels, the freed up space on the ground can be used for pond systems that capture, filter and store the needed water. This landscape is able to sustain high productivity within a circular systemd, while providing a more open and attractive landscape.

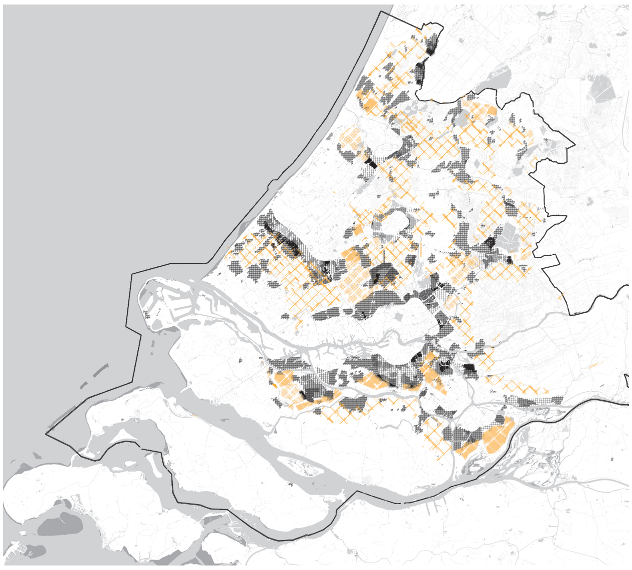


Figure 3.3.2.1: Possible agricultural productionscape locations
Figure by author

LOCATION CRITERIA

The agricultural producionscape is located in currently existing productive landscapes that are well connected by infrastructure. These landscapes are predominantly existing agri-food production landscapes, but locations such as emptying harbours can also be turned into an agricultural production scape.

Figure 3.3.2.2: Agriculture productionscape in space. Figure by author

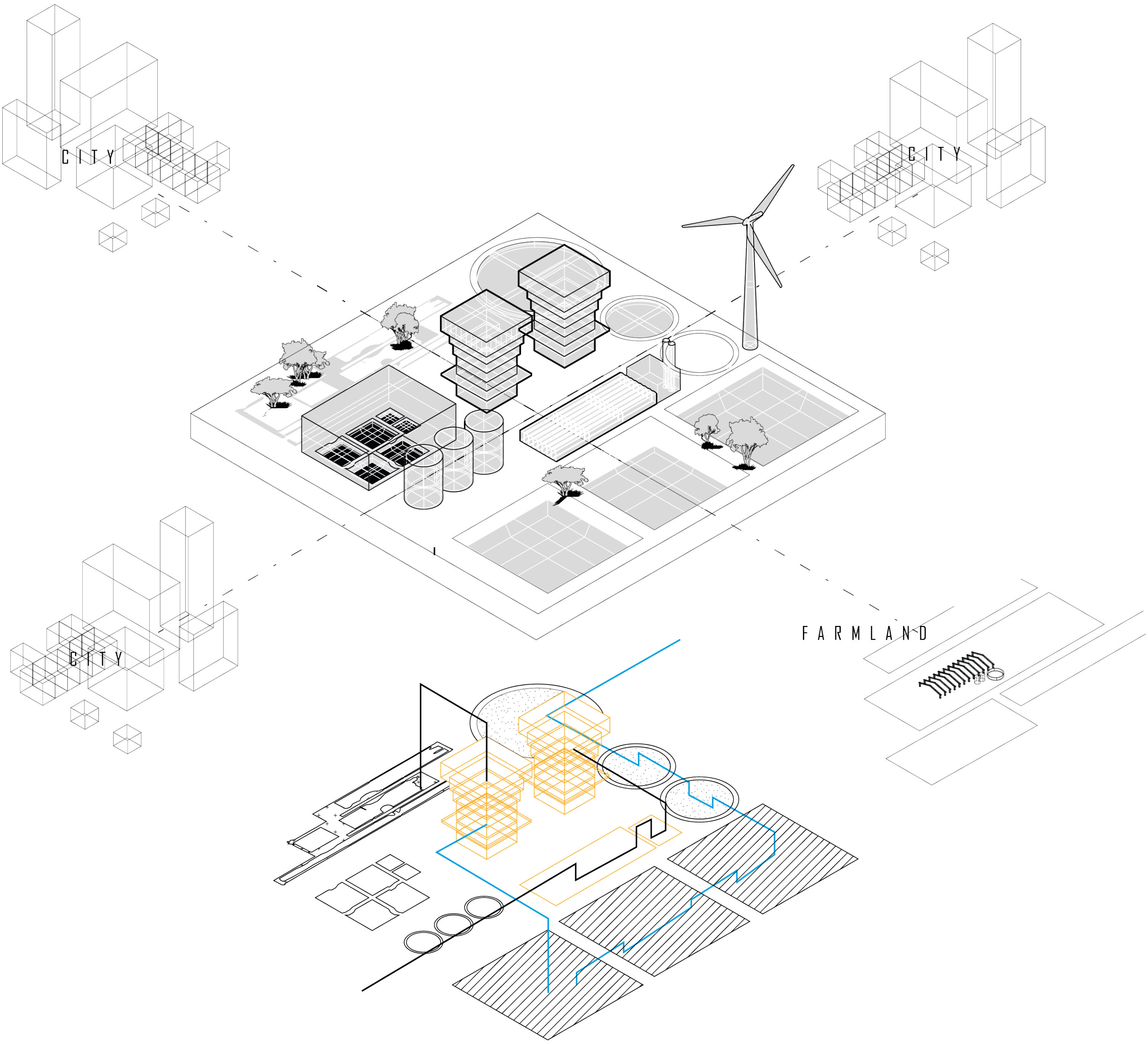


Figure 3.3.2.3: Agriculture productionscape system diagram
Figure by author

AGRICULTURAL KNOWLEDGESCAPE

The Agriculture Knowledgescape combines productive farm land with recreation areas and places a focus on spreading knowledge about local food and agricultural systems. It offers green spaces for the inhabitants of South-Holland and farm land for the agri-food sector. The combination of these functions brings the population in direct contact with agriculture. Farmers in these areas are encouraged to open up parts of their farms to visitors and initiatives related to food are invited to work in these landscapes and get visitors involved.

Knowledgescapes can be placed in two types of locations; there are rural agriculture knowledgescapes and urban agriculture knowledgescapes. The rural knowledgescapes are located outside of the cities and focus on letting people experience the agricultural process. Spaces such as park supermarkets are introduced, where people can pick their own food from the plants or catch their own fish and learn where their food actually comes from. Urban knowledgescapes are located in cities and focus on giving easy access to fresh produce for people living in high density urban areas. People can follow workshops or go to events to learn about new developments in the Dutch food culture and how to use these in their own home.

LOCATION CRITERIA

Knowledgescapes are located either in or next to urban areas in the province. They are in close proximity to infrastructure such as public transport and bicycle routes to make access for the residents easy. Farmers in the location.

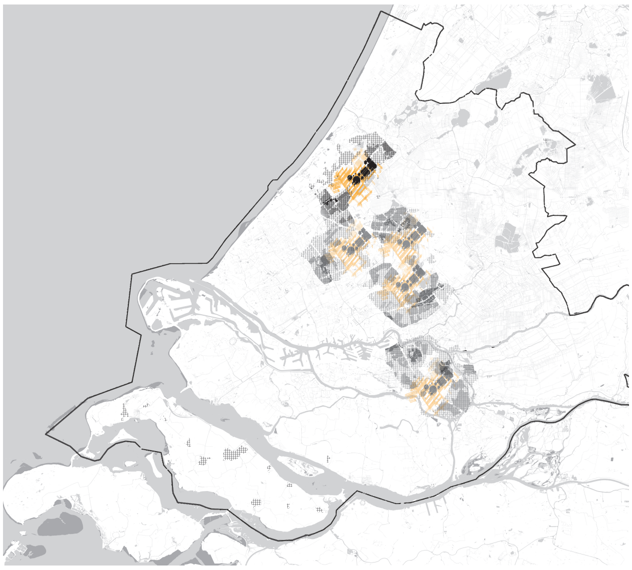


Figure 3.3.2.4: Possible agricultural knowledgescape locations
Figure by author

Figure 3.3.2.5: Agricultural knowledgescape in space. Figure by author

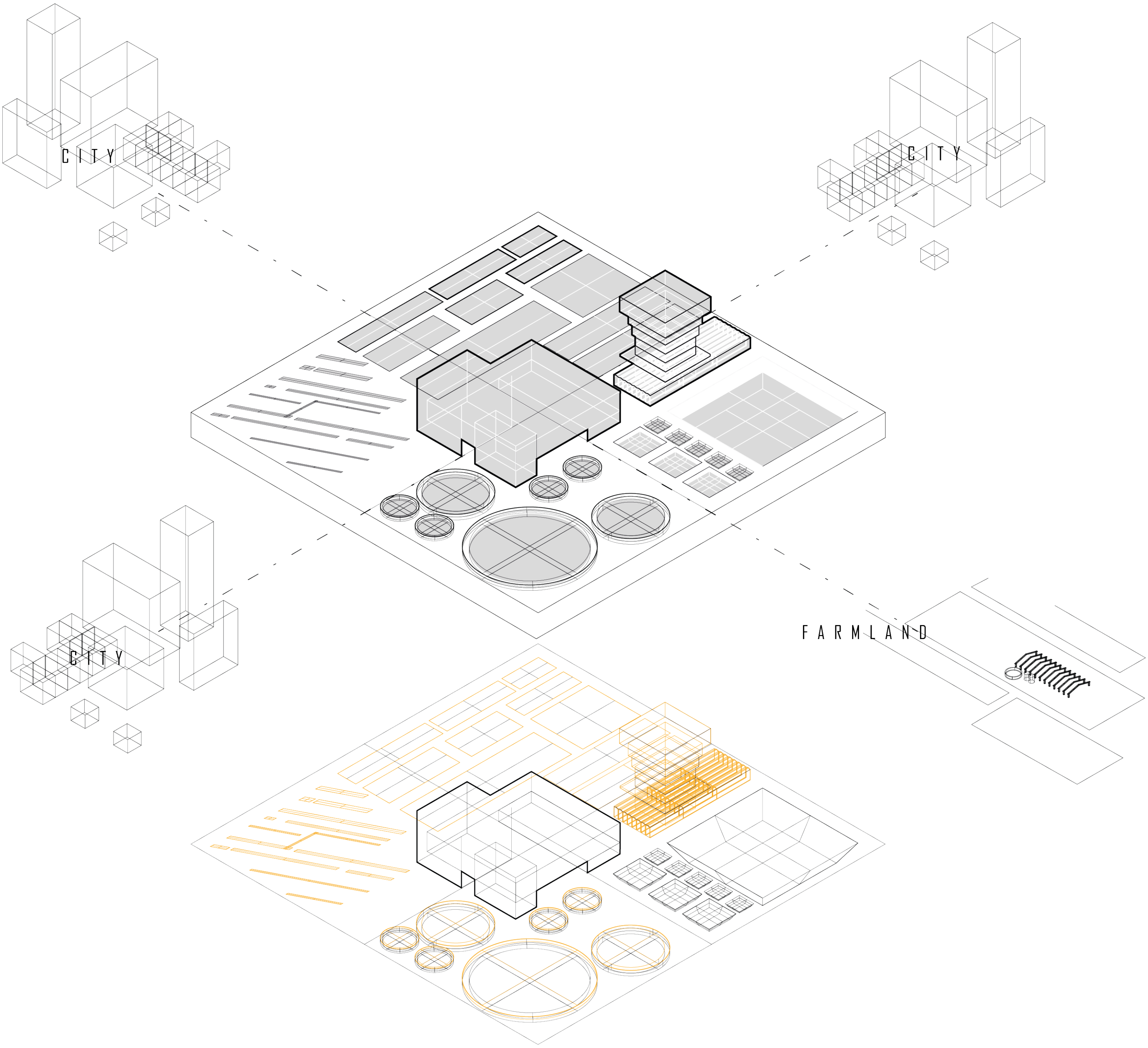


Figure 3.3.2.6: Agricultural knowledgescape system diagram
Figure by author

3.3.3 NATURAL HYDROSCAPES

POLDER HYDROSCAPE

The polder hydroscape is a landscape that is focussed on natural hydraulic systems that are partially controlled to create wet zones. The wetlands improve the environment and biota of the province due to its naturally purifying of incoming water before it is stored and the high CO_2 absorption properties. The transitional space has two main focus points, one is to be available as a water buffer zone for seasonal rises in river water levels, when it can be used as a water storage location. Secondly, it is a recreational area for people that want to get out of the high densified cities and into nature, where they can experience the influence of these changing water levels and new biota created because of it.

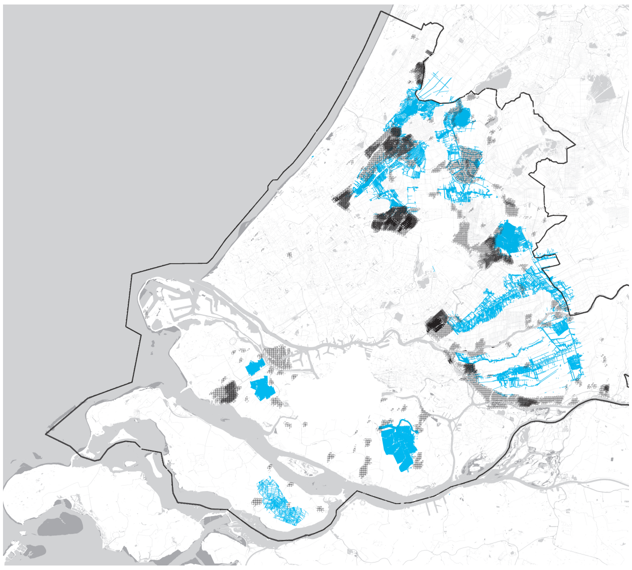


Figure 3.3.3.1: Possible polder hydroscape locations
Figure by author

LOCATION CRITERIA

These are landscapes located next to the river, either on the riverbeds or in low-lying areas connected by direct channels with the riverbeds, that are already exposed to water infiltration. They are sparsely inhabited and mainly used for dairy production. It has to be possible to use the area as a water buffer and will therefore often be located in between the first and second dike systems in a natural way, with a controlled inlet further inland, to ensure water safety to the people living in South-Holland.

Figure 3.3.3.2: Polder hydroscape in space. Figure by author

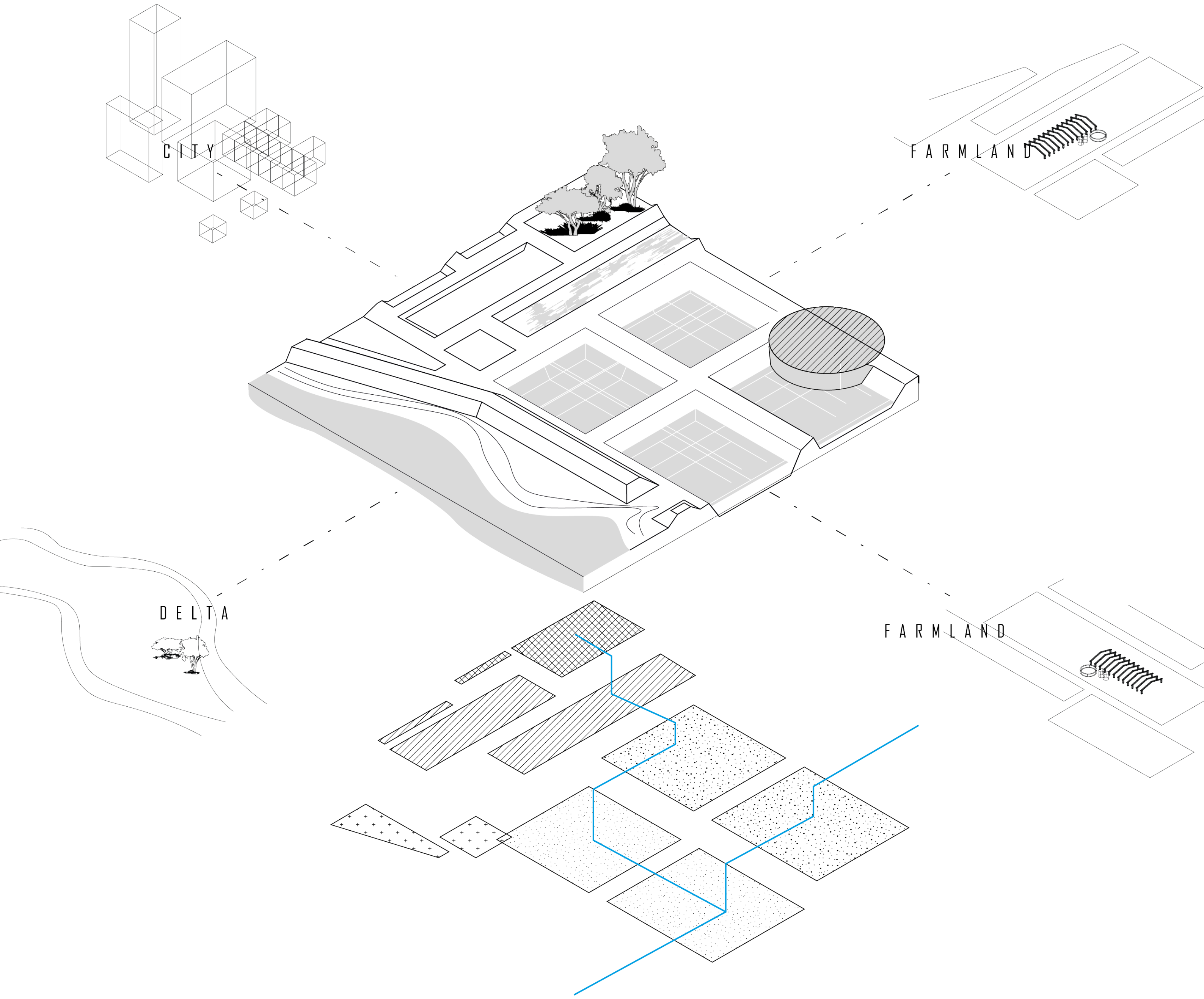


Figure 3.3.3.3: Polder hydroscape system diagram
Figure by author

SEDIMENT HYDROSCAPE

A formation of cays and sandbars is created in front of the current coastline of the Netherlands, based on the principles of natural hydrology for sedimentation and deposition of sands, like the principle of the Sand Motor. Natural sedimentation and the creation of a secondondary shoreline protects the coast from heavy storms that can occur in the future due to climate change. These shallow waters function as a buffer to the primary shoreline, in order to protect it from caving. The landscape, based on the natural hydrological systems of sedimentation and deposition, will offer a new ecosystem for marine biota and will be an interesting new recreational landscape for the residents of the province. The direct connection to open seas is moved onto these new islands and cays.

Figure 3.3.3.4: Possible sediment hydroscape locations
Figure by author

LOCATION CRITERIA

These hydroscapes are located at the coast of the province, starting with the locations that are most vulnerable for extreme weather conditions.

Figure 3.3.3.5: Sediment hydroscape in space. Figure by author

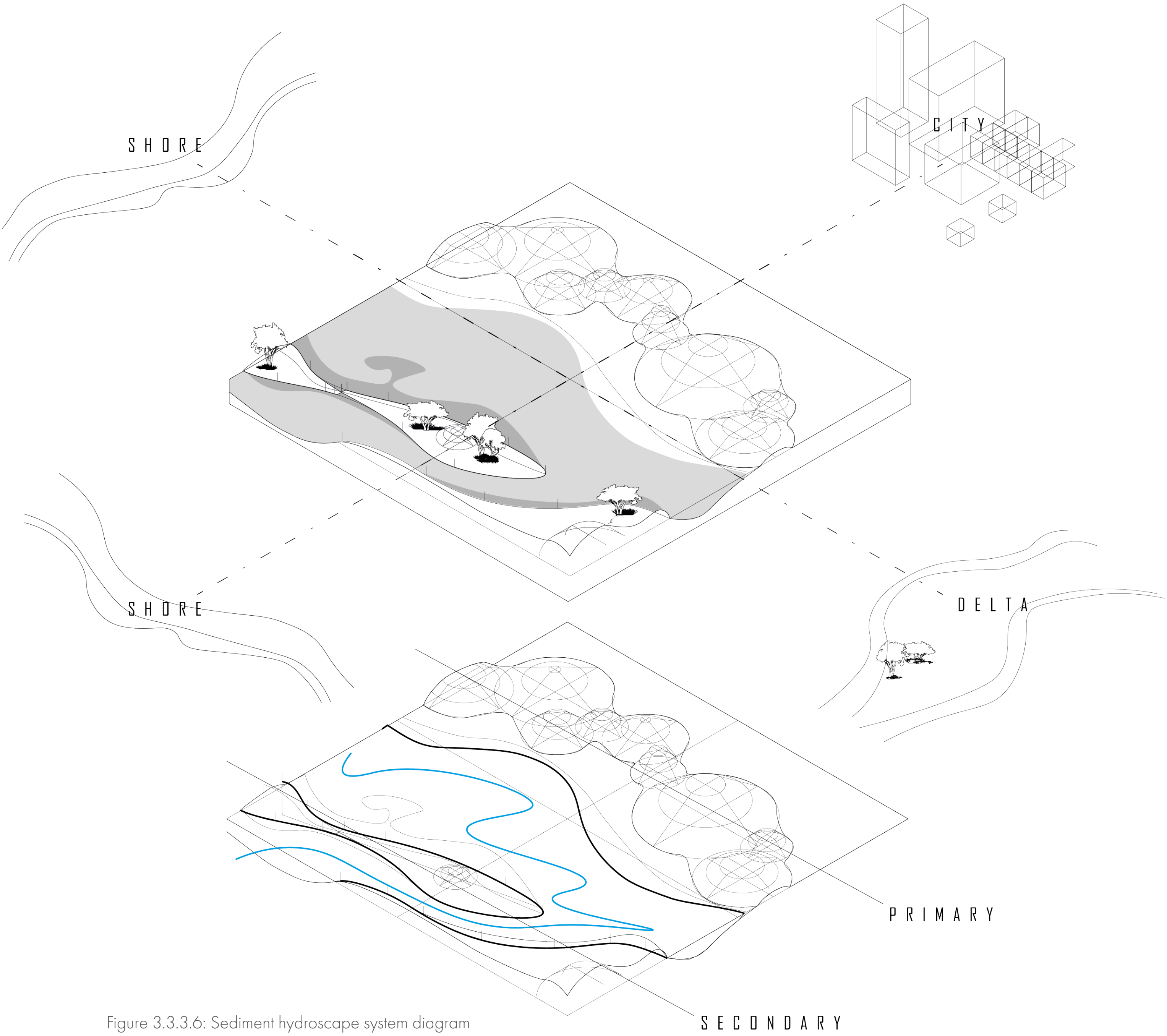
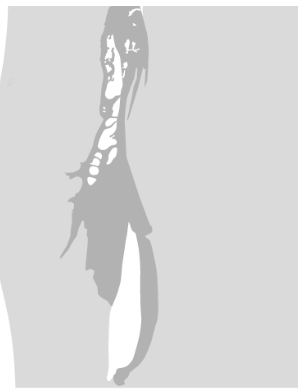


Figure 3.3.3.6: Sediment hydroscape system diagram
Figure by author




AGRI-FOOD SECTOR
WATERMANAGEMENT
CONTESTED SPACE
URBANISATION

4. HOW DO WE GROW SMALLER?

A STRATEGY TO REACH GROWING SMALLER BY 2100

4.1 GROWING SMALLER IN TIME

4.1.1 TIME-LINE

Growing smaller is a vision for South-Holland in 2100. The process of getting to the final stage of the vision is split into three phases, as can be seen in figure 4.1.1.1. Phase one, initiate, holds the two strategic projects that get this process started. The second phase, develop, focusses on the progression of the strategic projects into other transitional typologies in the vision, to develop the system further. Phase three, the implementation phase, indicates the moment that the new agricultural system is fully in place and is developing while adjusting to currently unknown aspects (such as the amount of waterlevel rise).

Each phase is explained in more detail in this chapter. The chapter also looks into stakeholders involved

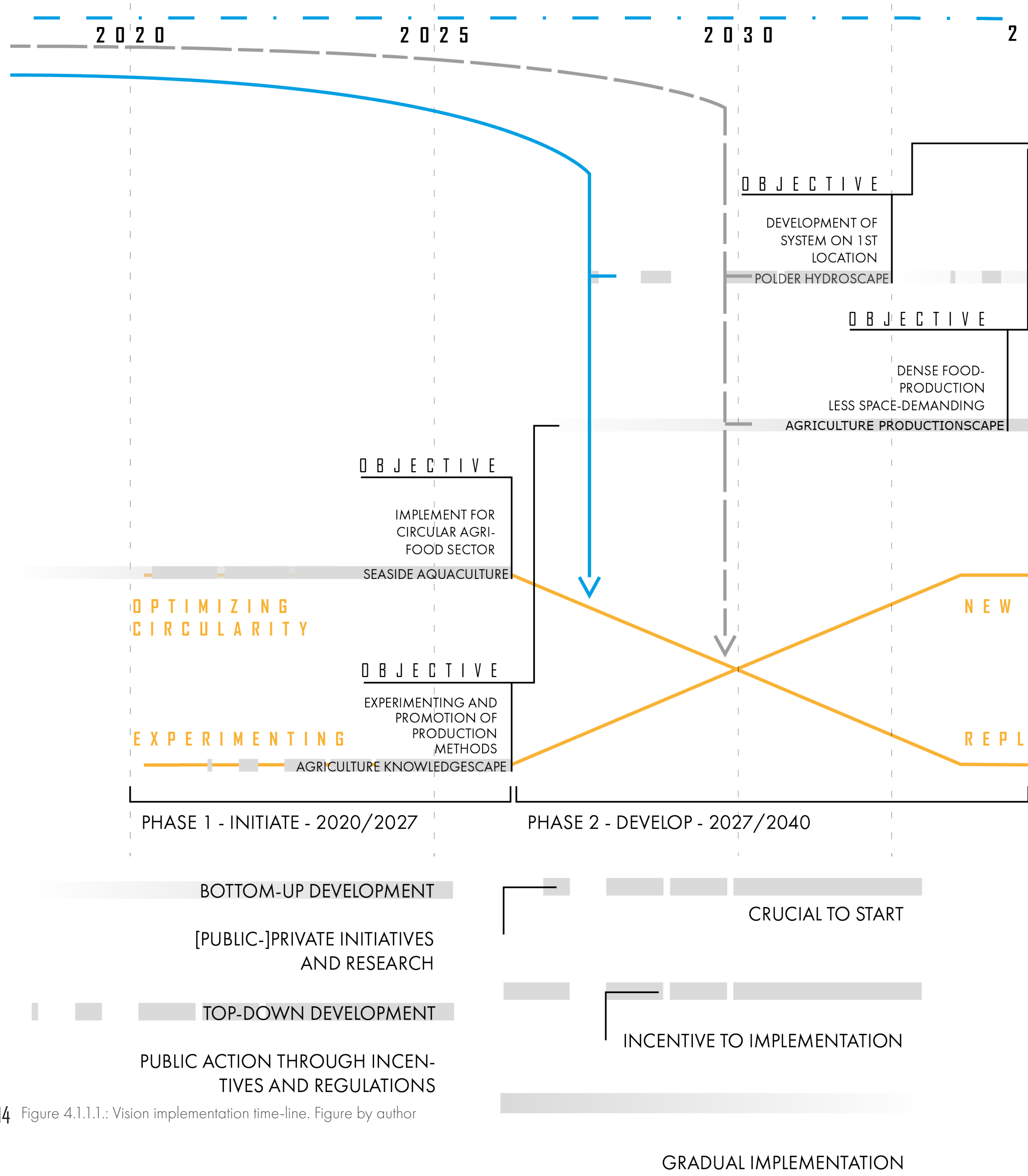
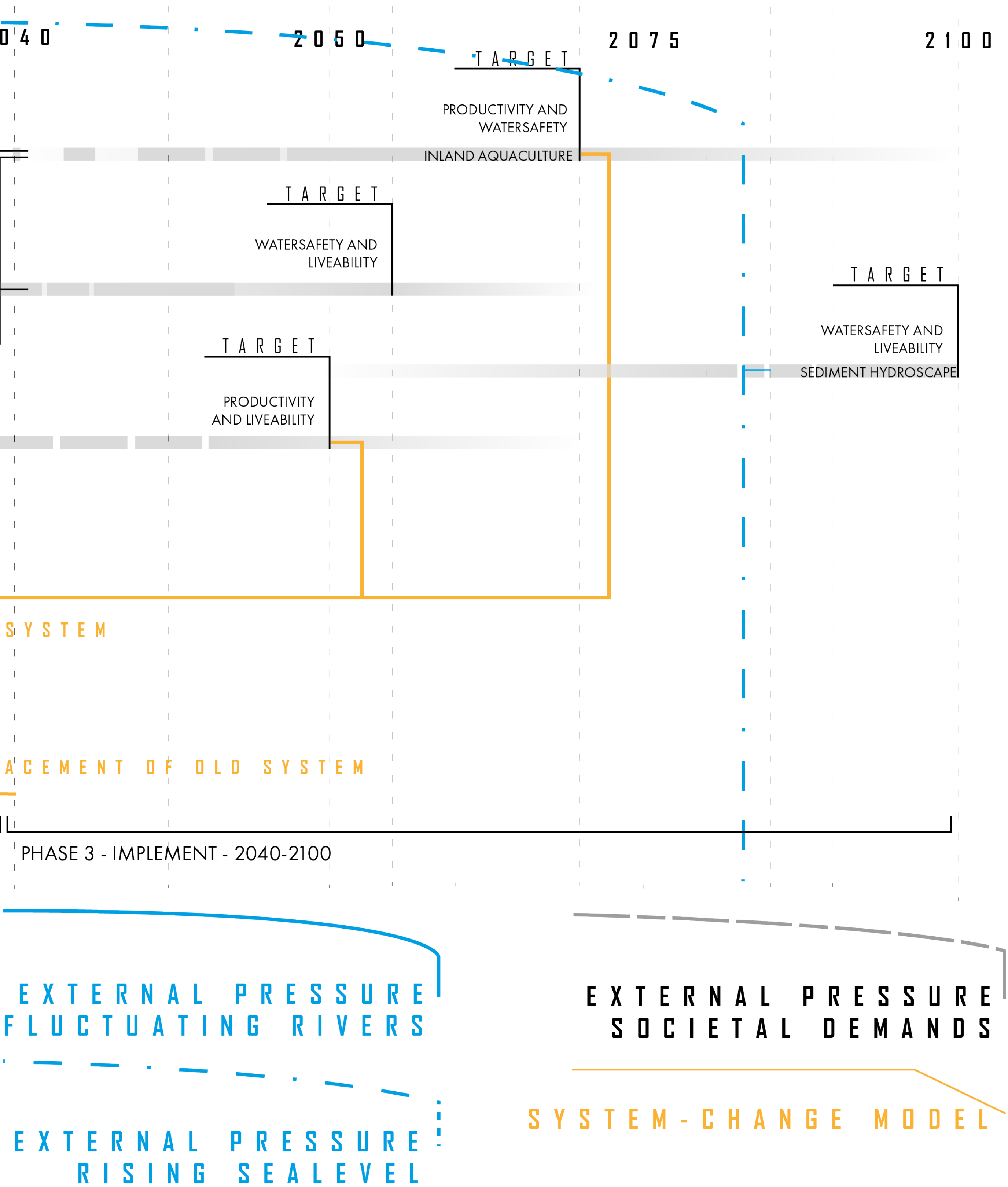


 Figure 4.1.1.1.: Vision implementation time-line. Figure by author

and has a more detailed explanation of the strategic projects. There is a focus on more detailed phasing, the type of involvement of stakeholders, and the implications on the chosen location.



4.1.2 PHASING

PHASE 0: SPACE CLAIMS

As explained, the building pressures of global food demand, floodrisk and society, have a catalyst effect on the interventions of this strategy. The consequences of the climate crisis are already visible in the south of the province, sea water pressure changes underground flows and increases soil salinity (Haasnoot et al. 2017). That is why both decision-makers and farmers are already very aware of pending changes, and interested in new production solutions (Staff of the Delta Program Commissioner 2020). In the north, the building societal pressure demands a healthy living environment for both people and nature, while the increasing densification (1 mln homes task, among others) in cities commences. Although new housing programmes can be located in densified urban districts, it also pushes on current city limits. This pressures farmers, who are heavily spatially limited and try to maximally expand or use the space available for production, sometimes at the cost of the natural environment. The timeline shows these pressures coming in, and the changes they catalyze.

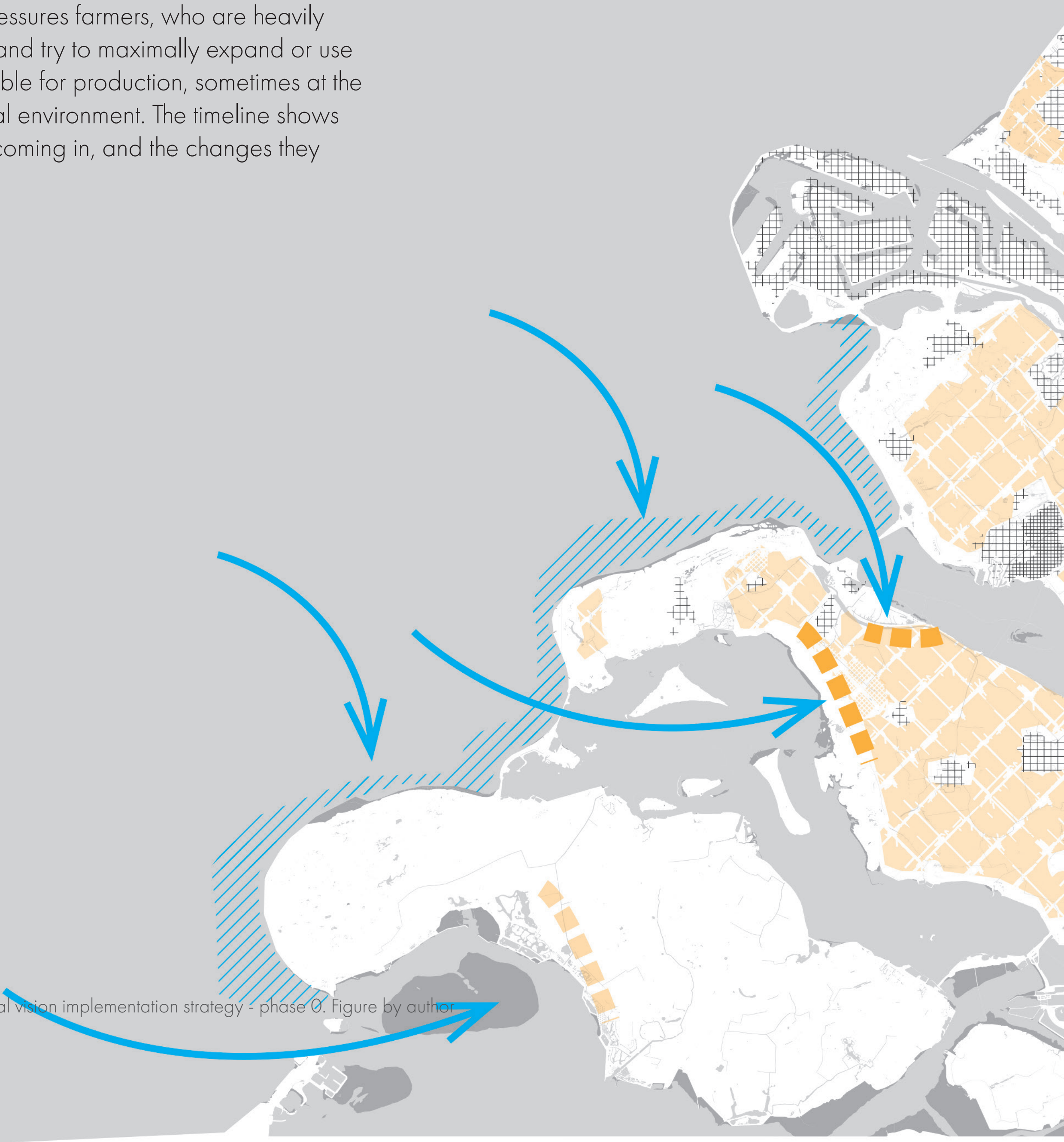
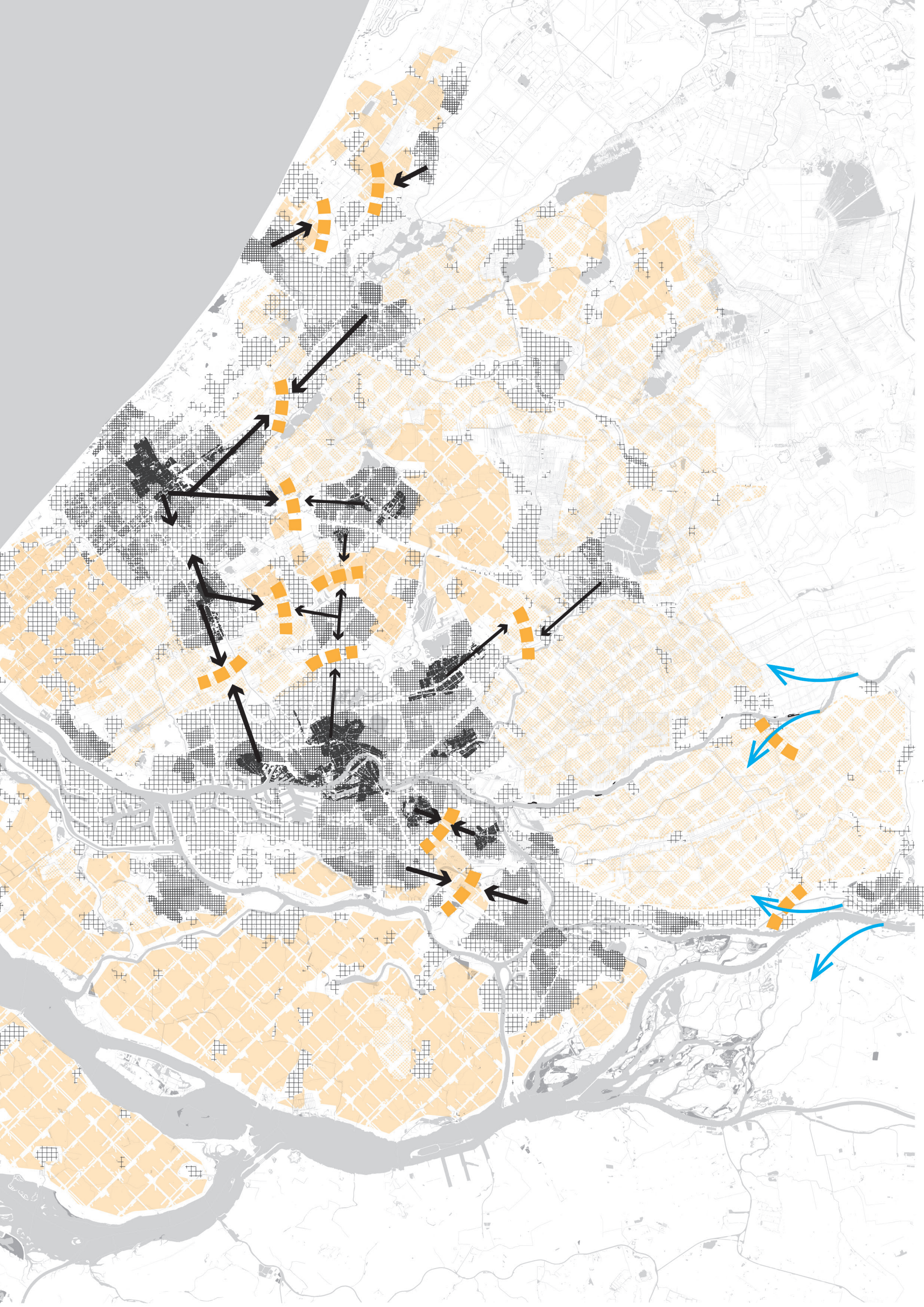


Figure 4.1.2.1: Regional vision implementation strategy - phase 0. Figure by author

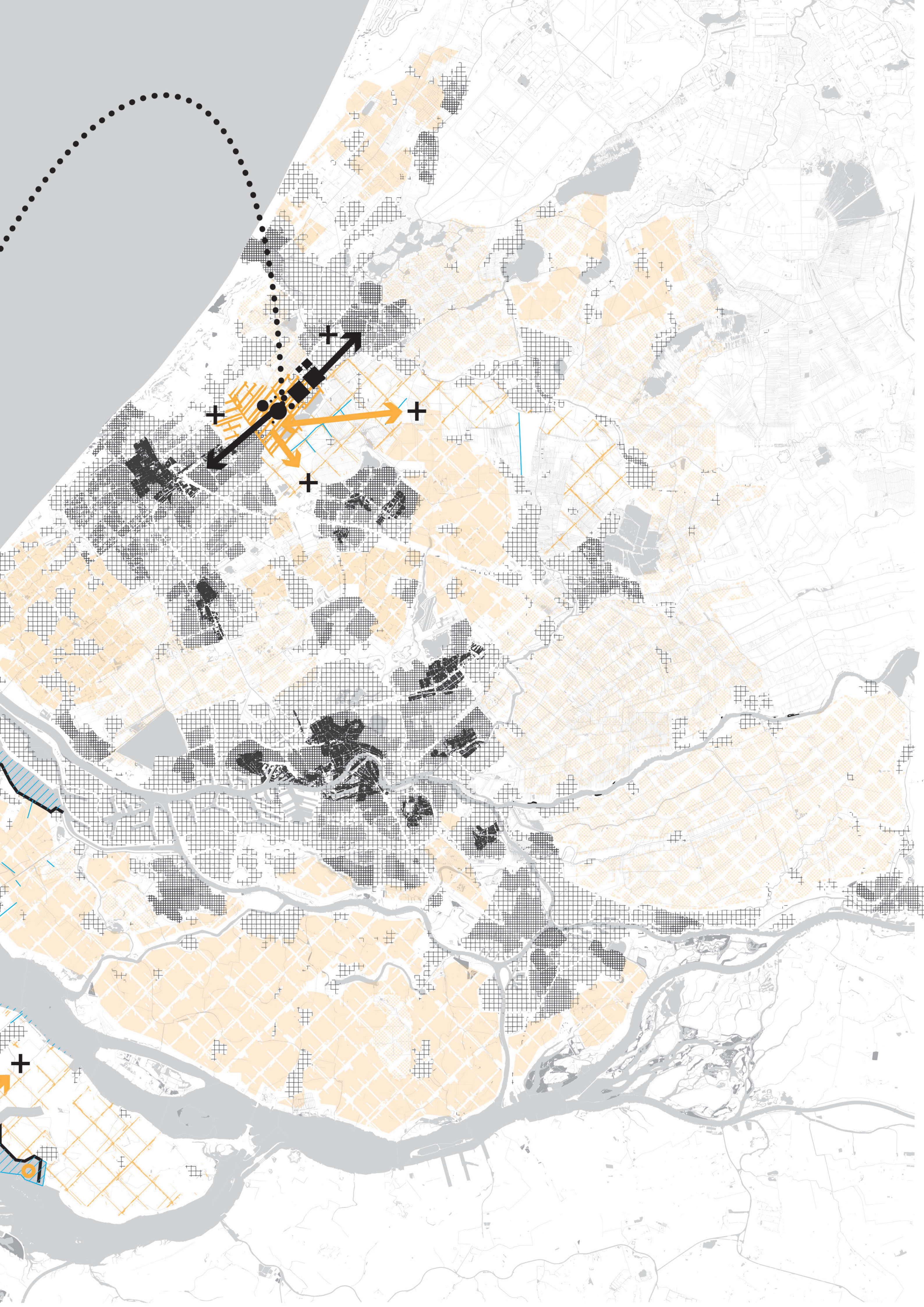


PHASE 1: INITIATE

The two strategic projects are placed at key locations in the province. The **SEASIDE AQUACULTURE** intervention at Goeree-Overflakkee, a location vulnerable to the water system. Combined with the presence of research projects already started regarding Seaside Aquaculture, the island provides good ground for starting the production of seaweed on a larger scale and enriching it for local food production.

An attractive place for the **AGRICULTURE KNOWLEDGESCAPE** intervention is the Voorschoten area along the main railway line between The Hague and Leiden; a mix of agricultural land and the Groene Hart - Coastal Dune corridor. The creation of an attractive park for urban residents combined with a food production development center will give the opportunity to promote the latest methods of growing food both in and outside the city. It will also help to develop awareness needed to influence the dutch food culture- and promote healthier products for itself as well as for Dutch agriculture and the environment. These two strategic projects will, as the timeline shows, kickstart the spatial and operative changes in the current agricultural model.

Figure 4.1.2.2: Regional vision implementation strategy - phase 1. Figure by author



PHASE 2: DEVELOPMENT

Seaside Aquaculture on Goeree-Overflakkee is continuously developing, farmers are able to feed their cattle the needed seaweed to produce more dairy on a smaller surface. The greenhouse horticulture is starting to convert to a circular business model, pushed by societal demands and awareness for a more environmentally friendly food production process. This implementation of the new production method is lead by the Agriculture Knowledgescape in Voorschoten, where both producers and consumers are acquainted with the concepts. The first **AGRICULTURE PRODUCTIONSCAPES** arise.

As the timeline shows, the Seaside Aquaculture and Agriculture Knowledgescape will create a synergy in the development of the new system, which will form under the urban- and waterpressures. The pressures also push for the start of the **POLDER HYDROSCAPES.** Water pressure in the lowlying delta increases. Floods and droughts intensify, the need for filtration- and storage capacity grows. The first Polder Hydroscape pilot projects get started.

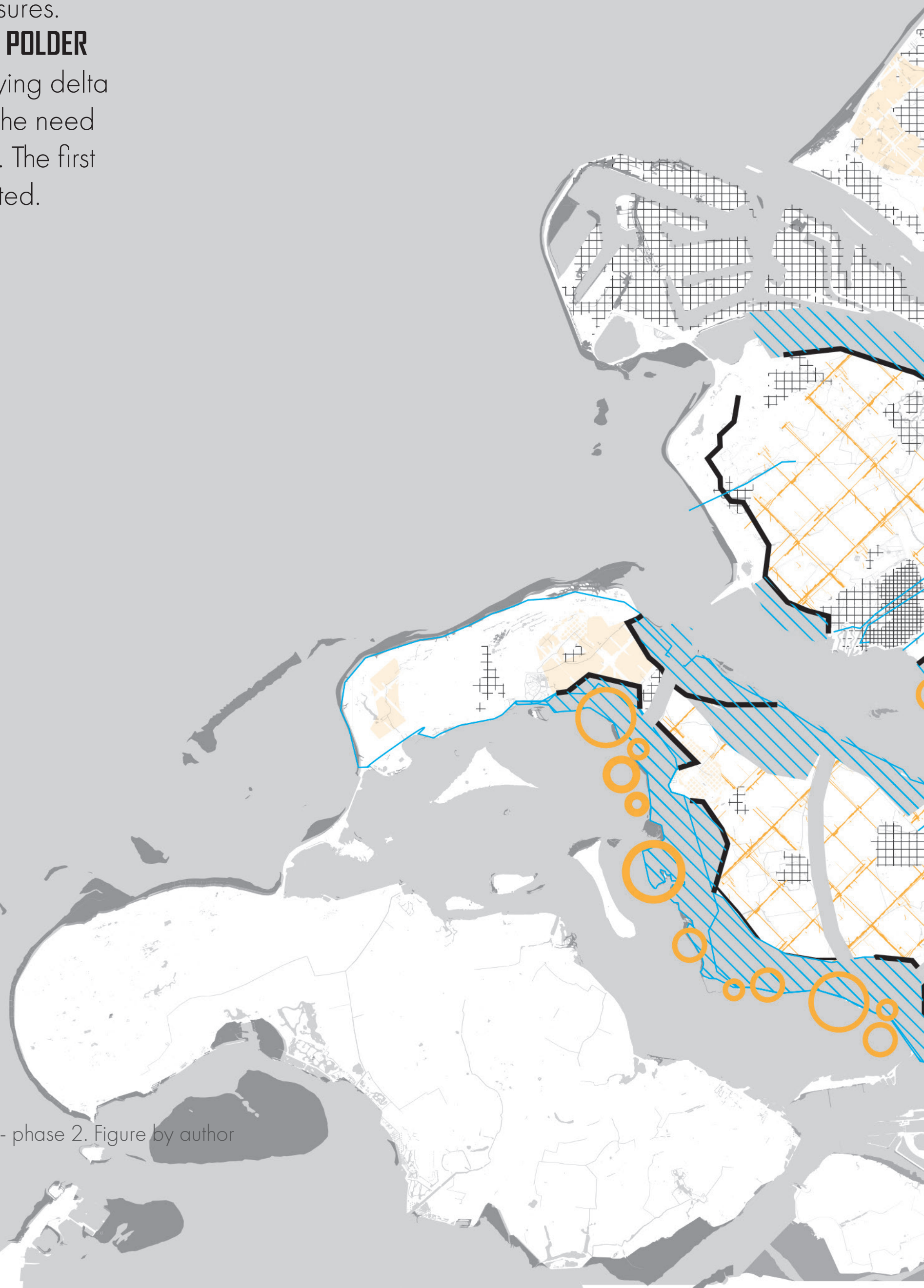
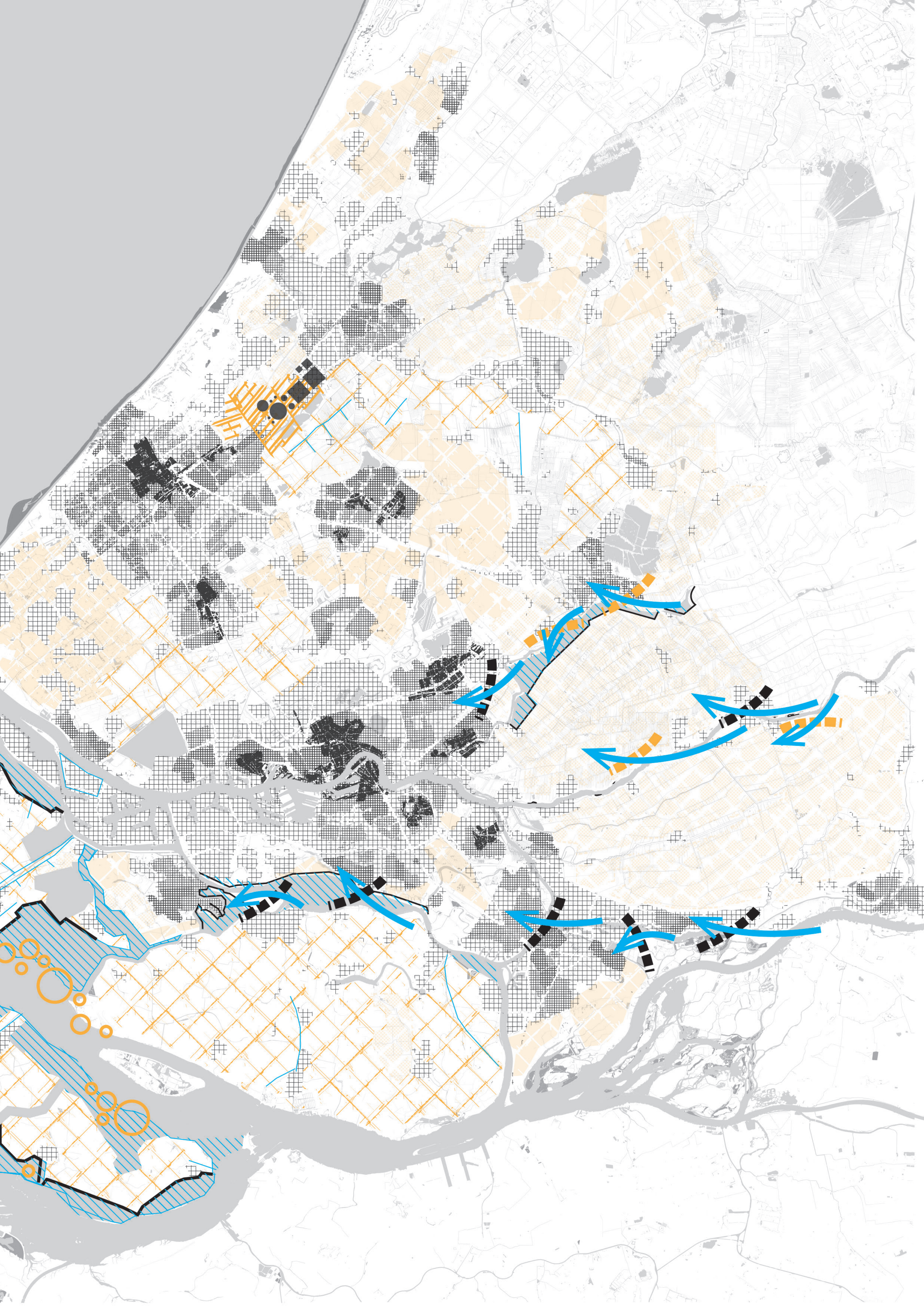


Figure 4.1.2.3: Regional vision implementation strategy - phase 2. Figure by author



PHASE 3: DIVERSIFICATION

The transitional territories in the province are rede-veloped, combining watersafety, sponge capacity and productivity. At the same time, the rising seale-vel starts to eat away at our costs. A more natural way to protect our shores is developed by creating a series of small artificial cays and sandbars; the **SEDIMENT HYDROSCAPE.** This secondary line of defen-ce allows for a constant sedimentation on the main shores by natural hydrological systems.

Pressured by the inland water, changes appear in soil conditions and groundwater flow, which create the necessity to develop inland water retention re-servoirs. In these waterscapes, **INLAND AQUACULTURE** can be developed to still be able to use the land in a productive way. The densified cities stand as islands in this new typical dutch landscape, compri-sed of hydrologically engineered wetlands with high natural and health values - and highly productive agricultural areas.

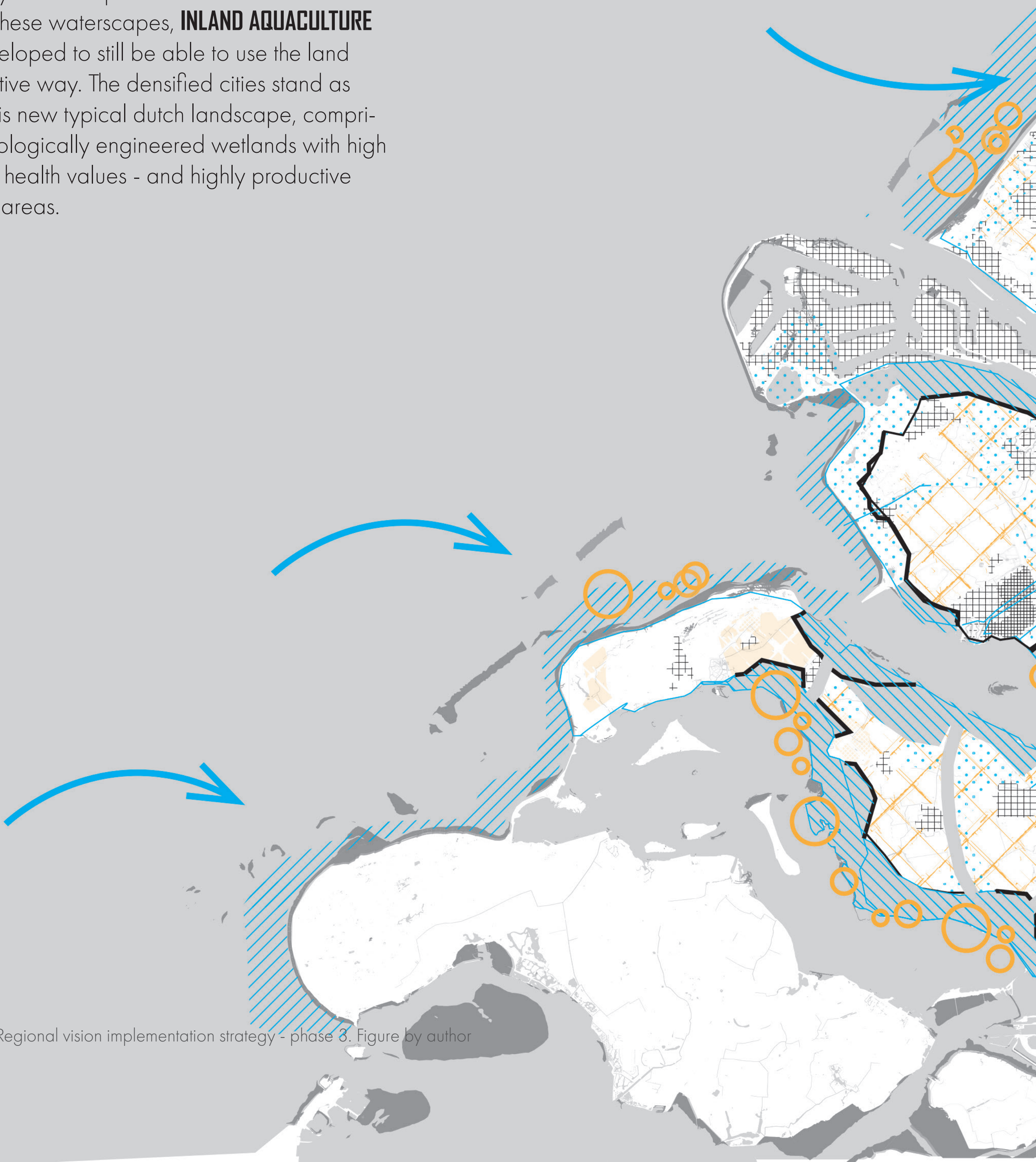
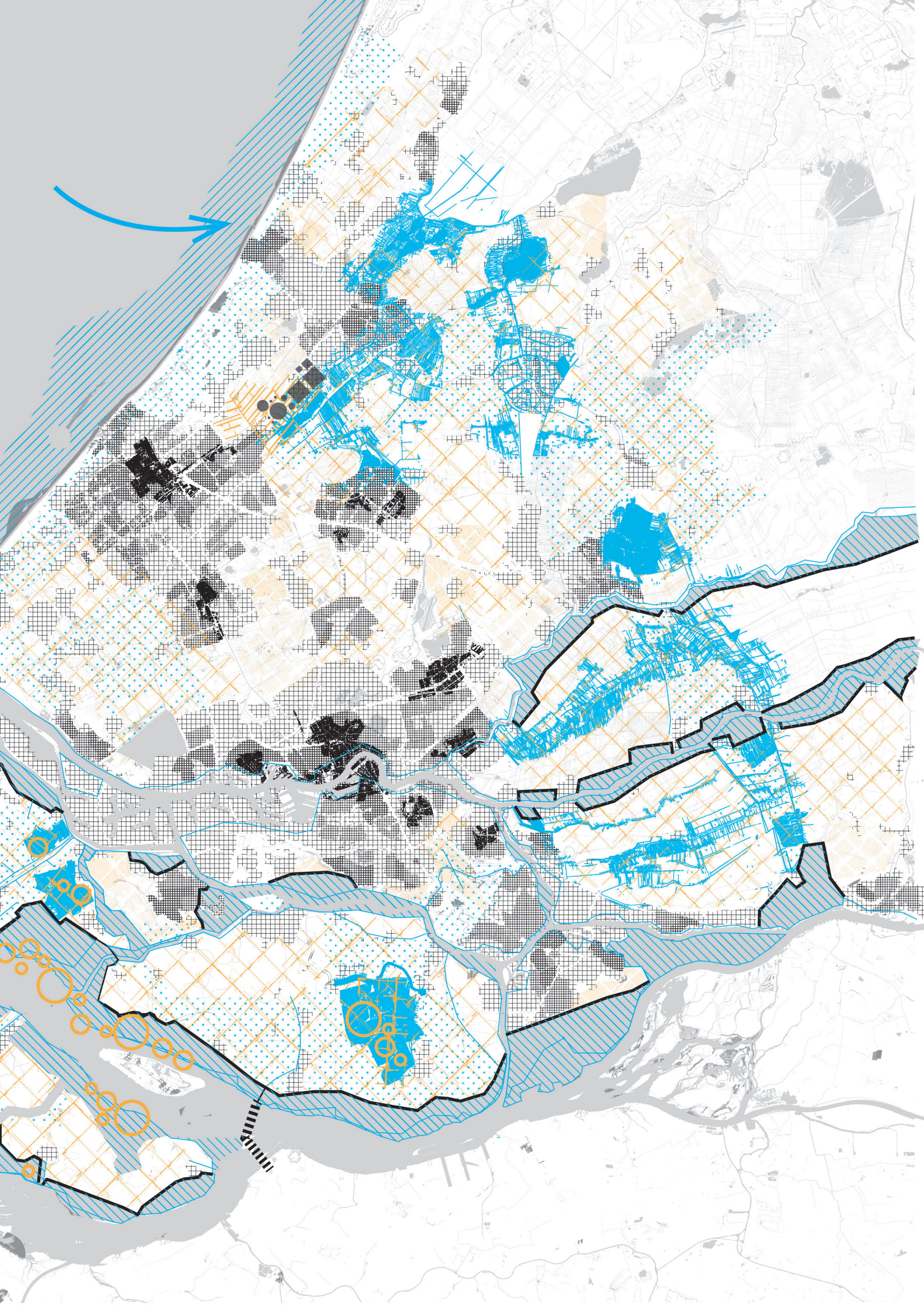


Figure 4.1.2.4: Regional vision implementation strategy - phase 3. Figure by author



4.2 REGIONAL STAKEHOLDER ANALYSIS

As for every type of regional project, this project has to deal with a large number of stakeholders. These stakeholders can be either actively or passively involved in the project, as is shown in figure 4.2.1, which indicates a stakeholder meeting. Stakeholders sitting at the table are either already more actively involved, or are stakeholders that need to be actively involved to realize the vision. The passive stakeholder is mainly involved as being an instrument, for example, the european union can provide subsidies, or aquaculture initiatives can be used as an example for both new farms as well as residents of the region.

The table is divided into the three space claiming sectors; agri-food, urbanisation and watermanagement. From each sector, the most important stakeholders are briefly described.

AGRI-FOOD SECTOR

In this sector, the stakeholders that are most influenced by 'Growing Smaller' are the farmers and landowners. A large amount of land will have to be (temporarily) available for water retention resulting in a needed shift in use of the land. This also accounts for farmland. This, together with the change to a new agri-food production system places a need for farmers to cooperate in using new production methods.

URBANISATION

In the urban areas it is the resident that wil be most influenced, and are therefor also an important stakeholder to take into account in the desicionmaking. The goal of creating a livable city has everything to do with the needs and wants of the residents to live a healthy lifestyle. Current residents have to be involved in local implementation desicions to ensure these needs fit the location.

WATERMANAGEMENT

A main focus in watermanagement in the provinces safety from the water threat imposed by climate change. On the other hand, there is a need for a connection with water, instead of pushing it out. This is where the waterboard becomes an important stakeholder: to preserve water quality, create more green-blue systems and still ensure safety for the residents of the province.

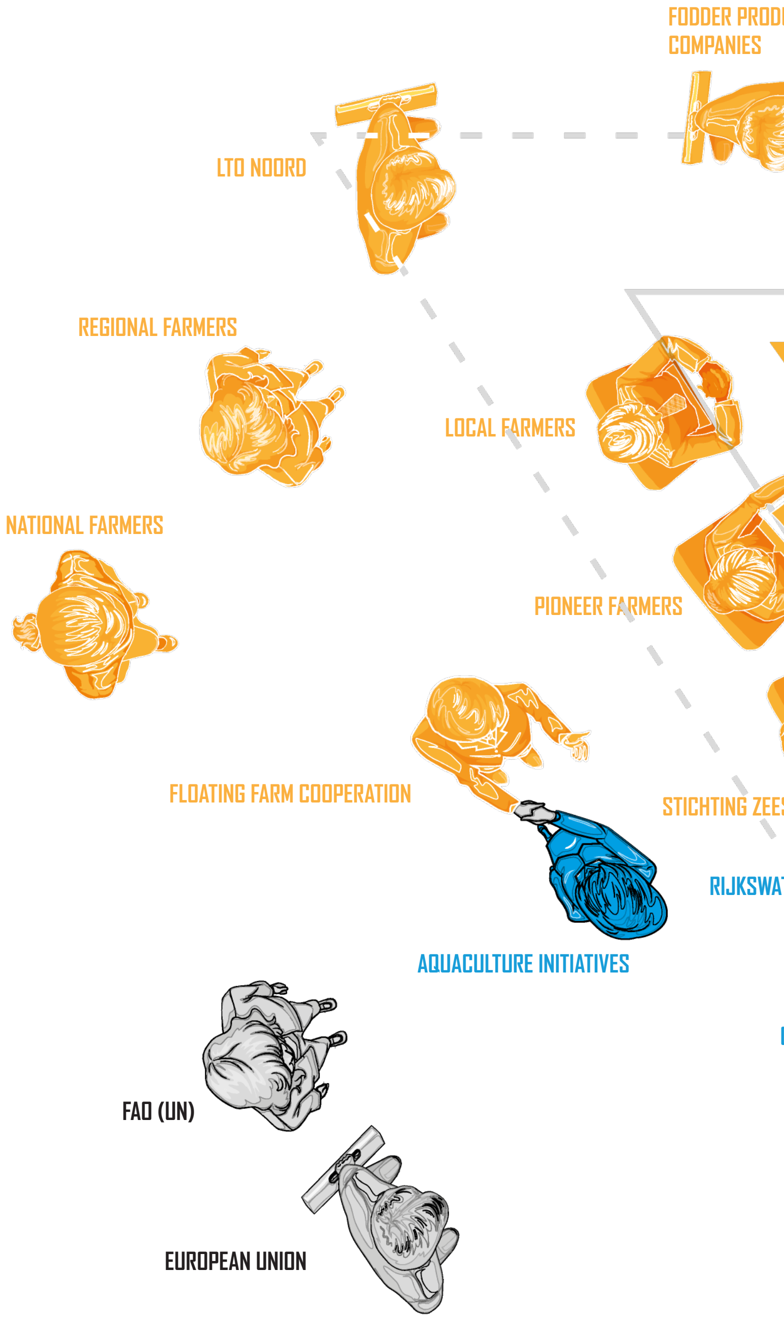
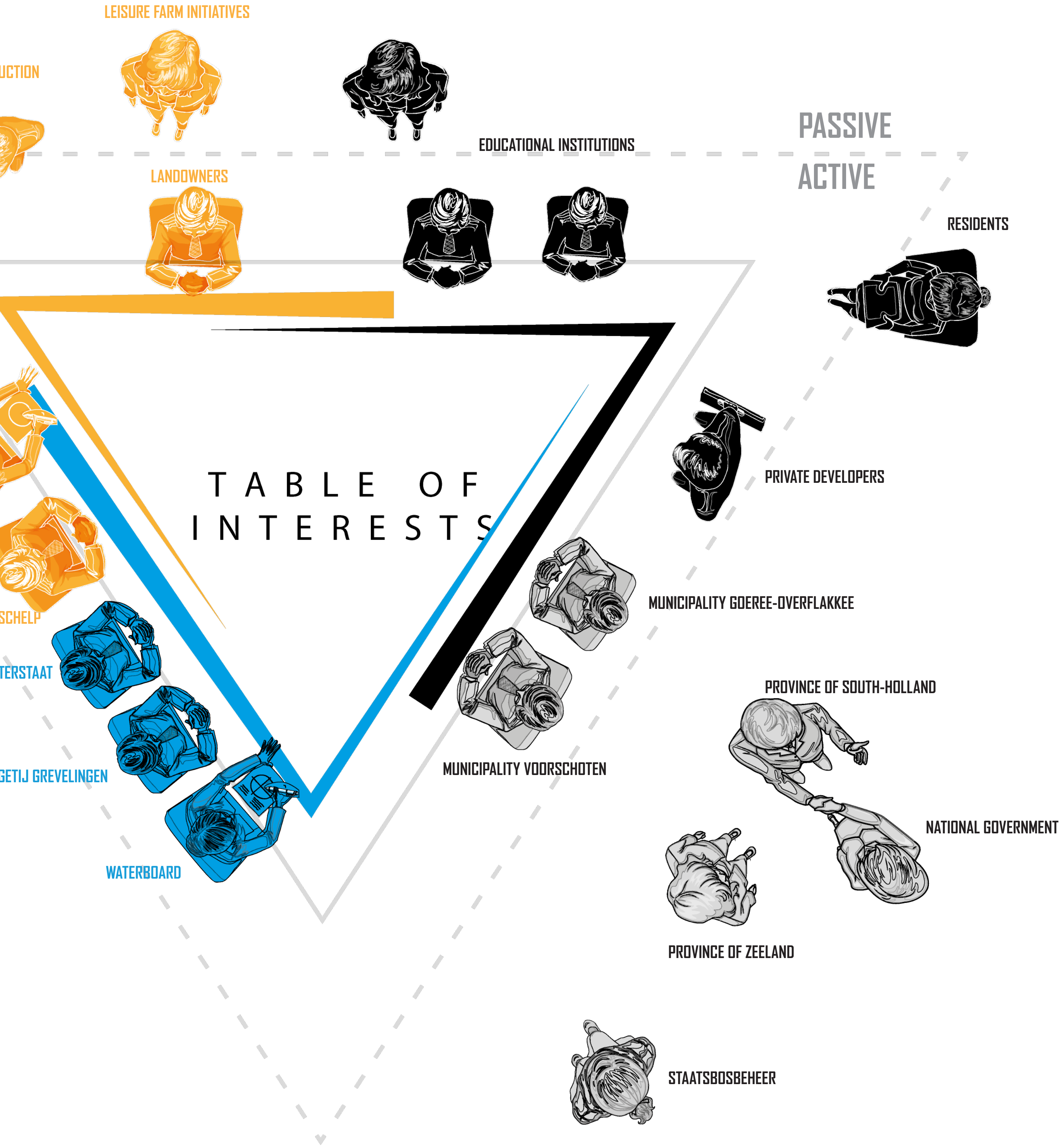


Figure 4.2.1: Regional stakeholder involvement



LEISURE FARM INITIATIVES
UCTION
EDUCATIONAL INSTITUTIONS
PASSIVE
ACTIVE
LANDOWNERS
RESIDENTS
TABLE OF INTERESTS
PRIVATE DEVELOPERS
MUNICIPALITY GOEREE-OVERFLAKKEE
SCHELP
TERSTAAT
PROVINCE OF SOUTH-HOLLAND
GETIJ GREVELINGEN
MUNICIPALITY VOORSCHOTEN
NATIONAL GOVERNMENT
WATERBOARD
PROVINCE OF ZEELAND
STAATSBOSBEHEER

4.3 STRATEGIC PROJECTS

4.3.1 SEASIDE AQUACULTURE GOEREE-OVERFLAKKEE

Seaside aquaculture is one of two strategic projects to realize the growing smaller vision. The project builds on existing (local) projects to kickstart the transition into the new circular agri-food system for South-Holland. Aquaculture production, and in particular seaweed production, are set up in the Grevelingenmeer. Local farmers from different agri-food sectors are involved to work in and/or with the new water-based production sector. A market for this sector is to be created, where the project places its focus on aquaculture in food production, consumption and research into other possible uses.

The project also prepares the local economy of Goeree-Overflakkee for new conditions and challenges. For one, there will be a redevelopment of the water protection system, giving more space to the water in a controlled system when needed. The saltwater in the area will also cause the need for a change in agricultural crops, which are more prone to higher soil salinity numbers. How this will all come about will be explained in more detail in the following pages.

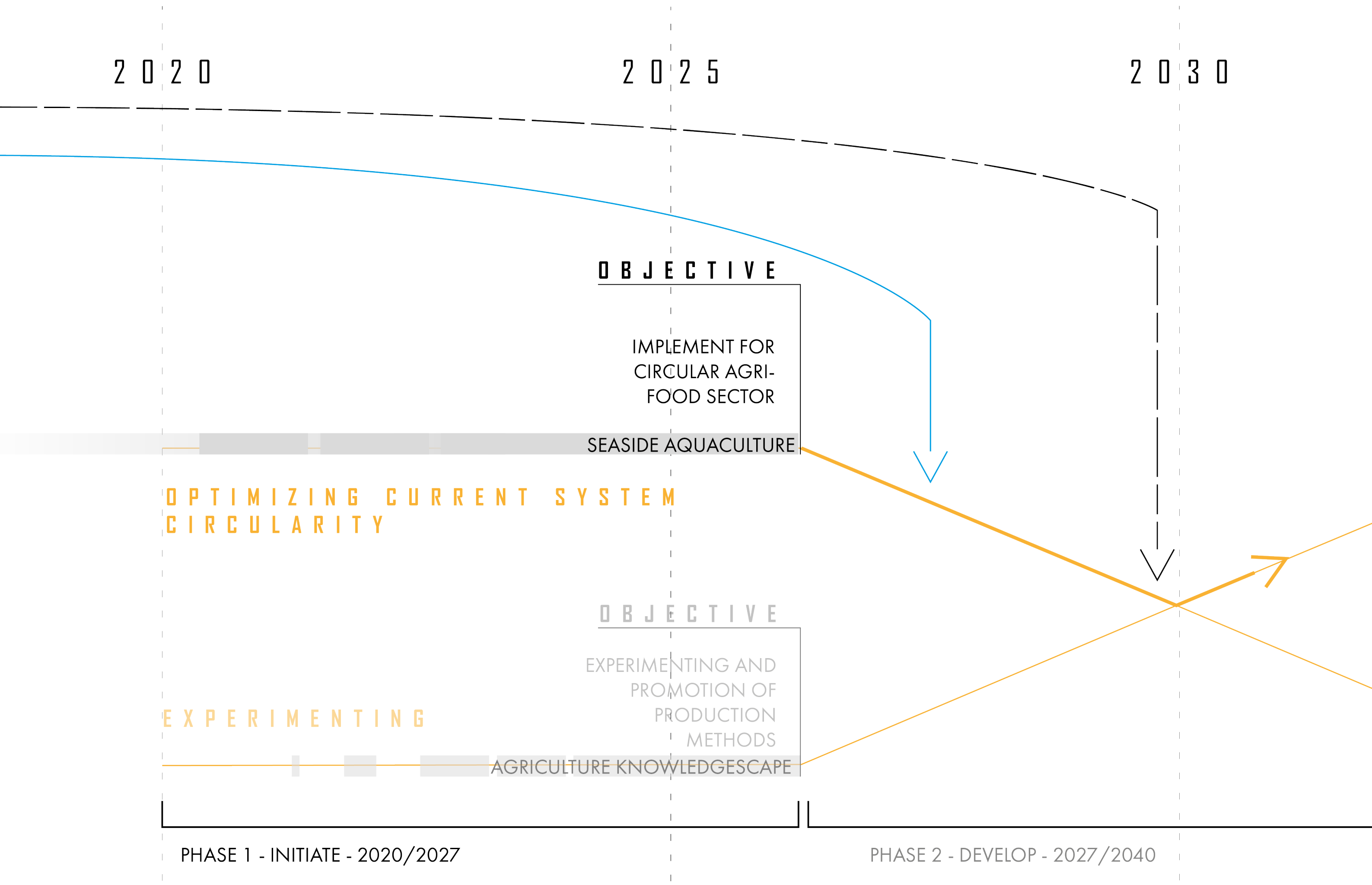


Figure 4.3.1.1: Position of the seaside aquaculture project Goeree-Overflakkee on the time-line. Figure by author

PROJECT LOCATION CRITERIA

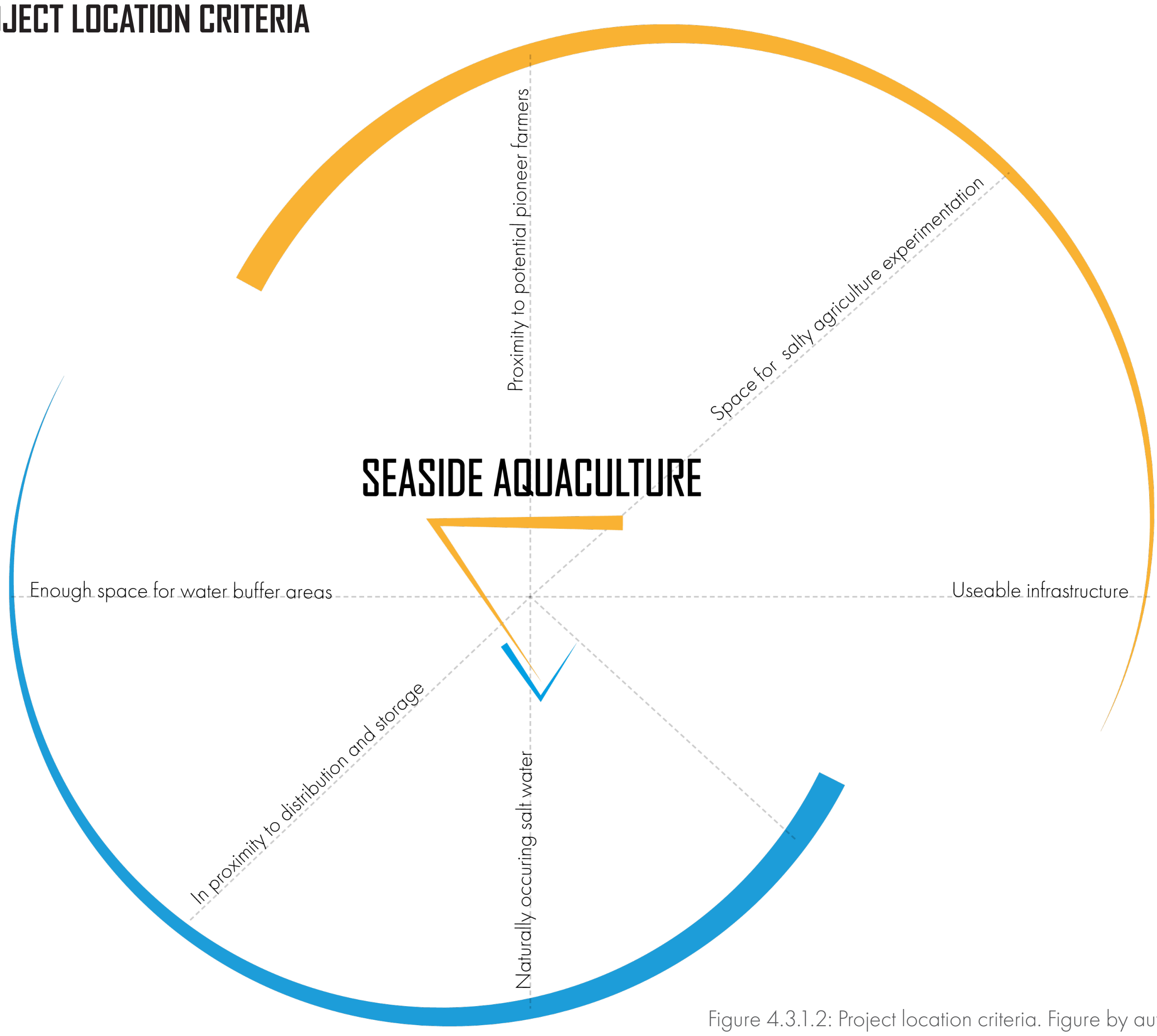


Figure 4.3.1.2: Project location criteria. Figure by author

- **NATURALLY OCCURRING SALTWATER**
  The location has space in a saltwater system where the setup of aquaculture food production can take place.

- **POSSIBLE LOCATIONS FOR ON-LAND AQUA CULTURE EXPERIMENTATION**
  Aqua-culture production does not only take place on existing water bodies, but also has potential on future flooded areas, which are also fit as a water buffer zone.

- **ACCESS TO LOCAL PIONEER FARMERS WITH POSSIBLE INTEREST IN CIRCULAR AGRI-FOOD PRODUCTION**
  Local farmers have to get involved in the project to be able to kickstart the change to the circular agri-food system.

- **POSSIBLE LOCATIONS FOR WATER BUFFER AREAS ON LAND**
  Water buffer areas are needed to create a more natural cooperation between people and water and still being able to ensure safety for people and food production.

- **IN PROXIMITY TO STORAGE AND DISTRIBUTION FOR THE AQUACULTURE PRODUCE**

  The existence or possibility of storage space close to aquaculture production site and proper distribution possibilities are key to properly implement aquaculture into the system and culture.

- **USEABLE INFRASTRUCTURE**
  For distribution of agricultural products and for recreational access to the area for both locals as well as tourists.

GOEREE-OVERFLAKKEE NOW

Since the Netherlands has changed their water protection management approach to be more in line with nature, the process had to be diversified and more fragmented in implementation and decision making. Adaptation of land on large surfaces, the complexity of the whole process requires greater involvement of local authorities and stakeholders (Staff of the Delta Program Commissioner, 2020). The situation of Goeree-Overflakkee is characteristic in this context where the municipality and the province work together in an area program which enters into a dialogue with various parties on the island to find ways to change negative impacts from the climate crisis into opportunities. For example, to concentrate the sweet water resources, one project in Integrated Planning and Design in the Delta (IPPD) creates an alternative channel with fresh water from the upper parts of the river to create sweet water bodies in the center of Goeree- Overflakkee (Meyer, 2015).

Another example is the Getij Grevelingen project. After the Grevelingen was closed off from the sea, the water quality started to decrease; there is a lack of oxygen in the water due to the disappearance of the tides. This lack of oxygen causes a dying out of animals at the bottom of the Grevelingen, removing an important link in the food chain and ecosystem. A controllable gap will be made in the 'Brouwersdam' to bring back the tide in the Grevelingen. Only a partial tide will be let in to ensure safety from the water for residents around the Grevelingen (Getij Grevelingen, n.d.).

Besides an active Goeree Over-Flakkee municipality, local farmers are also already aware and involved in the changes to a more sustainable food production. Companies like 'Breen agrarisch bedrijf' or 'Wou! Onze (H)eerlijke Zuivel' build the attractiveness of their company and product based on being a sustainable entrepreneurship with organic production.

Close to the Goeree, Zeewaar, located in Zeeland, is an organisation working on putting together a chain of sustainable seaweed farms along the coast of Europe. They have started this chain with a seaweed farm in the Oosterschelde, Zeeland. They have started with a small test production system and will increase this with the years (Zeewaar, n.d.).

These activities in the area give the project interesting stakeholders that can be involved in the starting phase of the project to give it an impuls. These, and other stakeholders are mentioned below and their relation to the porject can be seen in the power, interest, support scheme in figure 4.3.1.3.

PROJECT STAKEHOLDERS

GOVERNANCE

European Union
National government
- Ministry of Agriculture, Nature and Food Quality
- Ministry of Infrastructure and Water Management

Province South-Holland
Province Zeeland
Municipality Goeree Over-Flakkee

PUBLIC SECTOR

Waterboard
Rijkswaterstaat
Natura 2000
Staatsbosbeheer
Land- en Tuinbouw Organisatie Nederland (LTO)
- Land- en Tuinbouw Organisatie Noord

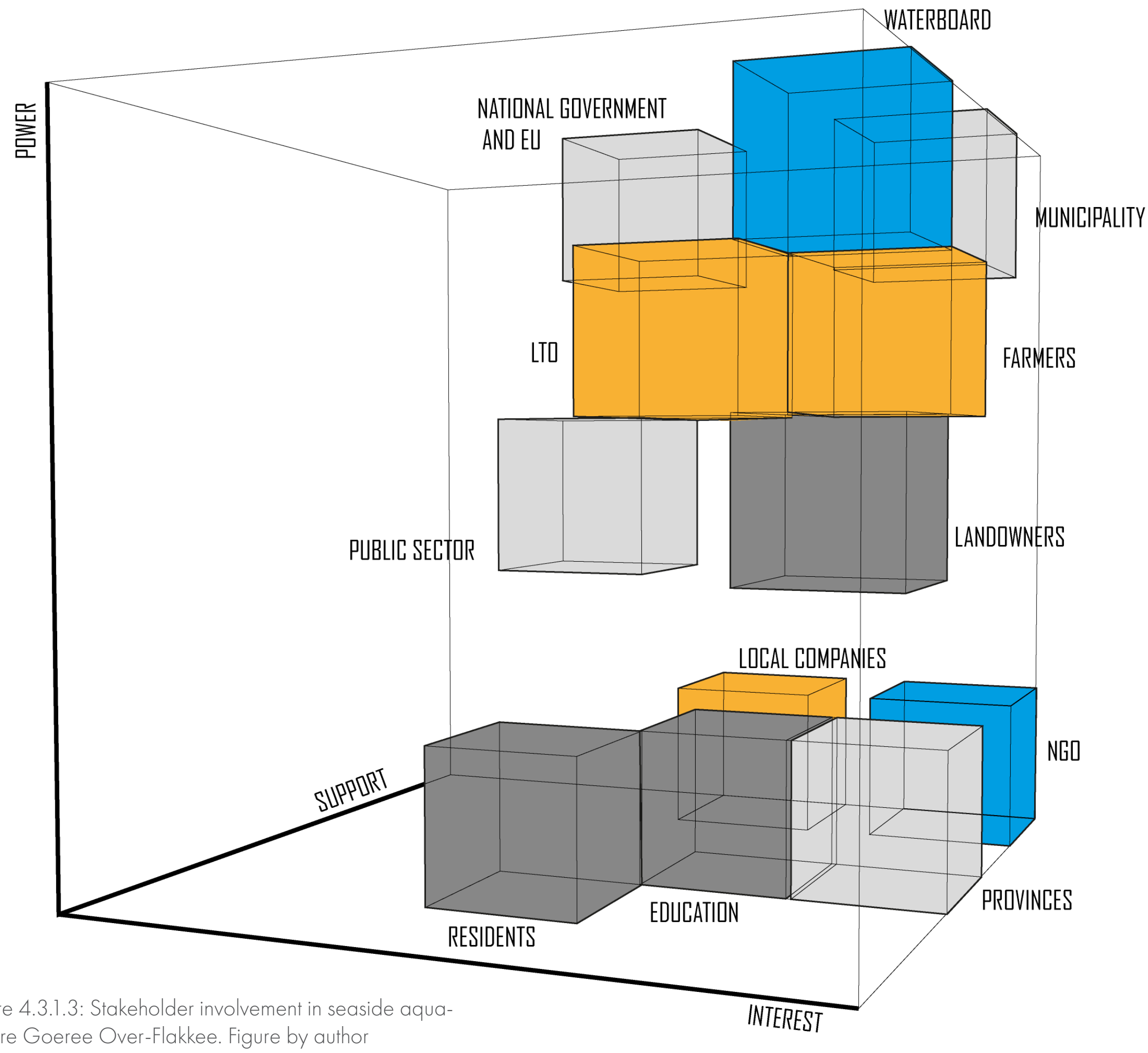


Figure 4.3.1.3: Stakeholder involvement in seaside aqua-culture Goeree Over-Flakkee. Figure by author

PRIVATE SECTOR
Farmers
Local companies
Zeewaar Zeewierboerderij (Seaweedfarm)

NGO
Getij Grevelingen
Stichting Zeeschelp

EDUCATIONAL SECTOR
Wageningen University and Research
Hogeschool Zeeland

CIVIL SOCIETY
Residents
Land owners

TIME-LINE

As can be seen in figure 4.3.1.4, the project will be divided into four phases: 1. Integration and support, 2. Implementation, 3. Development and 4. Distribution. The most intensive phases for the local area of Goeree Over-Flakkee will take place from 2020 to 2035, after which the project places its focus on regional and national implementation.

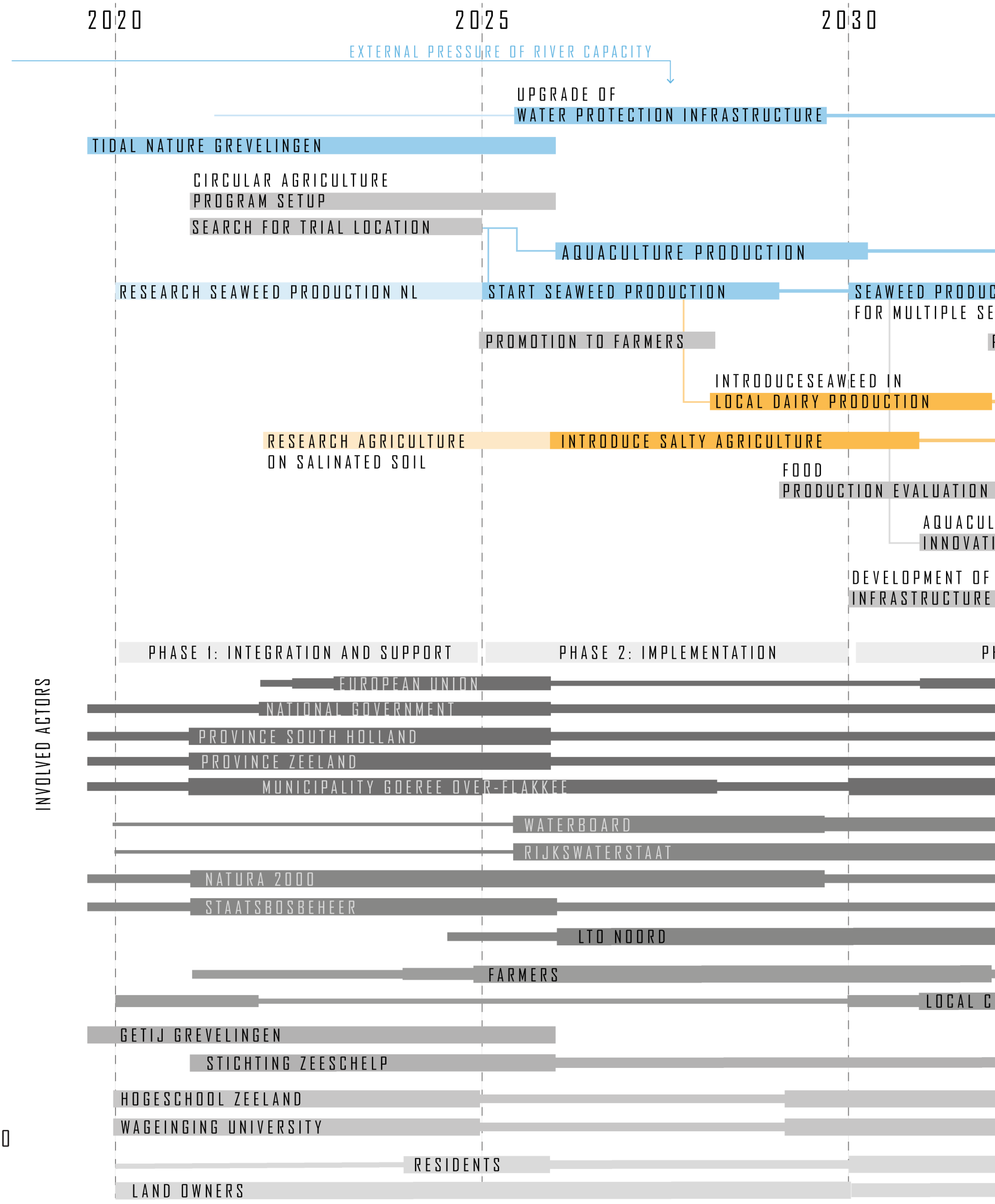


Figure 4.4.1.4: Seaside aquaculture Goeree-Overflakkee time-line. Figure by author

STAKEHOLDER ENGAGEMENT AND PROJECT INSTRUMENTS

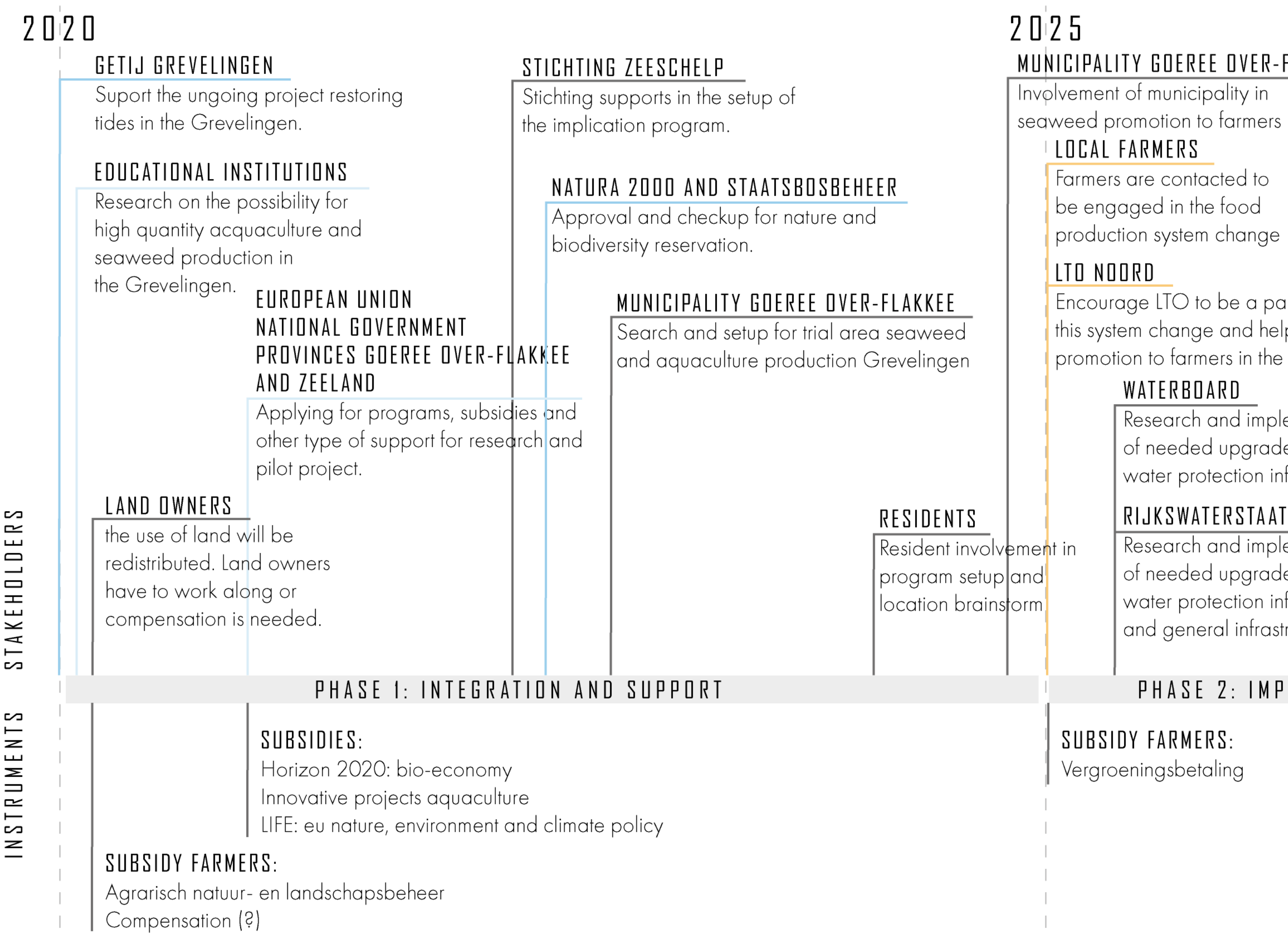
For this project, stakeholders can be divided into local stakeholders and external stakeholders. Local stakeholders would involve residents, landowners, farmers, local companies and the municipality of Goeree Over-Flakkee (as exception to other governance stakeholders). External stakeholders are governance, public sector, NGO's and educational institutions. The exact moments of involvement of each stakeholder in the project process is shown in the diagram below (figure 4.3.1.5).

LOCAL STAKEHOLDERS

It is of importance to involve the local stakeholders in as many phases of the project as possible, as it is their living and working environment that will be changed. In this area, landowners will be some of the hardest stakeholders to get involved as their land will either become a location for water buffer zones or will have a higher rate of salinization in the soil causing a prominent change in the land use. Together with the municipality of Goeree Over-Flakkee, decisions will be made on locations of aquaculture projects and recreational development of the area. Local farmers and residents will be involved in this process and give input in the development of ideas.

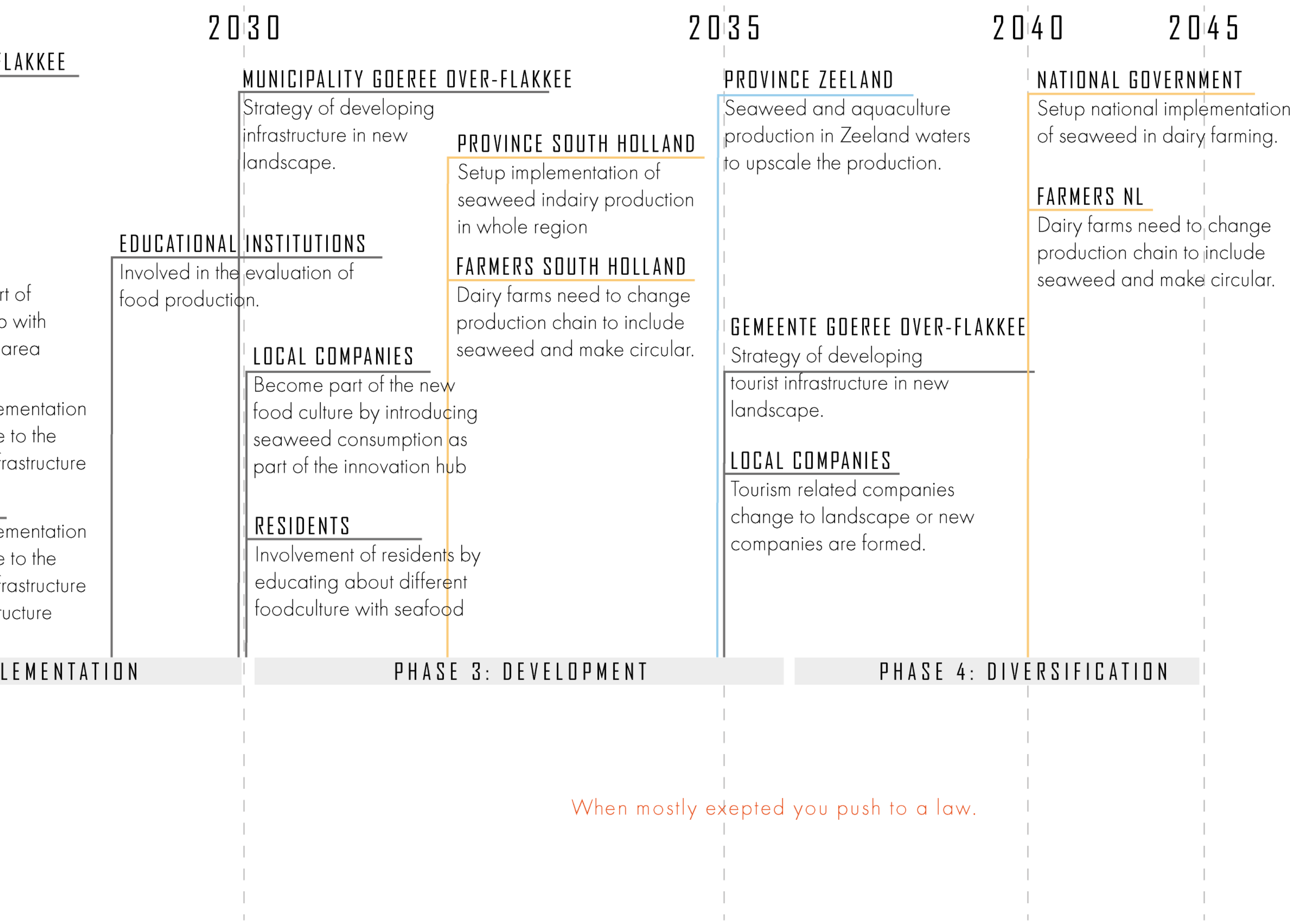
EXTERNAL STAKEHOLDERS

External stakeholders are involved in the setup of the project and financing. GNO's are involved as the starting points of the program, either because of research or started projects in the Goeree Over-Flakkee area. Educational institutions are also involved for their research on the aquaculture and



agri-food sectors. Governance organizations such as the EU and UN are reached out to for the financing, including subsidies for landowners and farmers active in the project. Other governance actors are, next to financing, also involved in the implementation of the project.

Figure 4.3.1.5: Seaside aquaculture Goeree Over-Flakkee stakeholder involvement and projects instruments placed in time. Figure by author



PHASE 1: INTEGRATION AND SUPPORT

In the first phase, the project starts by supporting two current projects in the area: Getij Grevelingen and Zeewaar seaweedfarm which are both crucial for setting up the right environment and system for seaweed production in the Grevelingen. Stichting Zeeschelp will be contacted to be an active stakeholder (figure 4.3.1.6) with setting up the project program and will look for a possible pilot location for the seaweed production together with the municipality of Goeree Over-Flakkee, Zeeland province and local stakeholders. A proposed location is the Grevelingenmeer, as shown in figure 4.3.1.7. Since part of the project requires the possibility of letting more water onto the land, landowners have to be involved in this part of the project to find out their interests and possible compensation possibilities.

To create a productive seaweed production system, more research has to be done on seaweed production in the Netherlands, and particularly in the Grevelingen. This research is done by the Hogeschool Zeeland, who focus on both aquaculture and seaweed, and Wageningen University and Research, where they focus on the biota in the area and aquaculture production.

In the meantime, the future increase of saltwater in the Grevelingen will cause salination of the soil on Goeree Over-Flakkee. To ensure that the agriculture can continue its current productivity, farmers need to be able to produce crops that are adapted to the new soil salinity, which is currently ongoing research for the Netherlands.

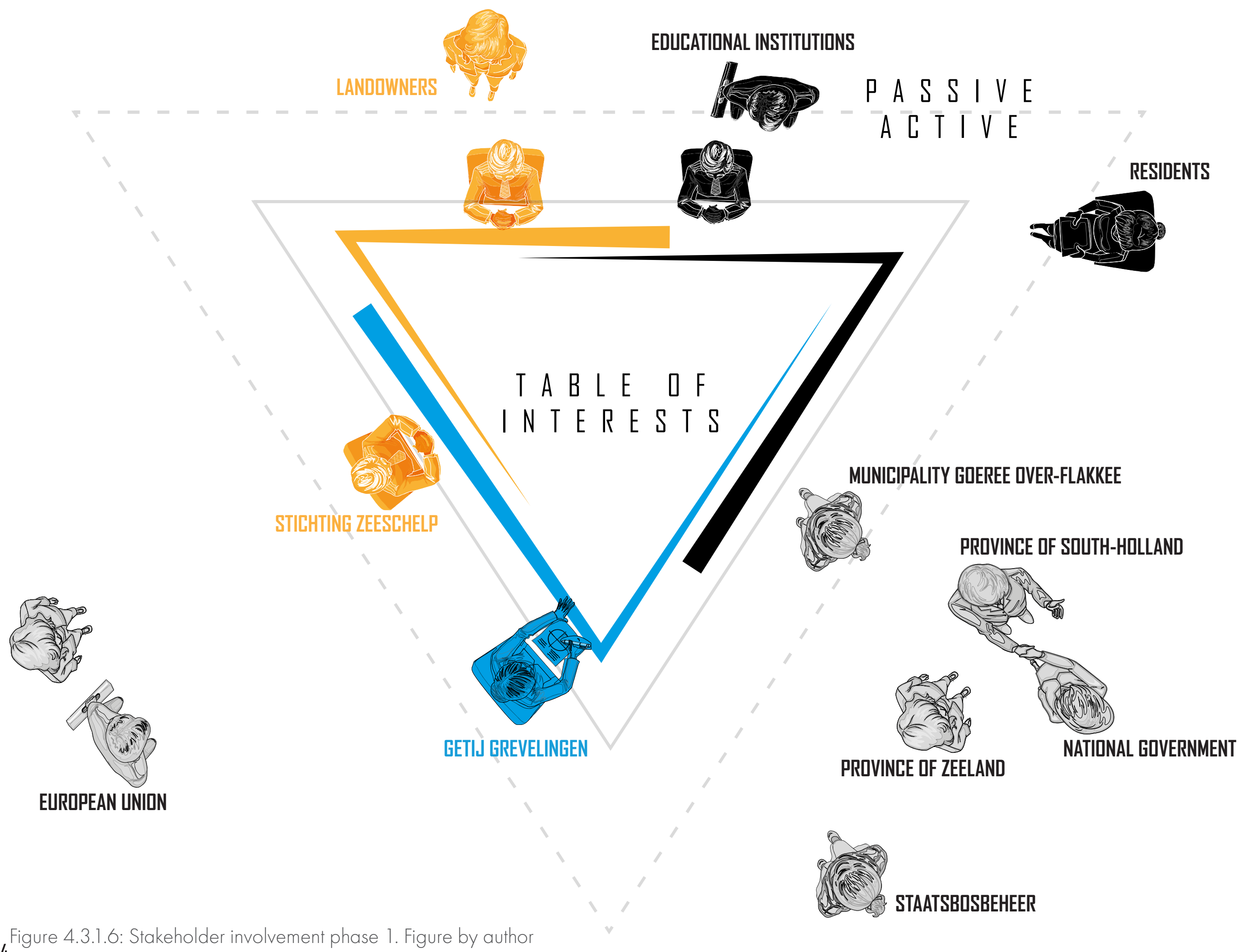


Figure 4.3.1.6: Stakeholder involvement phase 1. Figure by author

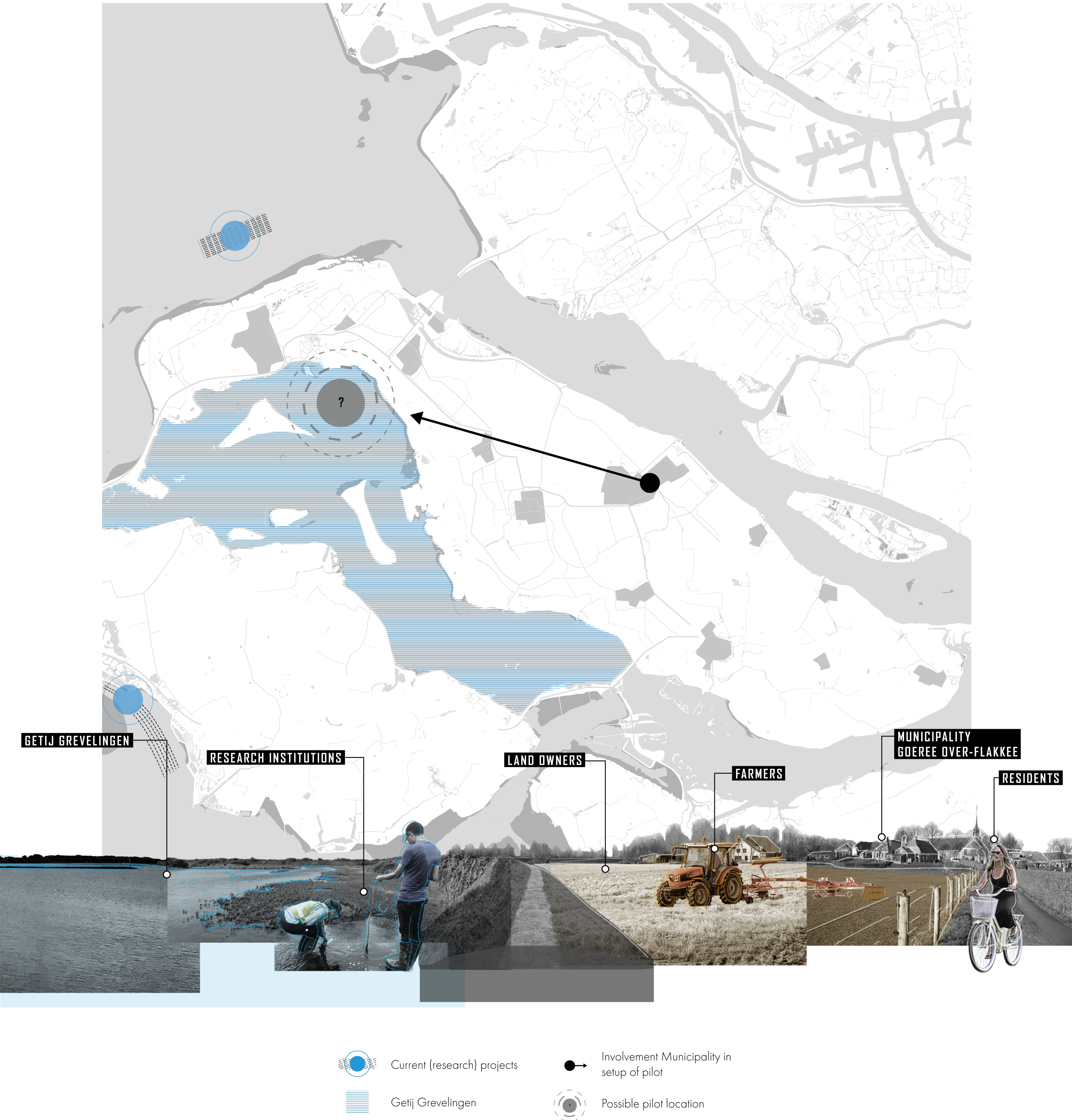


Figure 4.3.1.7: Spatial project implications, phase 1. Figure by author

PHASE 2: IMPLEMENTATION

In 2025, the seaweed production pilot has started in the Grevelingen (figure 4.3.1.9). This start also indicates the time to promote the new food production system further to the local farmers that are not yet involved in the project. The importance and different possible uses of seaweed and other aquaculture products in all different sectors is explained, starting with the dairy production sector. The pilot includes cooperation with local dairy farmers, as indicated in the map, to innovate on the use of seaweed in fodder. There will also be a change in agricultural crops that are produced in the area to crops that are more tolerant to high salt levels in the soil.

The pilot will be used as an example to local farmers in this phase and regional and national farmers in the next phases. It is therefore also of importance to start thinking of the possible market for new agri-food products that can be produced in the area and the different subsidies farmers can get for being involved in this new production system (such as subsidies for innovation in aquaculture).

In this phase, there will also be the first contact with the waterboard and Rijkswaterstaat (figure 4.3.1.8) to create detailed plans for the upgrading of the water protection system in the area. When needed, excess water will have a controlled overflow of water in between the first and second dike.

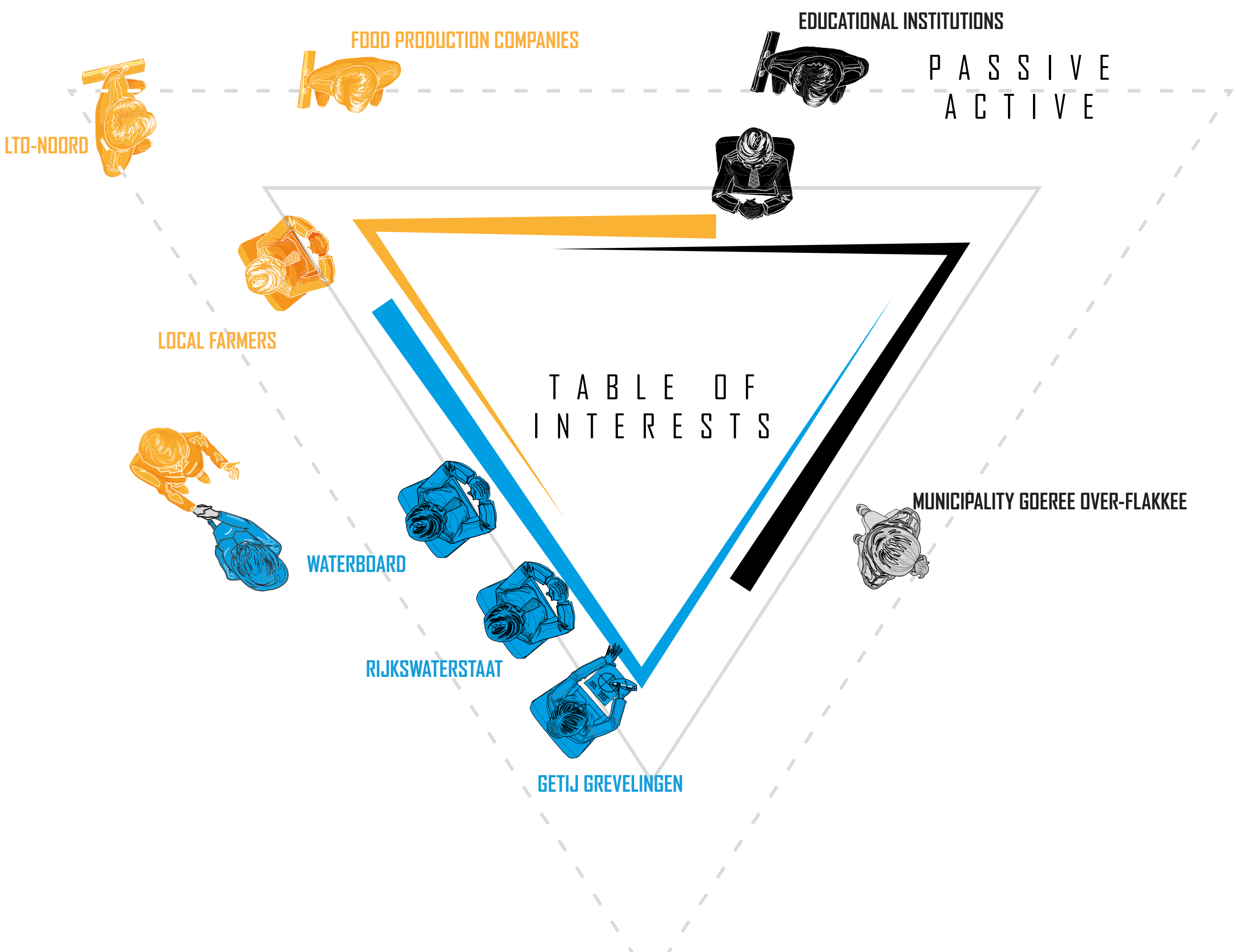


Figure 4.3.1.8: Stakeholder involvement phase 2. Figure by author

Figure 4.3.1.9: Spatial project implications, phase 2. Figure by author

PHASE 3: DEVELOPMENT

In the development stage, each part of this new food production system is developing to a larger scale as shown with the orange arrows in figure 4.3.1.11. Seaweed production will develop into a wider range of products to be used in different sectors (next to the agricultural sector): mainly consumption and medicine. These new consumption products need to become part of the new Dutch food culture, for which an innovation hub based on aquaculture is be implemented in the more urban regions. Seaweed will also be implemented into dairy fodder at regional scale. To do so, LTO Noord, the province and national government are contacted to set up a policy where seaweed becomes part of the dairy production chain (figure 4.3.1.10).

To be able to keep increasing the use of aquaculture products in different sectors, the distribution system has to be developed. Storage spaces, distribution centers and the right infrastructure have to be in place.

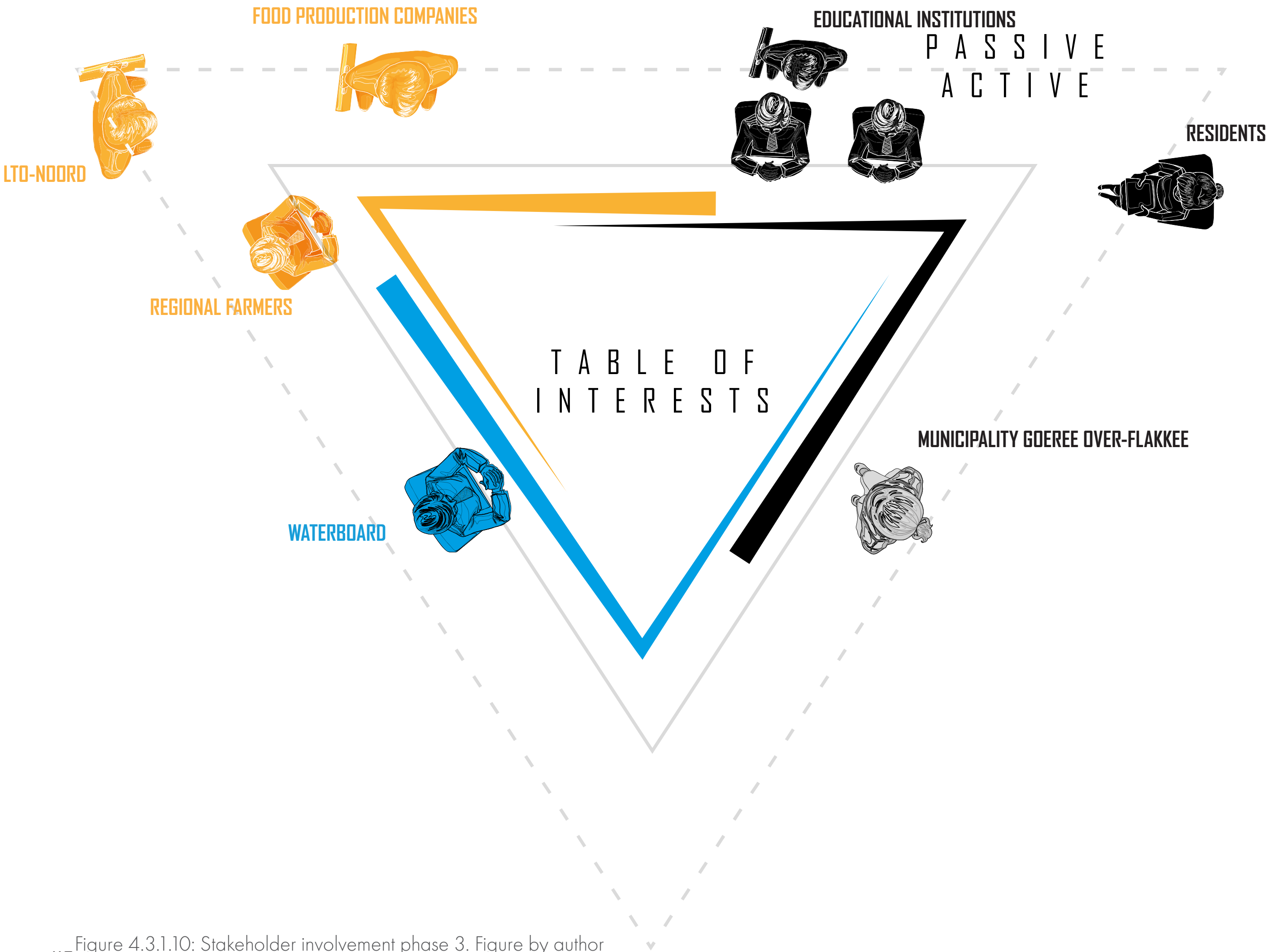


Figure 4.3.1.10: Stakeholder involvement phase 3. Figure by author

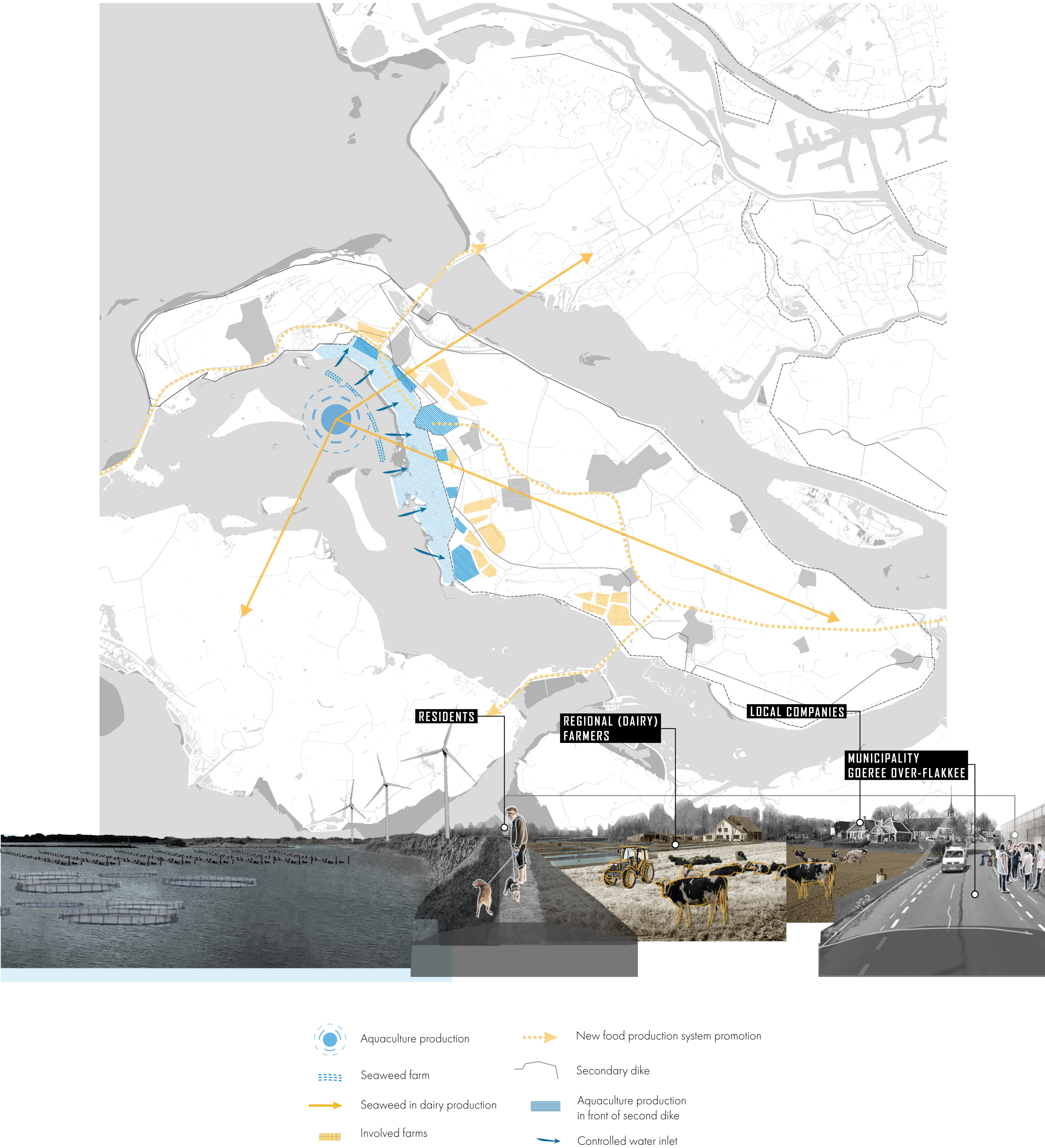


Figure 4.3.1.11: Spatial project implications, phase 3. Figure by author

PHASE 4: DIVERSIFICATION

The fourth phase mainly focusses on the final improvements of the new food production system, where the high production seaweed and aquaculture has to be in place to be able to produce enough protein sources for the region and for the circular agriculture system. When this is done, there is an implementation of seaweed in dairy production on a national scale (figure 4.3.1.13). To do so, regional farmers and national farmers need to be in contact about the circular agri-food system. The national government and LTO are involved to regulate the national agriculture production system (figure 4.3.1.12).

This new food production sector will also result in a new landscape typology with more water and different uses of that water. This new Dutch landscape and its innovative properties will be part of the tourist industry. Therefor tourist infrastructure and a setup of local (tourist) companies involved in this area are to be set up.

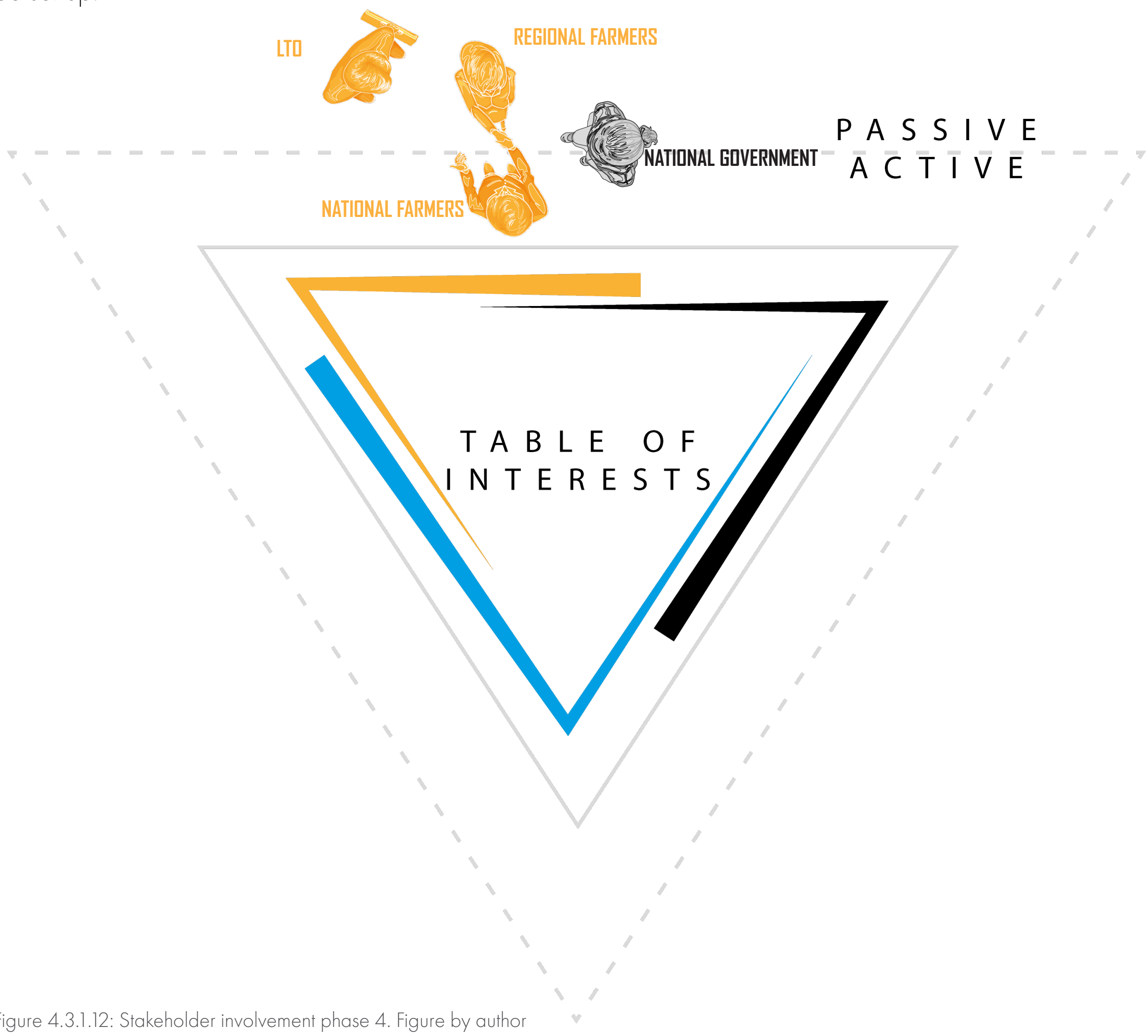


Figure 4.3.1.12: Stakeholder involvement phase 4. Figure by author

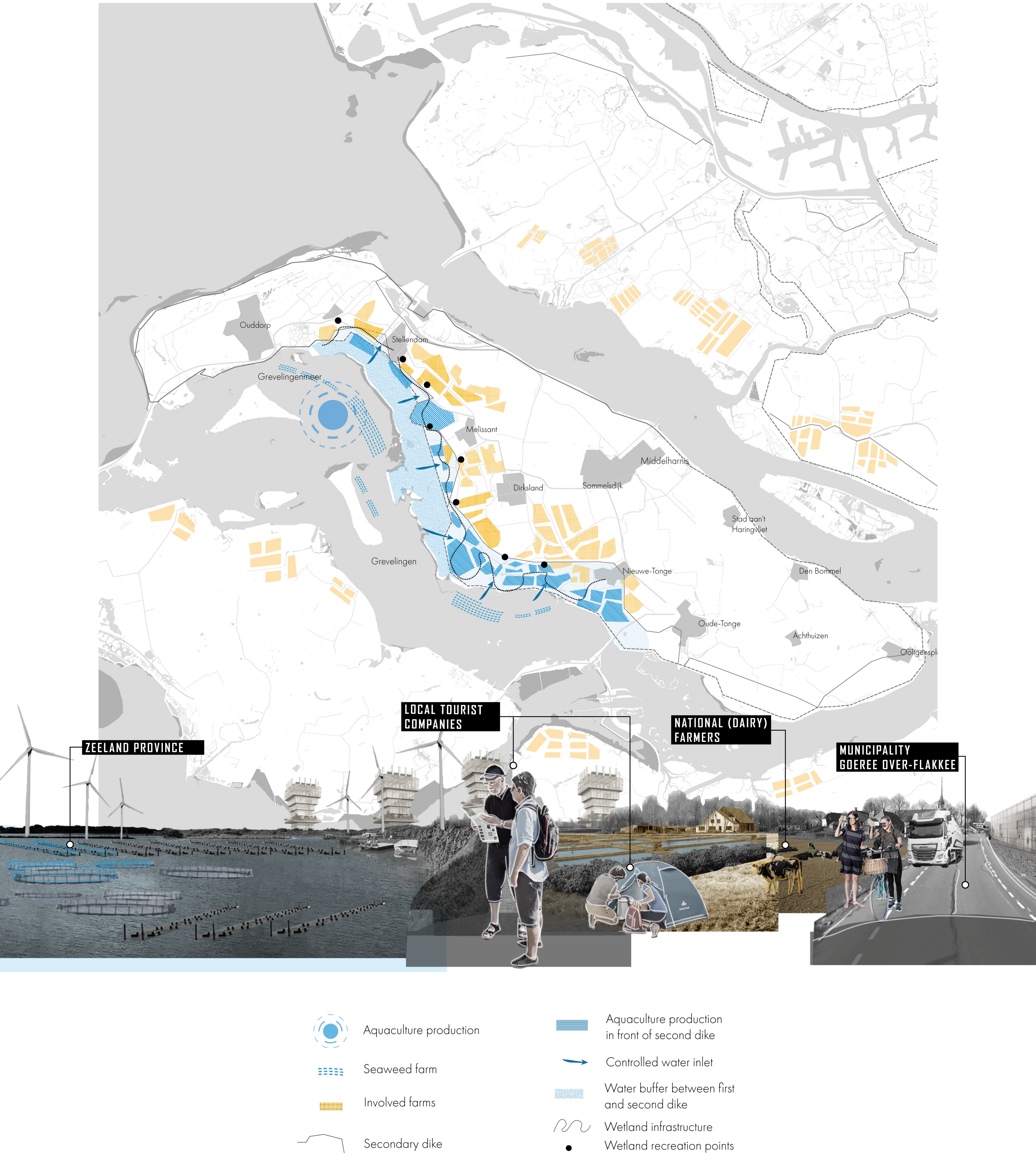


Figure 4.3.1.13: Spatial project implications, phase 4. Figure by author

4.3.2 AGRICULTURE KNOWLEDGE SCAPE VOORSCHOTEN

The second strategic project aims at implementing new agriculture methods in South Holland and to create a place for communication between stakeholder groups in the shift towards he new agriculture and flood protection system.

The Agriculture Knowledge scape Voorschoten will be the first Knowledge scape in the region. The Agriculture Knowledge scape is one of the six types of new landscapes that are explained in our vision. Knowledge scapes aim at combining recreation and food production in one place and involving consumers in the food production process.

But as the first knowledge scape, the Voorschoten project goes beyond the more generic characteristics of a knowledge scape. Unlike other knowledge scape, one of its goals is the development and experimentation with new agricultural methods. In this location these new agriculture methods and the landscapes that result from them will be promoted to farmers and the population. Furthermore, it aims at connecting researchers, farms and decision makers.

Finally, the knowledge scape serves as a central place for participation in the regional transition process. Here, inhabitants will get information about possible developments and get involved in participation processes that will be coordinated from this location.

Figure 4.3.2.1 shows the role of the knowledge scape for the overall strategy. It is one of the first measures to start, because here innovations are tested that will be further implemented in later stages of the strategy. Also farmers and the population are made aware of the necessity of this regional transition and how it can result in a positive future for the region. Beyond that, a regional participation process will be started here. The aim is to involve the population already at the beginning of the strategy.

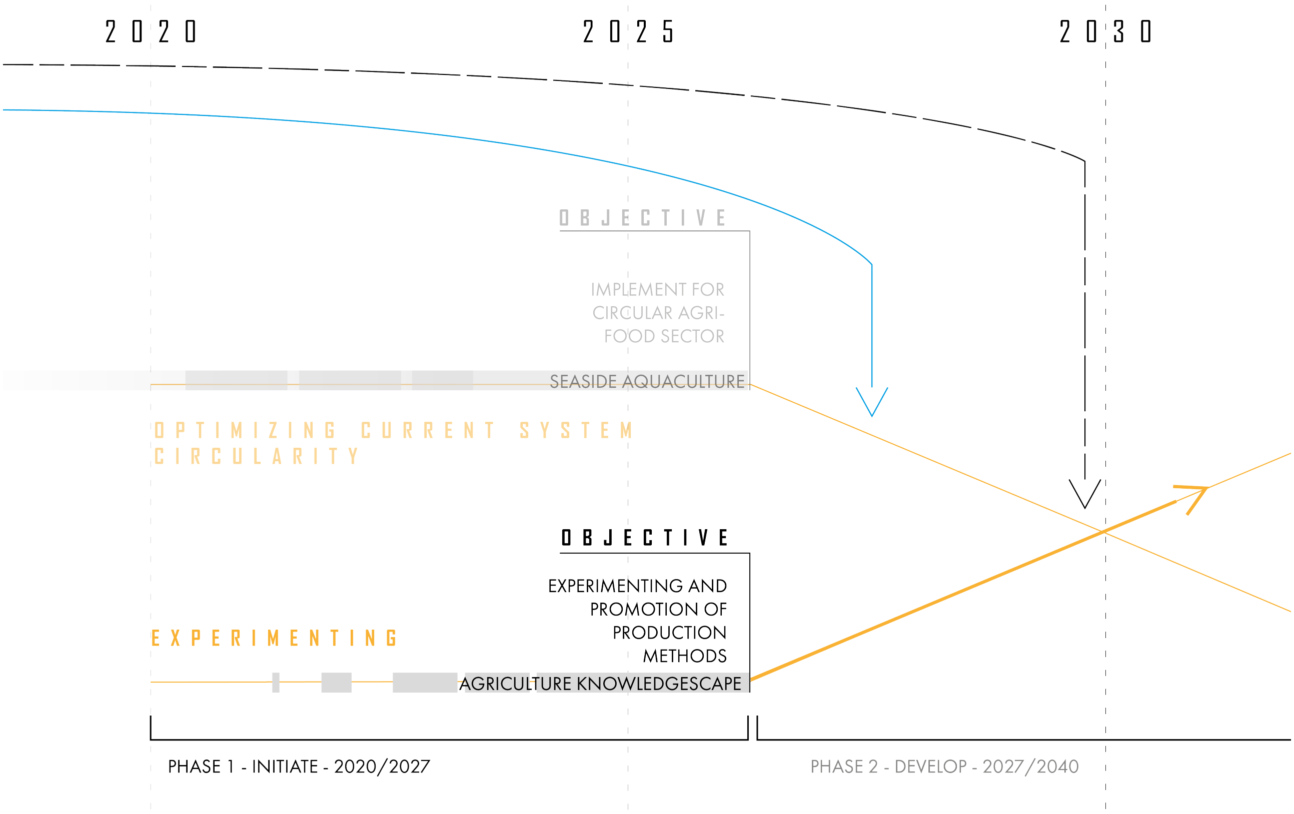


 Figure 4.3.2.1 The Agriculture Knowledge Hub as an impulse project for a knew agricultural regime. Figure by the Author

POTENTIAL LOCATIONS

INFRASTRUCTURE & PUBLIC TRANSPORT ACCESSIBILITY
The complete transportation network provides convenient conditions for the transportation of raw materials and products, also ensures the accessibility of urban residents, and strengthens the connection between agriculture knowledgescape and the city.

PROXIMITY TO CITY CLUSTERS
This enables hubs to be affected by the positive externalities of urban agglomeration and obtain resources and services of urban agglomeration Proximity to exisitng agricultural areas

PROXIMITY TO EDUCATION AND RESEARCH INSTITUTIONS
It is convenient for the commuting of high educated researchers, which promotes the accumulation of knowledge.

SPACE FOR RESEARCH, EXPERIMENTATION AN PROMOTION
In different phases, it is necessary to reserve flexible space for the construction of research centers, experimental farms, exhibition centers, and farm markets.

POTENTIAL TO INTEGRATE EDUCATION AND RECREATION ACTIVITIES
In the later phases, besides exporting healthy food, agriculture knowledge and ecological education should also be exported to farmers and residents. The realization of this function requires the location to have good natural landscape and recreation resources.

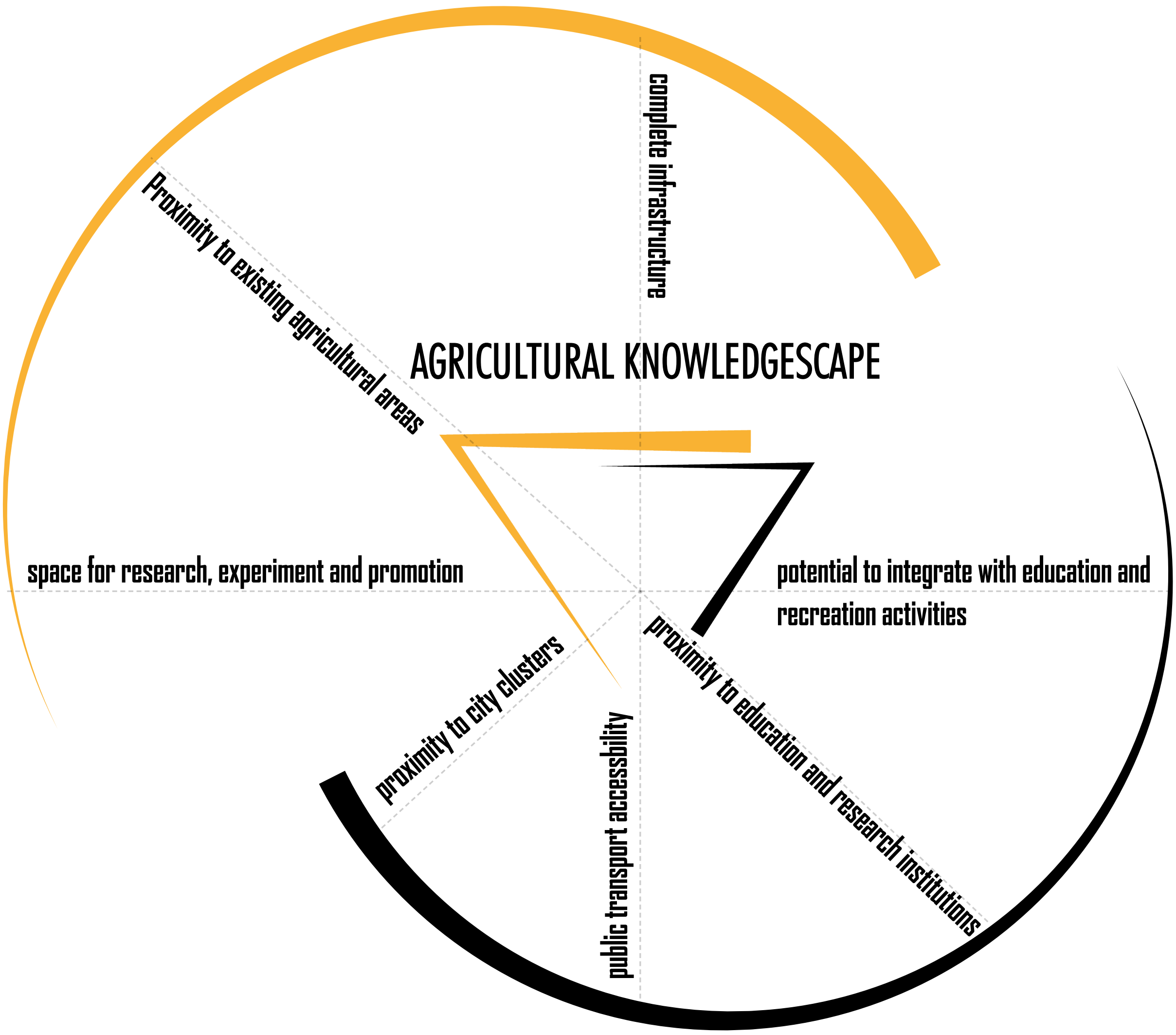


Figure 4.3.2.9 Criteria for the location of the agriculture hub. Figure by the Author

LOCATION VOORSCHOTEN CURRENT SITUATION

Figure 4.3.2.10 Location of Voorschoten in the Region. Figure by the Author

Figure 4.3.2.11 Infrastructure Networks of Voorschoten. Figure by the Author

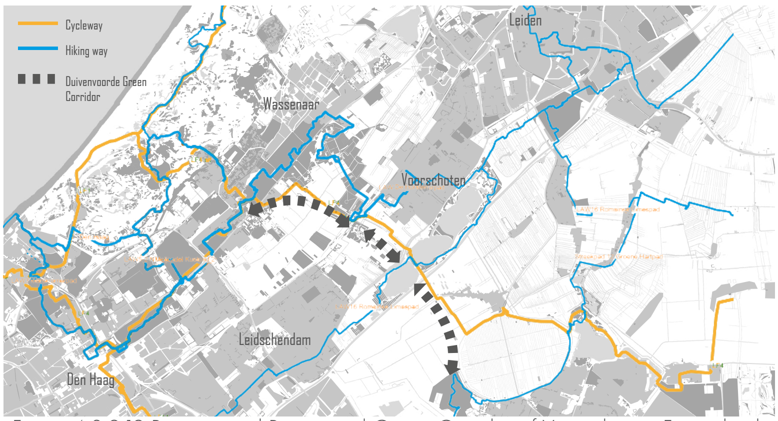


Figure 4.3.2.12 Recreational Routes and Green Corridor of Voorschoten. Figure by the Author

Voorschoten is a smaller town in the Randstad, enclosed by the cities of Leiden, Wassenaar and The Hague. As depicted on figure 4.3.2.3 it is proximity to research and educational institutions, such as Leiden University, TU Delft, etc.

The infrastructure networks of Voorschoten is complete. Figure 4.3.2.4 shows that Voorschoten lies along the railway Rotterdam-The Hague-Leiden-Amsterdam. High educated researchers are able to commute by train everyday. Public transport builds connection between the town and rural area.

In the rural area there are some farmlands with complete facilities, which provide space for research institutions and agricultural testing grounds.

Along the Duivenvoorde green corridor (Figure 4.3.2.5) there are some existing recreational routes and areas, which provide potential for further function integration.

PROJECT STAKEHOLDERS

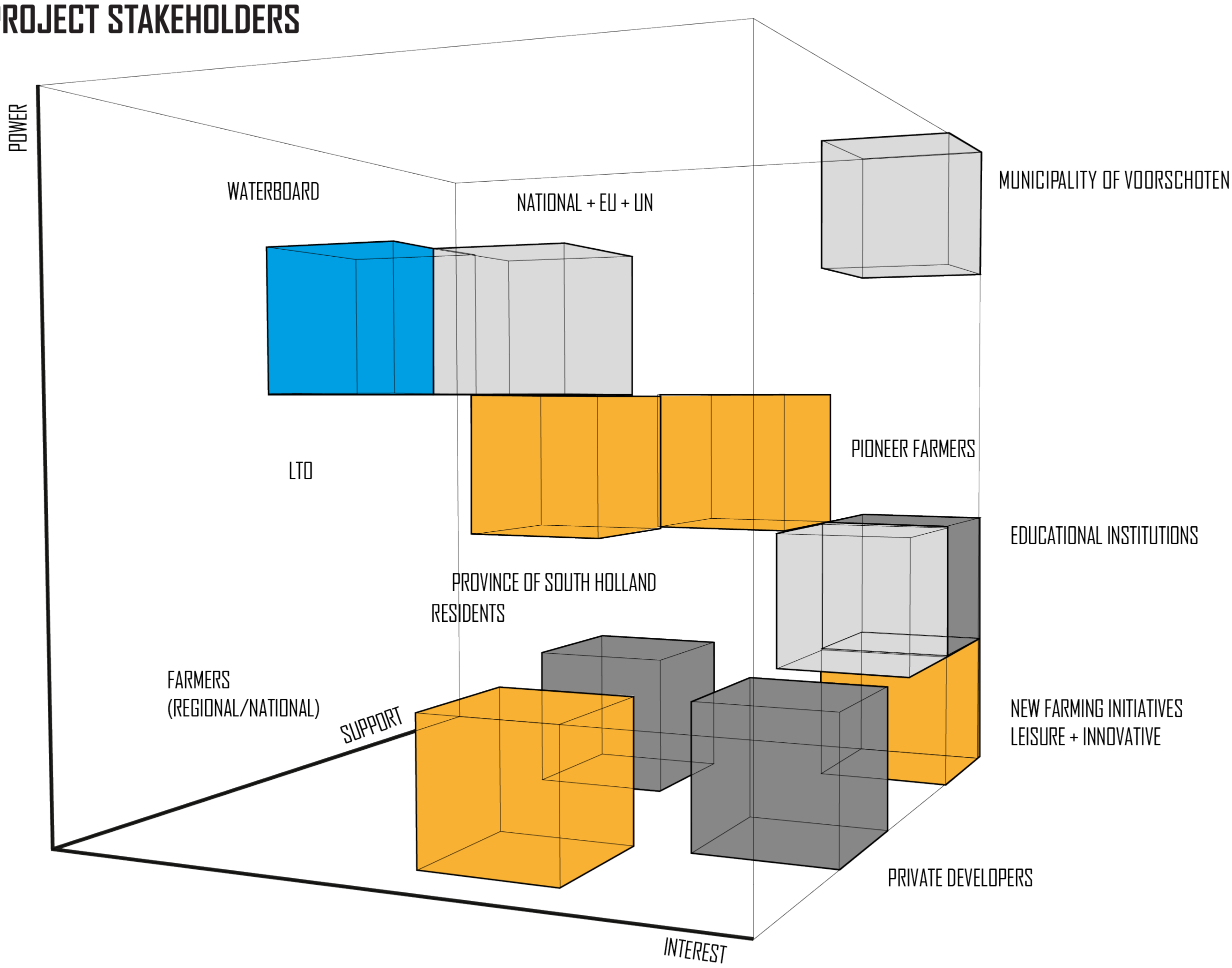


Figure 4.3.2.13 Stakeholder involvement in the agriculture knowledge scape Voorschote. Figure by author

GOVERNANCE

European Union

National government

Ministry of Agriculture, Nature and Food Quality

Ministry of Infrastructure and Water Management

Province South-Holland

Municipalities Voorschoten, Wassenaar and Leiden

PUBLIC SECTOR

Waterboard

Rijkswaterstaat

Natura 2000

Staatsbosbeheer

PRIVATE SECTOR

Traditional Farmers

Pioneer farmers

Local companies

PRIVATE INITIATIVES

New farm, The Hague

Floating farm, Rotterdam

Blue City, Rotterdam

EDUCATIONAL SECTOR

Leiden University

TU Delft

Wageningen University and Research

CIVIL SOCIETY

Residents

Land owners

Figure 4.3.2.6 shows the stakeholders that are involved in the knowledge scape project, organized by their power, interest in the project and support for the project.

SYSTEMS AND FUNCTIONS IN THE KNOWLEDGE SCAPE

The knowledge scape combines various goals and functions in one strategic location. Figure 4.3.20 depicts these functions and the socio-technical systems that connect them.

Research center

The aim of the research center is to collect knowledge about new agricultural methods and their implementation in south Holland and to build a network of researchers, decision makers. To support the regional transition of South Holland through science, researchers from different fields work together. Natural scientists, economists, engineers and social sciences analyse at the shift to a new agricultural and spatial system. The center gives space to researchers from different universities to promote their projects and prepare them for practice. Also, it creates a space for innovative initiatives to further implement their ideas.

Parts of the research center will be permanently used for specific research projects on urban farming and aquaculture in Holland. The participation in these projects is attractive for researchers because they can think beyond their own institution while contributing the specific knowledge from their background in interdisciplinary teams. This location is particularly attractive for research projects that aim at collaboration between different research institutions and the direct interaction with stakeholders.

Show case farms

Another benefit of the knowledgescape as a research location is the possibility to test innovations in the experimental show case farms. Here, new technologies can be tested in a diverse set of environments. Vertical farms make it possible to test innovations in an urban context. In waterscapes, aquaculture methods can be tested before being applied in other parts of the region. And of course, new forms of agriculture can be tested on dry or semi-dry farms.

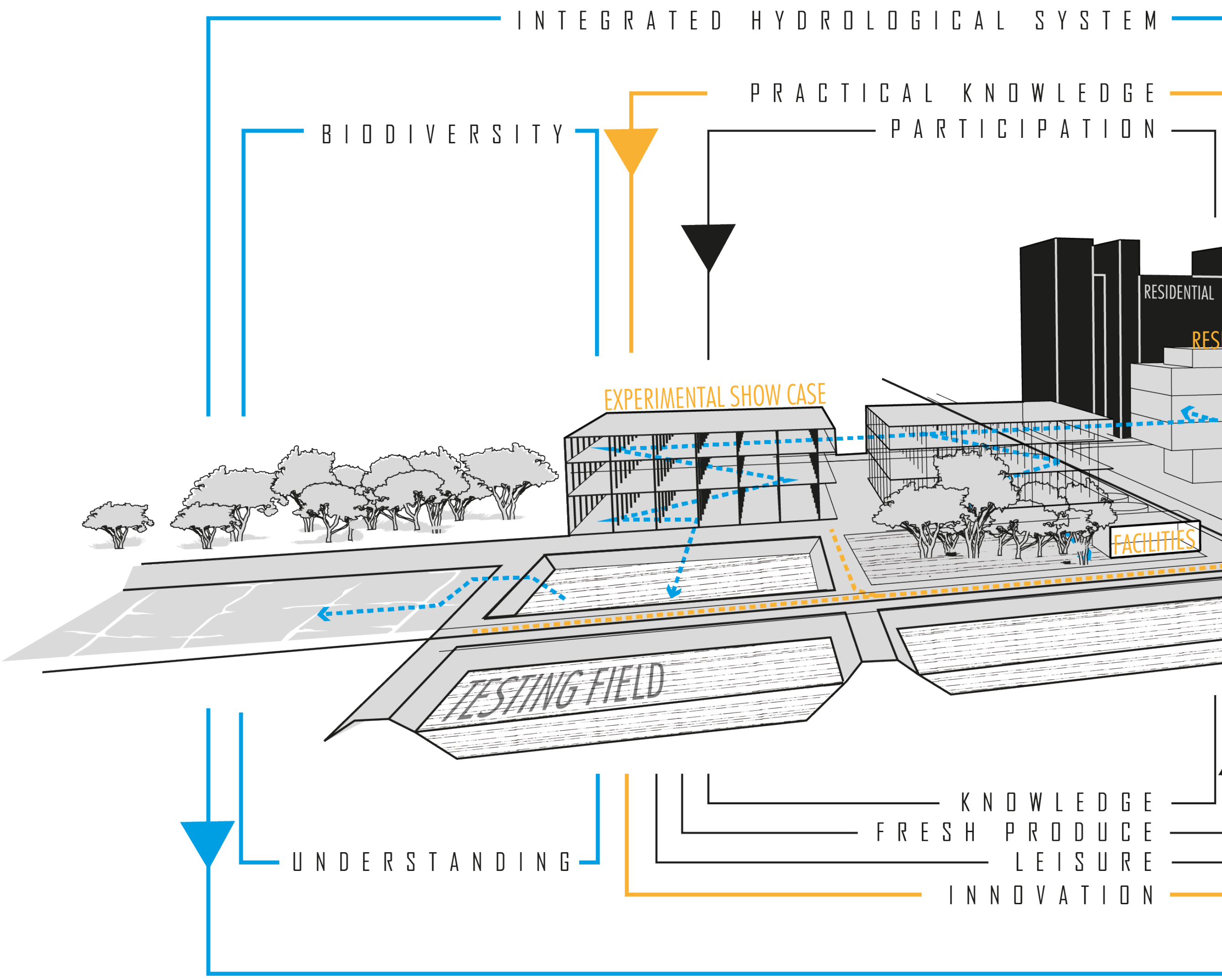


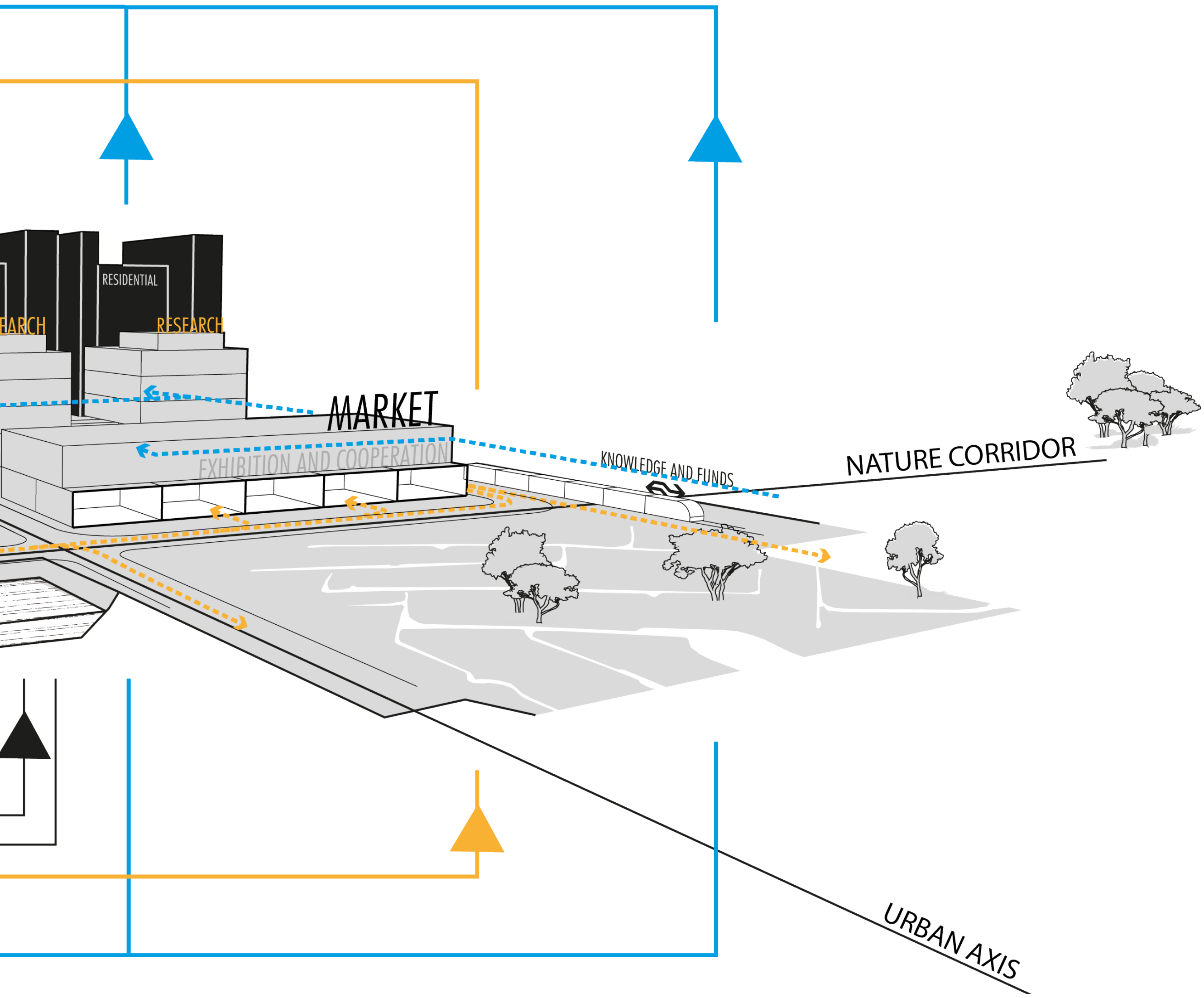
Figure 4.3.2.14 Functions and systems in the Knowledgescape. Figure by the Author

Besides the technical implementation, the social acceptance of new methods can be tested. Since many of these show case farms are open for the public and embedded in an attractive environment for visitors, researchers can directly interact with future consumers. This way, scientists can learn about the preferences of consumers.

Another group that can be involved in the research process are farmers. This is crucial because this way researchers can learn about the applicability of their projects in the agricultural practice. Farmers from the whole region are invited to visit the knowledge scape to learn about the current development in agricultural science. In the knowledge center, an exhibition about the state of the art in agricultural science is open to visit. In later phases of the project, participation processes will be organized to include farmers and inhabitants.

Park Market

The most accessible part of the knowledge landscape is the park market. On this platform, people with little background knowledge can learn about the knowledge landscape and its purpose or just enjoy shopping for fresh produce. The market is well integrated into the recreational corridor between the green heart and the dune landscape of Meijendel. The park market is an attractive stop for people using the regional bicycle routes and hiking trail that pass the area. By integrating informative offers like galleries and movie screening a broader variety of people can be reached, than with traditional participation method



TIME-LINE

As can be seen in figure 4.3.2.7, the project will be divided into four phases: 1. Research and development, 2. Pioneering, 3. Promoting and 4. Institutionalisation.

The most intensive phases for the local area of Voorschoten will be phase 2 and 3 from 2025 to 2035, after which the knowledgescapes will be reproduced on a regional and national scale.

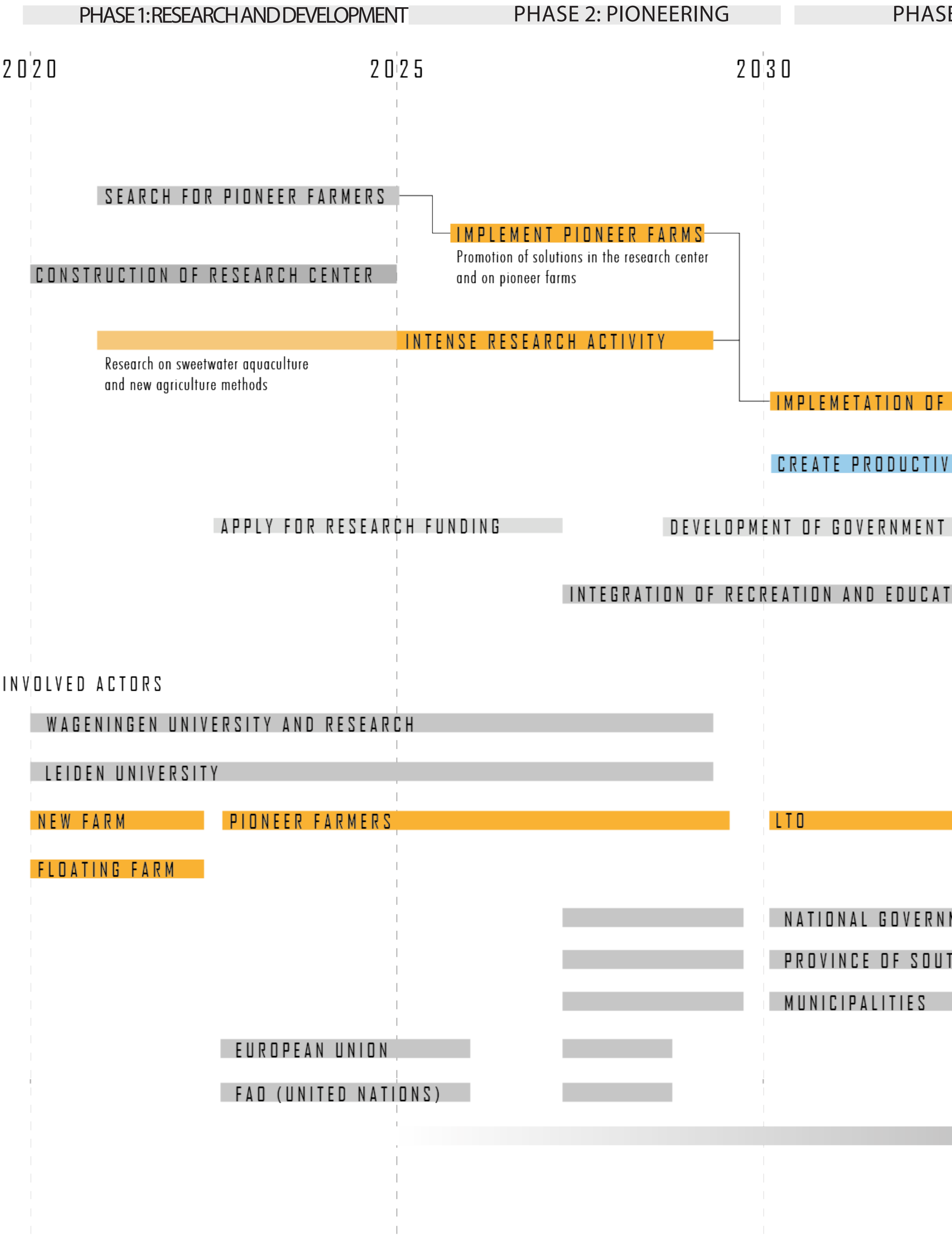
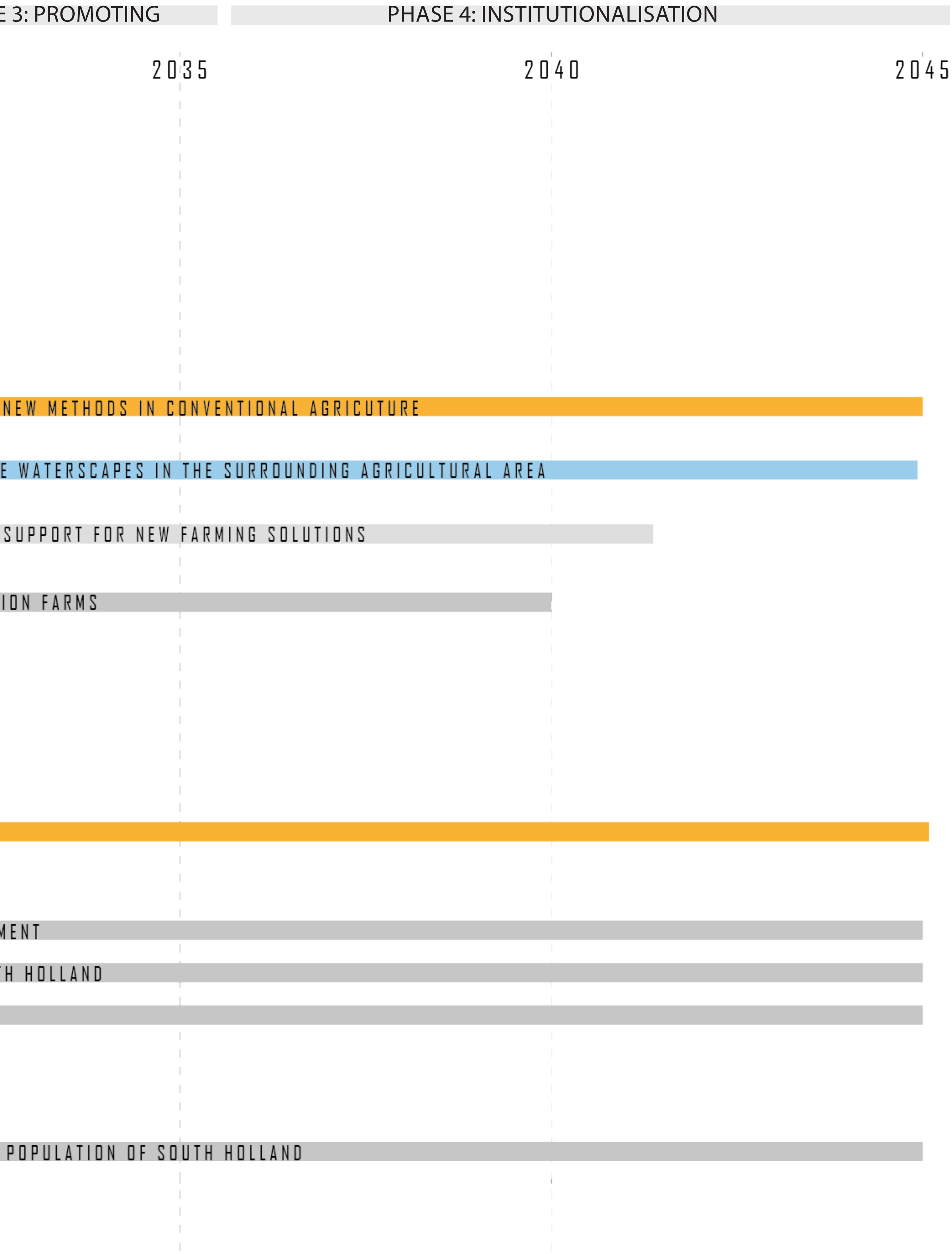


Figure 4.3.2.15 Project imeline. Figure by the Author



E 3: PROMOTING
PHASE 4: INSTITUTIONALISATION
2035
2040
2045
NEW METHODS IN CONVENTIONAL AGRICUTURE
E WATERSCAPES IN THE SURROUNDING AGRICULTURAL AREA
SUPPORT FOR NEW FARMING SOLUTIONS
ION FARMS
MENT
TH HOLLAND
POPULATION OF SOUTH HOLLAND

STAKEHOLDER ENGAGEMENT AND PROJECT INSTRUMENTS

Stakeholders can also be divided into local stakeholders and external stakeholders for this project. Local stakeholders would involve pioneer farmers, local farmers, residents, local social institutions and the municipality of Voorschoten. External stakeholders are governance, public sector, NGO's and educational Institutions, developers and food suppliers. The diagram underneath shows the involvement of stakeholders and collaboration between stakeholders in different phases. (Figure 4.3.2.9).

LOCAL STAKEHOLDERS

In this project, local farmers and residents are important powers in the developing and promotion of agriculture knowledgescapes. Local pioneer farmers will be involved in the pioneering phase to collaborate with the research center. Municipality of Voorschoten will be involved a coordinator to search for pioneer farmers and support experimental farming by policies. In the promoting and institutionalization phases, local farmer will be involved by implementing new methods in agriculture production. Residents will be involved in the reproduction of urban and rural agriculture knowledgescapes.

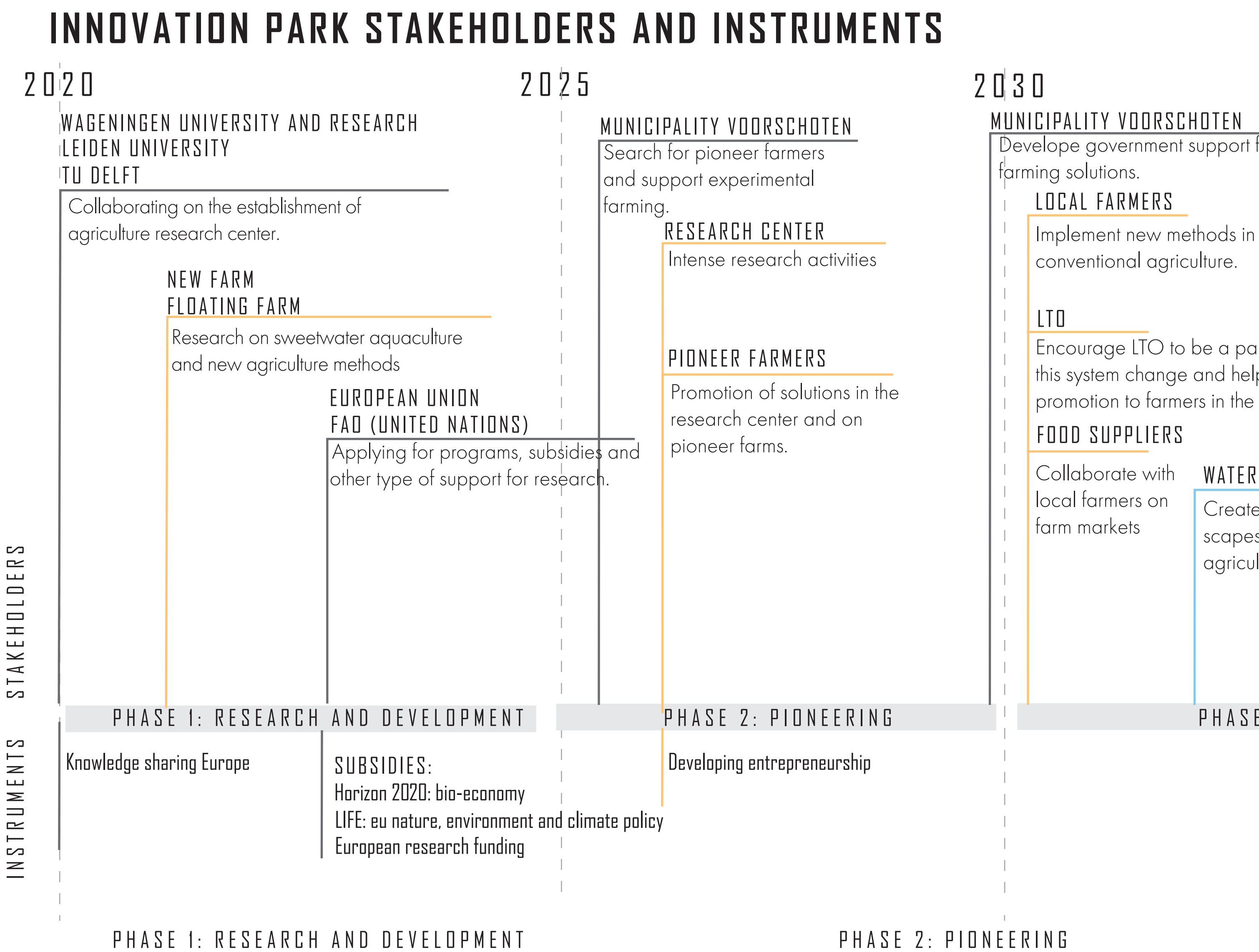
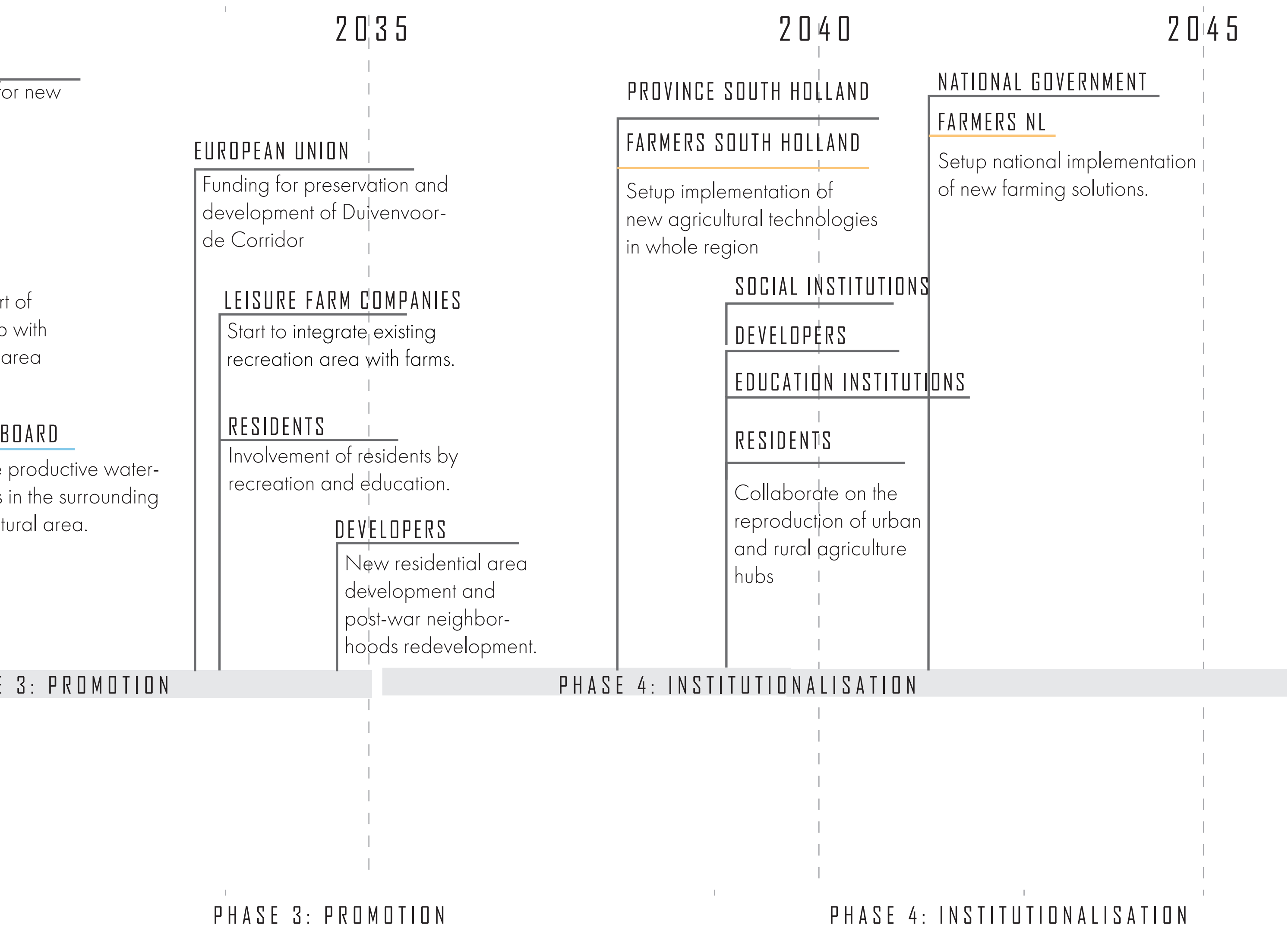


Figure 4.3.2.16 Actors in project phases. Figure by the author.

EXTERNAL STAKEHOLDERS

External stakeholders are involved in the whole process of the project. At the start of the project, education institutions collaborate on the establishment of research center. EU, FAO, LTO and other public sectors get involved by funding and supporting the experiment and promotion of new methods. Food suppliers and developers will be involved in the development of retial and recreational functions.



PHASE 1: RESEARCH AND DEVELOPMENT

The first step of the project is to implement the research center. The province of South Holland approaches various Dutch Universities to get involved and contribute their knowledge. Figure 4.3.2.10 indicates which actors are taking part in discussion "on the table" in a more active role and which ones act passively, for example through funding for the project. Wageningen UR will take the scientific lead, because it has the most knowledge in the field of agriculture. In this research center new agriculture methods are tested on their technical ans social implementability.

Besides Wageningen UR, Leiden University and TU Delft get involved during this phase. Scientist from Leiden can contribute their knowledge in social sciences. This can be helpful for the implementation of the project and the cooperation with different stakeholders and the population. TU Delft can start in depth research on technical innovations that could change the agriculture system, for instance on vertical farming.

Furthermore, initiatives in the food sector, like the floating farm or the blue city in Rotterdam get involved in this phase. These can contribute their knowledge about the practical application of food innovations in urban farming. Another initiative that could be integrated is the New Farm in The Hague. Although it had to close in 2018 (Sijmonsma,2018) the people behind it have experience with large scale farming in an urban context. They could restart the project if it is embedded in the overall strategy of "Growing Smaller".

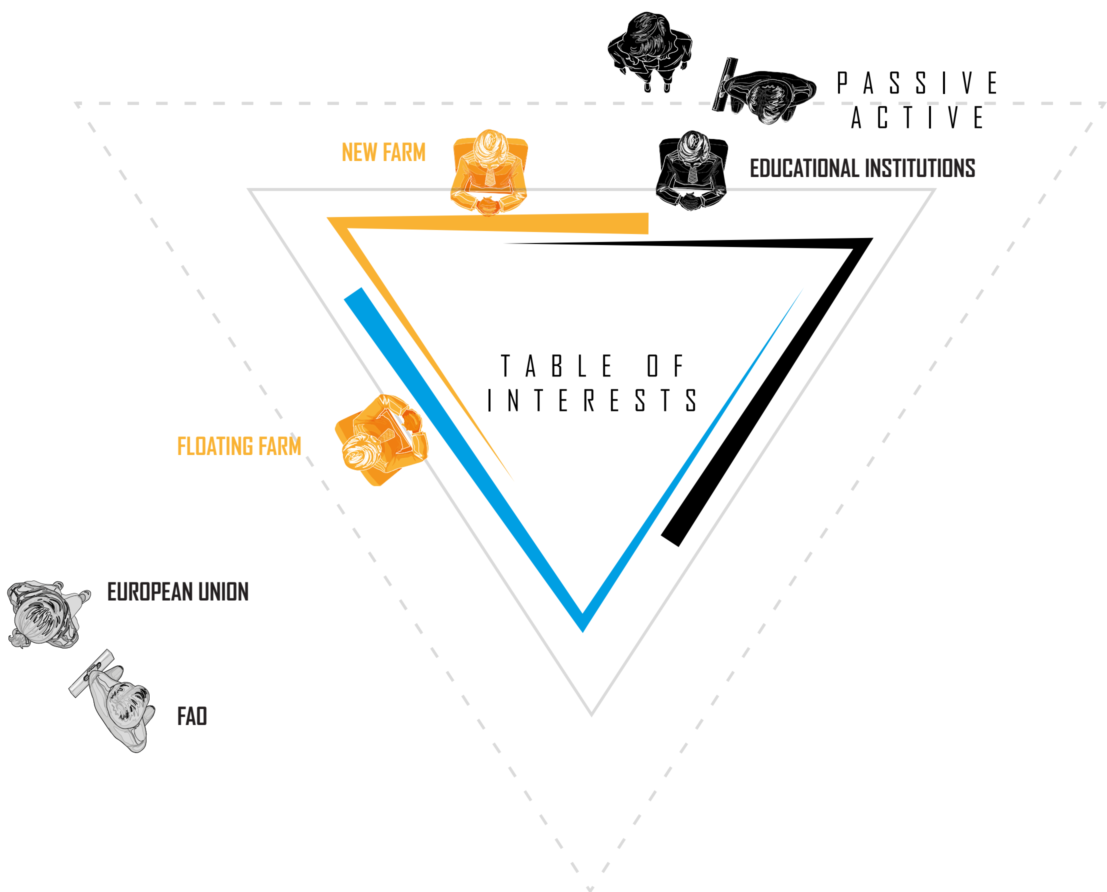


Figure 4.3.2.17 Table of interest phase 1. Figure by the author.

Figure 4.3.2.18 Collage and Map phase 1. Figure by the author.

PHASE 2: PIONEERING

In the second phase, first testing fields are implemented in cooperation with pioneer farmers from the surrounding municipalities. This action is coordinated and initiated from the research center and embedded in the research and development projects of the center. Figure 4.3.2.12 shows which actors get involved in this phas

Together with the Province of South Holland as well as the municipalities of Voorschoten, Leidschendam-Voorburg and Wassenaar, the scientists from the research center approach farmers to find pioneers.
There are various reasons for farmers to participate. The chance to be involved might first be attractive for farmers who are already using alternative methods and are working in close cooperation with consumers and inhabitants. For them, this project is a chance to get more attention. Furthermore, farmers can get higher subsidies from the Dutch Government and the EU if their work is embedded in a bigger transition strategy. Finally, this project aims at making the agriculture more resilient to the effects of climate change Therefore, farmers could be interested in broadening the scope before they are forced to change their methods due to the changing climate.

Scientists conduct research on the implementation in a co-production process. The farmers are not seen as the object of the research but as a crucial part of

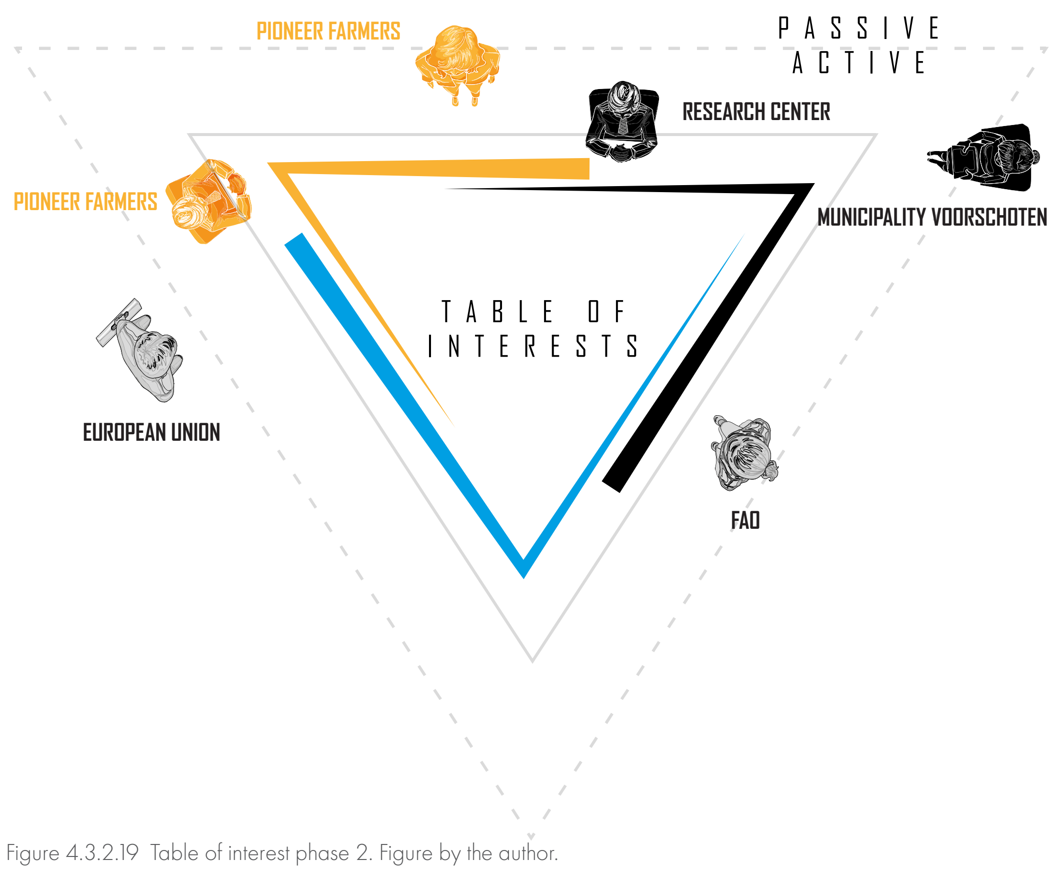


Figure 4.3.2.19 Table of interest phase 2. Figure by the author.

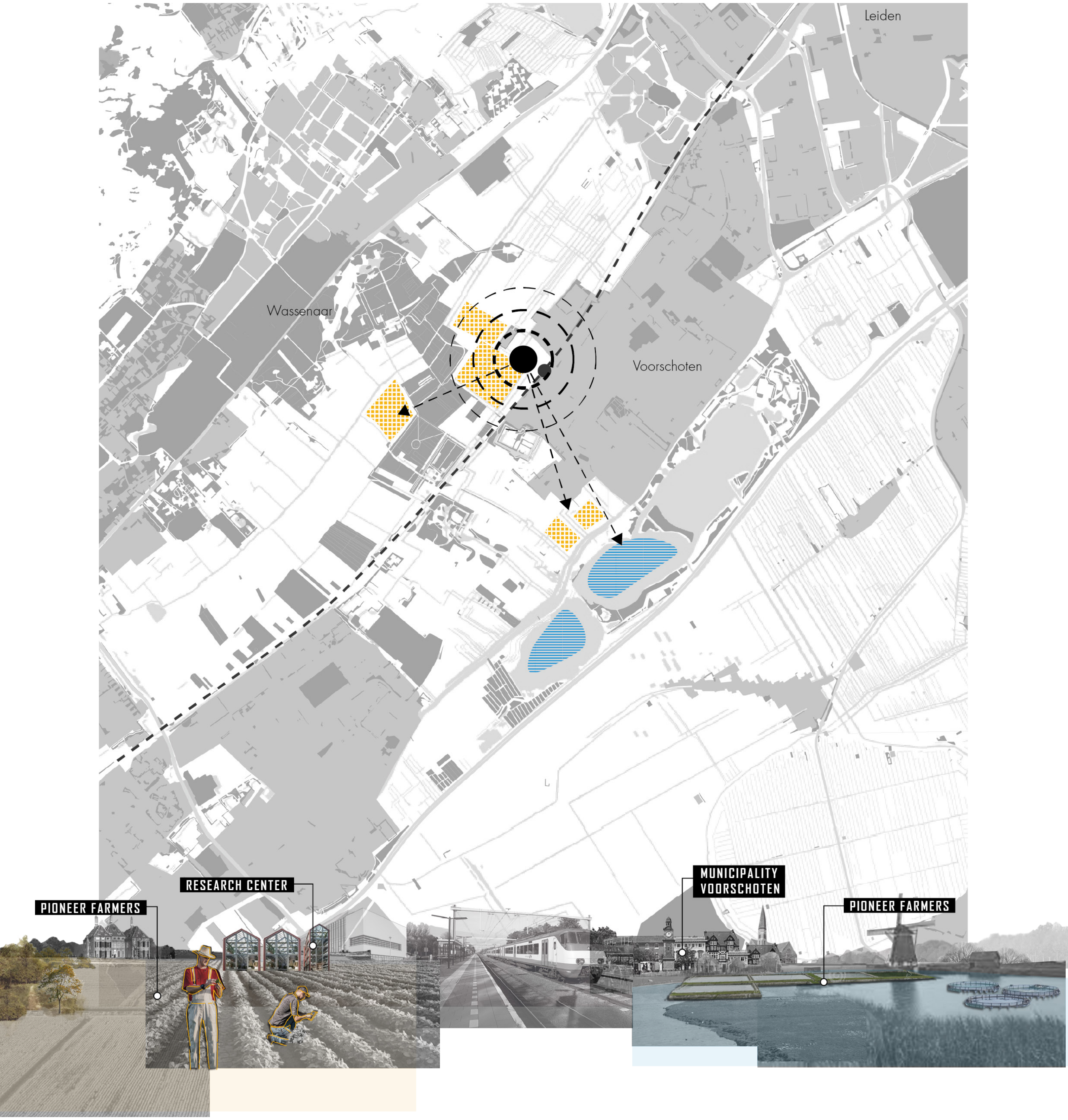


Figure 4.3.2.20 Collage and map phase 2. Figure by the author.

PHASE 3: PROMOTION

The aim of phase 3 is to promote the new production methods and to show how landscapes that combine food production and leisure activities could look like. The testing-farms are expanded to surrounding fields. Since the project becomes well known in the farmer community, more pioneers want to get involved and food suppliers become actors start selling unique products from the knowledge scape (see Figure 4.3.2.14). As a result, a diverse set of farming techniques can be explored. The knowledge scape really becomes a landscape in this phase. The experimental show-case farms are embedded in a network of green and blue spaces that make the area attractive for visitors. As can be seen in figure 4.3.26, the Knowledge scape is located between the green heart and the Meijendel dunes. The knowledge scape will be a connection within this regional network of green spaces. As a consequence, people on leisure trips from the whole province will visit the area and see the show-case farms. Showing them how attractive the future landscape can be is a starting point for a regional participation process. But the aim is not only to inform the inhabitants, but also to learn from them. The public should also get involved research and food production processes. This way researchers and farmers can learn more about the acceptance of certain methods in the society and how a new method or product can be implemented in cooperation with the consumers. In other words, visitors become co-producers of knowledge.

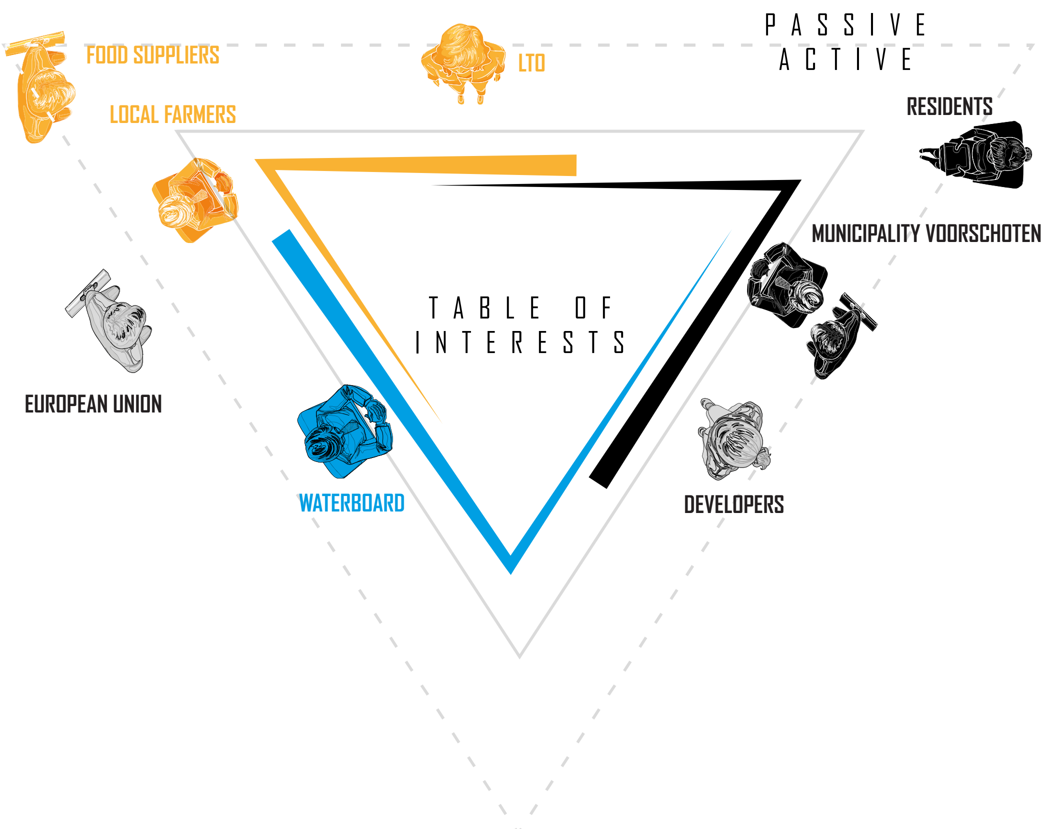
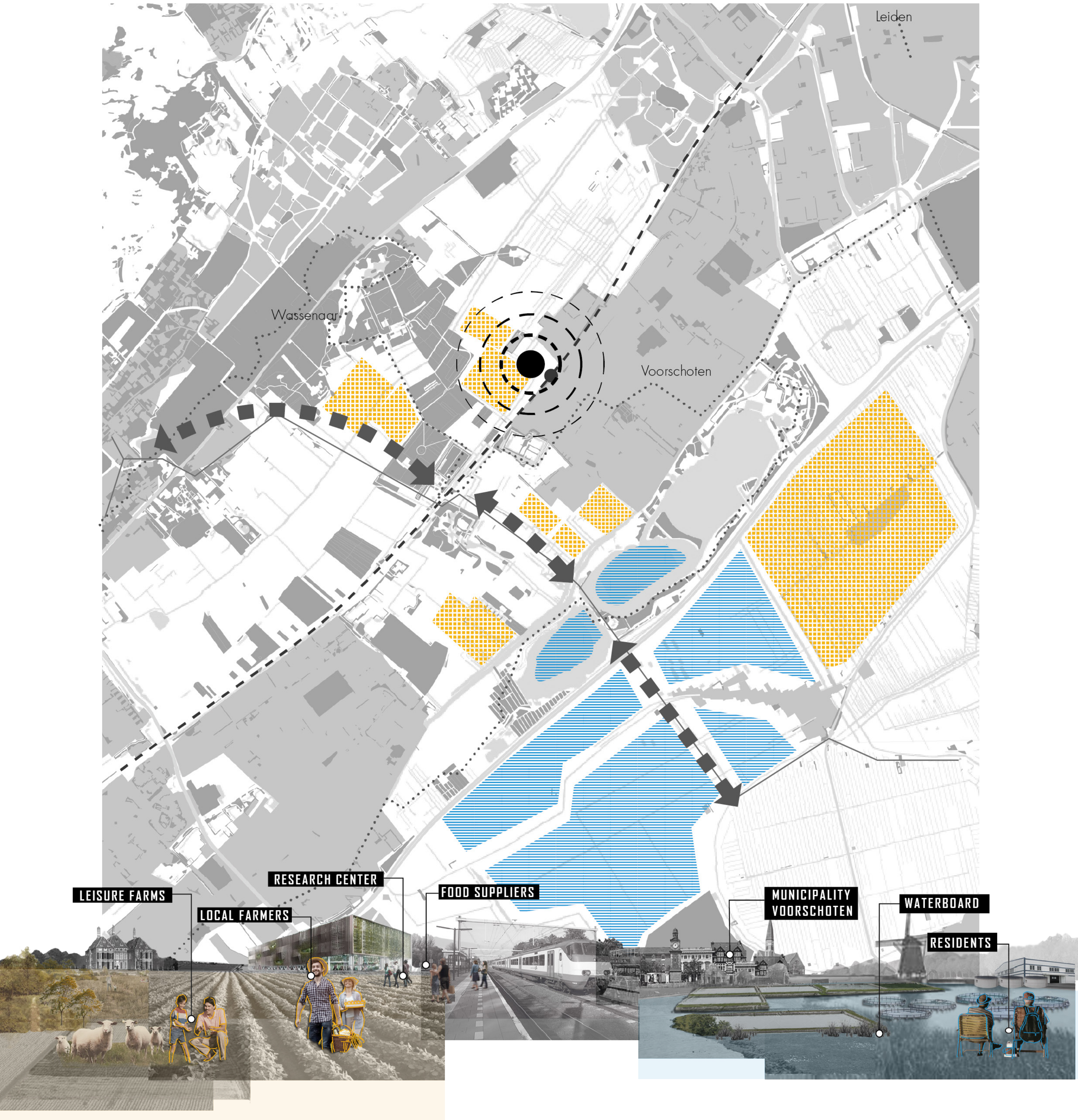


Figure 4.3.2.21 Table of interest phase 3. Figure by the author.



Agriculture knowledge center

Green corridors

Hiking route

Bicycle route

Figure 4.3.2.22 Collage and map phase 3. Figure by the author.

PHASE 4: INSTITUTIONALISATION

In the final phase, knowledge and new methods become institutionalised. The innovations that were tested in the knowledge scape spread in the province and are implemented in other locations. The Voorschoten knowledgescape focuses even more on its leisure functions. As indicated in figure 4.3.31, the park market is opened. It attracts a different group of people than the previous functions and allows the communication with a large amount of visitors.

In cooperation with educational institutions, education hubs are implemented in between the recreation areas and the showcase farms. Here, students and other interested people can learn about food production and agricultural innovations.

The research center will keep on researching agricultural innovations. Although the focus will shift from research to implementation, it is necessary to further research potential future changes in agriculture and how to adapt to them.

Overall, the knowledge scape becomes a well integrated part of Voorschoten and an important regional recreation and education landscape. Since the most important actions during this phase are taken on a regional level only a small number of actors are involved in the local processes (see also Figure 4.3.2.16).

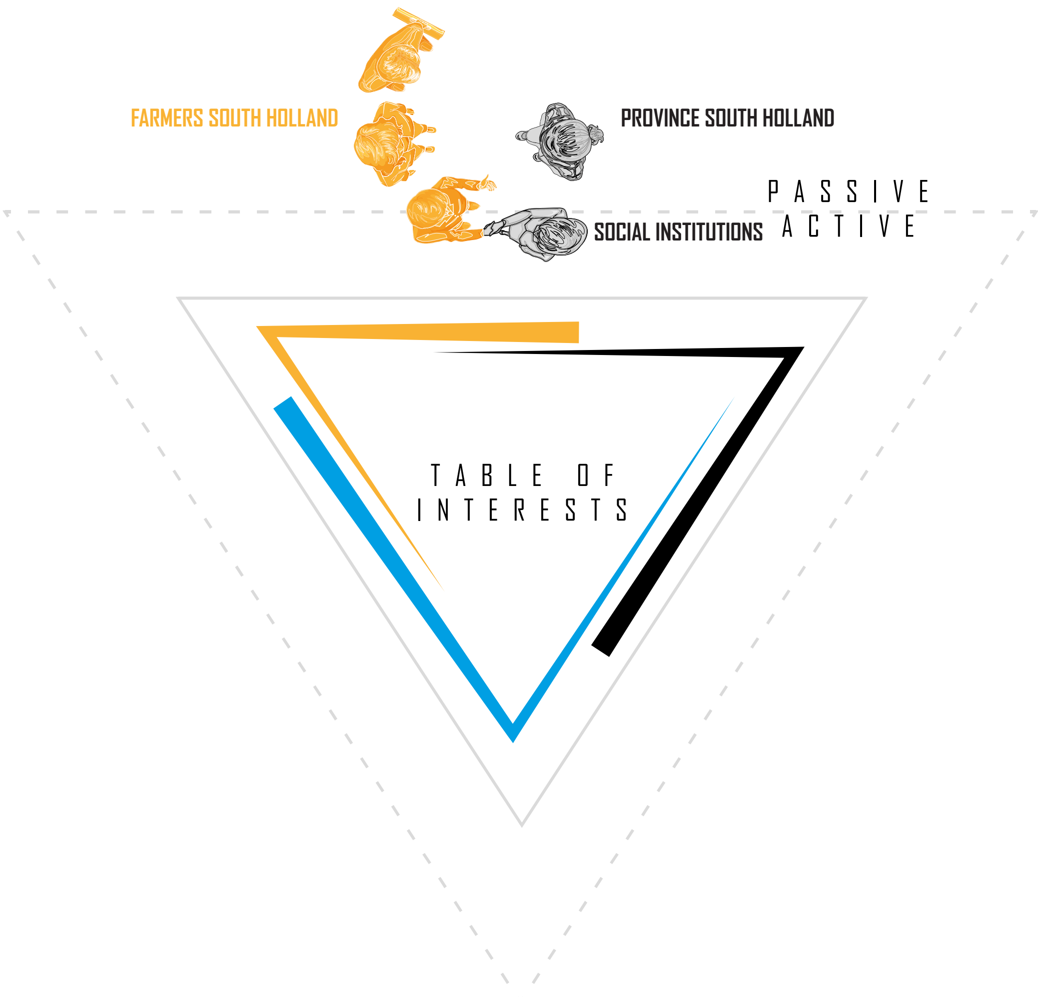


Figure 4.3.2.23 Table of interest phase 4. Figure by the author.

Figure 4.3.2.24 Collage and map phase 4. Figure by the author.

SPATIAL PLANNING THEORIES FOR PHASING

Considering the crucial effect of public transport on Voorschoten agriculture knowledgescapel's spatial planning and the dynamics of phasing, we did research on related theories as the basis of spatial strategies in the phasing. In phase one, the development of Voorschoten agriculture knowledgescape will start from the areas around Voorschoten station. According to the Transit Oriented Development theory(TOD), to build research center and supporting facilities near the station can maximize the benefits of public transportation.

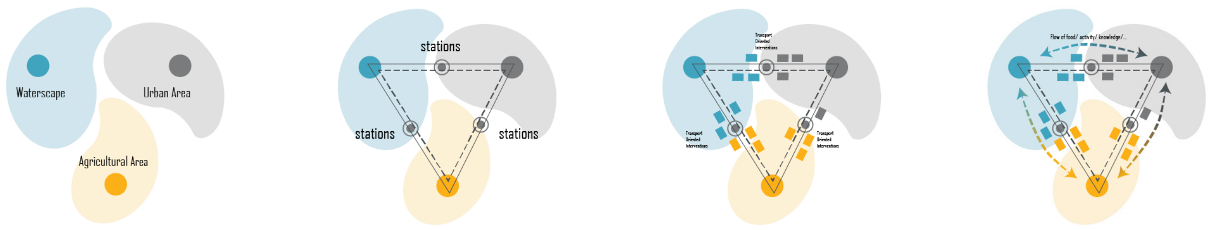


Figure 4.3.2.25 Transit Oriented Development around Station Areas. Figure by the author.

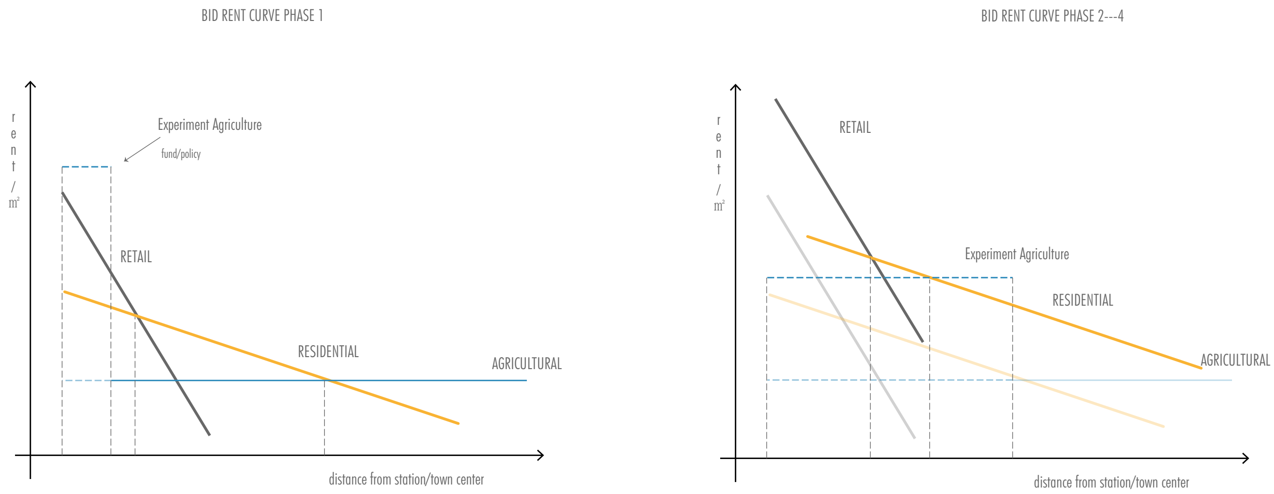


Figure 4.3.2.26 Bid Rent Curve aroud Station/ Town Center Areas. Figure by the author.

The bid rent curve (Figure 4.3.2.19) explains the location change of the agricultural function center from station areas to rural areas in the third phase. In the early stage of development, experimental agriculture was supported by financial subsidies and policies, which could afford the land price near the station and make full use of the benefits of public transportation. With the development of agriculture knowledgescape, land price has increased. On the one hand, the cost of experimental agriculture and related facilities has increased, and on the other hand, the competitive ability of retail and residential development has increased. As a result, agriculture-related development will leave the area around the station and move to rural areas.

REGIONAL REPRODUCTION

As a starting point for our strategy, the knowledge scape concept will be reproduced in other parts of the region. Figure 4.3.2.20 shows potential locations for future knowledge scapes. Their implementation should be started during the fourth phase of the knowledge scape Voorschoten. The experiences made in Voorschoten can be used in these other locations. On the next pages the reproduction of the knowledge scape concept is explained in further detail.

But regional significance of the knowledge scape Voorschoten goes beyond the its reproduction. Even after the final phase of the project it can serve as a showcase area for future production methods. The research center will keep investigating coming transitions in the food sector. Also the population's engagement in the food production process will go on after the final implementation. This ensures further food education and the continuing cooperation between farmers, scientists and the population.

Figure 4.3.2.27 Regional implementation of knowledge hubs. Figure by the author.

RURAL AGRICULTURE KNOWLEDGESCAPES

In the region, we choose rural areas with great potential for agriculture and complete infrastructure networks to implement rural agriculture knowledgescapes. The principle of rural agriculture scape is to protect farmland and natural environment in rural areas, and to preserve traditional Dutch agricultural landscape to a certain extent. Therefore, the reproduction of rural agriculture knowledge scapes will pay special attention to reduce the impact of agricultural production on environment, and to preserve natural landscape and reduce artificial construction as much as possible.

On the basis of protecting the natural environment and agricultural landscape, rural agriculture knowledgescapes will integrate the functions of recreation and agricultural education to promote the popularization of ecological and agricultural education by optimizing public participation. For example, leisure farms and farm markets provide residents with the opportunity to learn about agriculture and participate in farming and harvesting in the natural environment (Figure 4.3.2.21). Local educational institutions,in cooperation with sweet water agriculture sector and research institutions, regularly organize camping activities to enable local residents to understand and support the transition of agricultural landscape in the region (Figure 4.3.2.22).

Figure 4.3.2.28 Rural Agriculture Knowledgescapes: Leisure Farms.Figure by the author.

Figure 4.3.2.29 Rural Agriculture Knowledgescapes: Waterscape Education Center. Figure by the author.

In terms of the reproduction of urban agriculture hubs in the inner city, we have combined it with the post-war neighborhood densification projects. This also reflects our concern for spatial justice.

On the one hand, we set sharp edges for urban areas to protect the rural areas for agriculture and resilient natural landscape. On the other hand, we need to meet the housing demand from the 1 million home project. Therefore, we will achieve the goal of densification through the redevelopment of post-war neighborhoods and emphasize spatial justice concerns.

In the Netherlands, there are many post-war neighborhoods built in the 60s and 70s. At present, the spatial quality of these neighborhoods has much room for improvement (Figure 4.3.2.23). Through redevelopment, we not only improve the density and quality of housing in these neighborhoods but also plan neighborhood agriculture hubs as a crucial strategy to enhance livability.

Residents can grow and harvest healthy foods and learn the latest agricultural knowledge in the neighborhood agriculture hubs within ten minutes' walk. Those hubs not only improves the ecological environment but also serves as a place for residents to have leisure and social activities. Urban agriculture hubs bring new vitality to the declining post-war neighborhoods.

Figure 4.3.2.30 Urban Agriculture Hubs in Post-war Neighborhood Densification. Figure by the author.

ACCESSIBILITY OF URBAN AGRICULTURE HUBS

The concern for spatial justice is also reflected in the strategy of the three-level agriculture hubs system. We have planned agriculture hubs on three scales: neighborhood, city, and region. Residents living in inner city can reach the nearest neighborhood agriculture hubs within a 10-minute walk. The city and regional agriculture hubs can also be reached by bicycle, private car or public transport conveniently. Urban residents have equal access to healthy food or recreational activities.

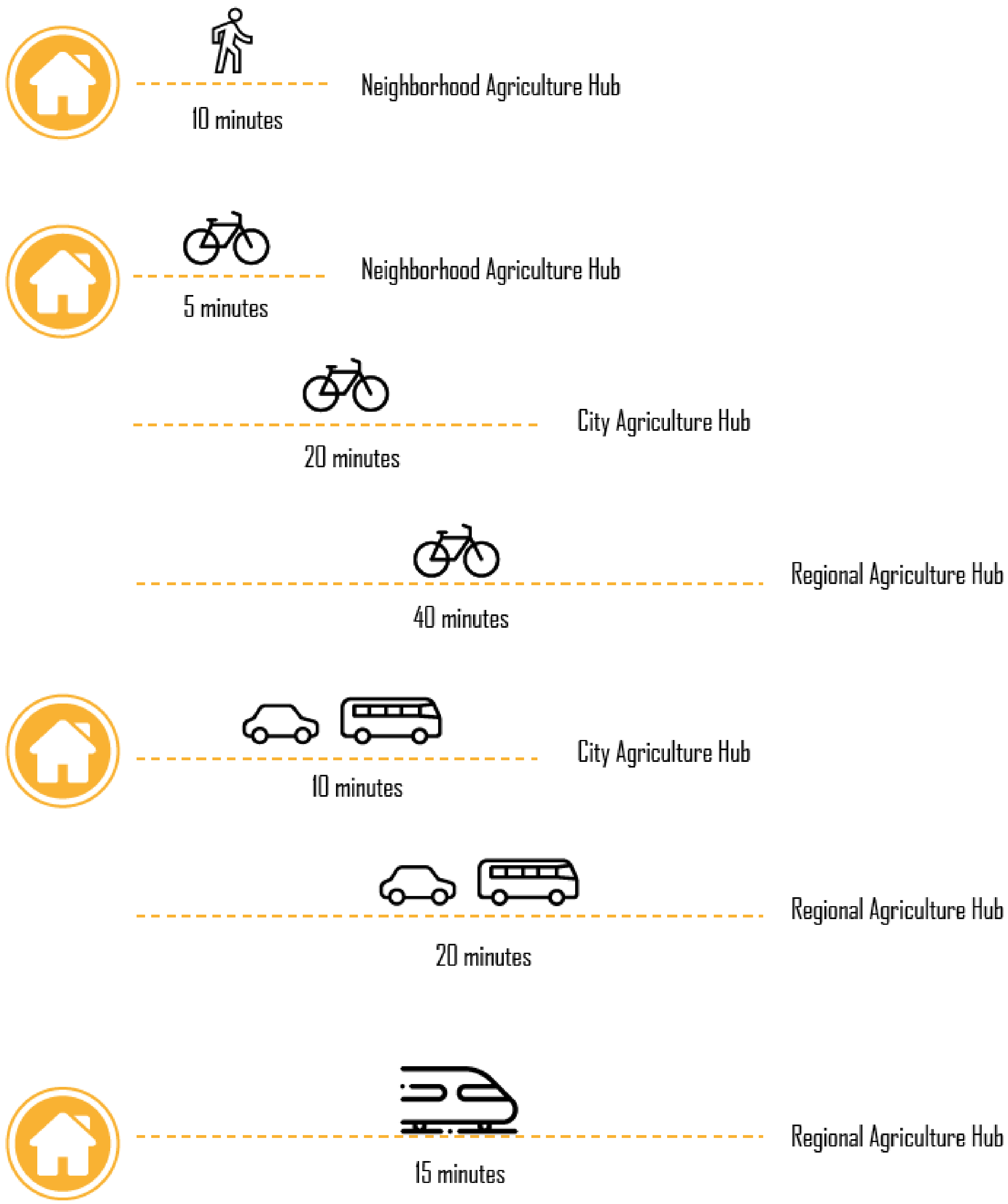
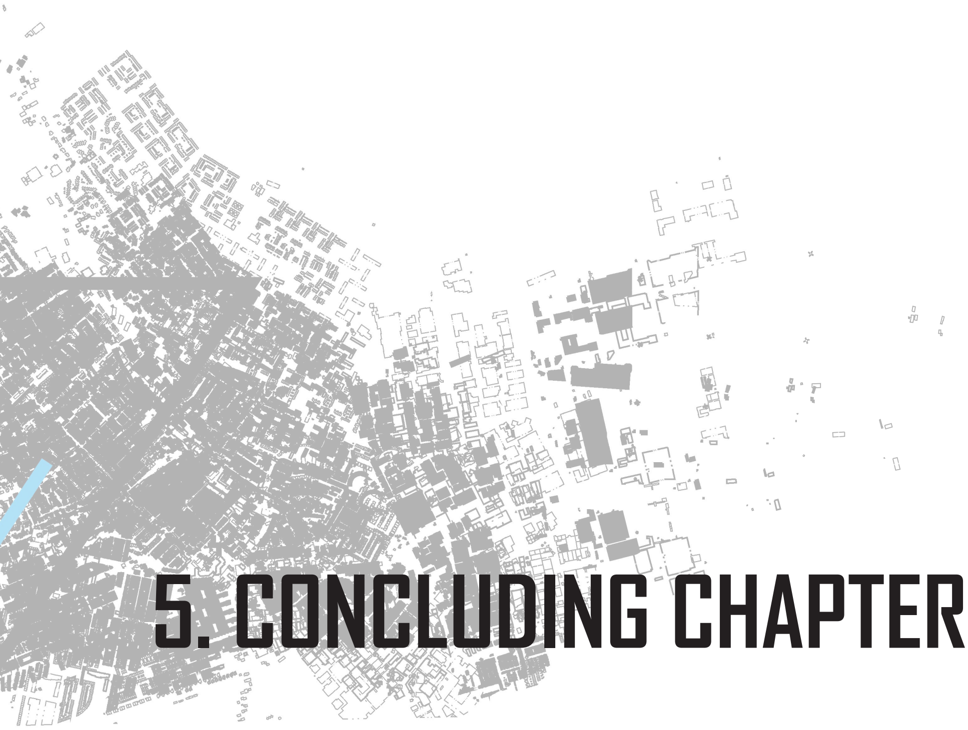


Figure 4.3.2.31 Accessibility of Agriculture Hubs by Different Transport Means. Figure by the author.


AGRI-FOOD SECTOR
WATERMANAGEMENT
CONTESTED SPACE
URBANISATION



5. CONCLUDING CHAPTER

5.1 GENERAL CONCLUSION

The province of South-Holland, being located in the Randstad, has to cope with an intensive competition for its spatial resources. The space is, for the most part, claimed by three sectors: agri-food production, urbanisation and water management. Each sector is showing the need for growth, either due to climate change, increase in population or both. To resolve this problem of space claim, this research and design report aimed at formulating a vision and strategy where the province is protected from the effects of climate change, while still producing sufficient foods and keeping the livability of the region.

To achieve this, three main vision goals were formulated; creating a productive environment for agri-food production, creating a livable environment in densifying urban systems and providing equal safety from water throughout the region. After analysing the three sectors of space claim, it could be concluded that it is the synergies between the systems that provide the highest potential for reaching all three goals. A set of transitional landscapes have been created on these synergies; productive waterscapes, agricultural landscapes and natural hydroscapes maximize the benefits of the systems and avoid spatial unbalance by using one sector to fulfill the needs of another sector.

In the new landscape, wetland ecosystems provide safety from rising water levels and contribute to biodiversity. The agricultural sector uses methods that can be more integrated in the natural environment, reducing its land demand and therefore creating space for water protection measures. A sustainable production of local food is kept through the large presence of aquaculture, which is integrated into the different agri-food sectors to create a circular production system. A network of green and blue spaces is integrated in the urban landscape and makes compact cities more livable and inclusive. Agriculture hubs and open air supermarkets close to dense urban areas ensure the region's innovative power in the food sector, creating new jobs and bridging the gap between producer and consumer.

Two strategic projects have been defined, which are key to making this vision a reality. The first is the seaside aquaculture, located in Goeree-Overflakkee, which is used as a catalyst to start the change to the new agri-food system. The second strategic project is an agriculture knowledgescape, where recreation and agri-food production are combined in a center in Voorschoten with the main goal to educate people in the province on healthy local foods.

By implementing the system changes in the agri-food system and water management, in 2100, the province of South-Holland will be a resilient landscape. Water, agriculture and urbanisation work in unison ensuring safe and healthy conditions for both society and environment.

5.2 DISCUSSION AND RECOMENDATIONS

The main objective of our project "Growing smaller – South Holland 2100" is to balance the needs of three main stakeholder groups and thus to make the region more liveable and more resilient to future challenges. The first group is the regional agri-food sector. It has a high economic importance and in the context of increasing global food demand it should stay as productive as it is while becoming more circular. The second group is the population of south Holland. For this group of stakeholders, the main aim is to make it easier to lead a healthy life. This will be achieved by creating new spaces for outdoor activities, improving the quality and availability of local food and most importantly, increasing the knowledge about food and its production in the society. Finally, the project aims at improving conditions for silent stakeholders, like regional ecosystems and future generations. The proposed re-naturalization of agricultural land gives back space to local plants and animals, reduces the risk of flooding in inhabited land and, simultaneously, reduces the region's environmental impacts.

The project not only brings added value for the region but also contributes to international goals like the UN's sustainable development goals (SDGs)(United Nations [UN], n.d.). By helping to reduce hunger, improve health and education, provide clean water, ensure economic growth, create good conditions for innovation, make cities and communities more sustainable, make consumers and producers more responsible, improve the climate and protect life below water and on land, the project contributes to at least 11 out of 17 SDGs. Furthermore, it stands in line with the European green deal by enabling the food industry to become more circular.

But when considering the benefits of this project, one of the most important questions is how added value and disadvantages are distributed within the society of South Holland. The project takes interventions in the whole province and therefore affects most of the inhabitants. But since the interventions differ per region, some groups might be disadvantaged.

The first potentially disadvantaged group are farmers, landowners and employees in areas that will go through a transition. Especially in the south and the east of the province, landscapes will change and new types of agri- and aquaculture will be needed. This could lead to a reduction in the value of land in some parts of the region and increase it in others and therefore have unjust effects for landowners. Additionally, some farmers might not be able to cope with the transition and have to give up their business. The same might happen to employees, since they might not have the right education to work in the new food industry.

There are various policies that could help to reduce the unjust effects of this strategy but go beyond the scope of this project and the province of South Holland. Most of them should be implemented on a national or European level. Firstly, the state could help farmers to go through this transition with financial support. This would support existing companies to adapt to the changing landscape and therefore protect the local social structure. Another crucial part of our project is education. In the context of a changing work environment, this topic becomes even more important. Employees in the food industry need to gain further education to find a job in the future food sector. For some might need a retraining to handle new production methods. Others might strive for higher education since the food industry will be further automatized and therefore have a reduced labour demand. For both groups, scholarships and investments in education institutions will be necessary.

Another risk is the deepening social injustice between people living inner city neighbourhoods with a comparably low average income and wealthier neighbourhoods on the urban fringe. Our analysis has shown that most of the poorest neighbourhoods of south holland are located in the central areas of the bigger cities. Therefore, they benefit less from new recreational areas on the border between city and rural areas. Furthermore, many of these neighbourhoods are next to industrial areas and could therefore suffer more from industrial emissions.

There are two approaches to reduce this injustice. They are part of our strategy but further research will be necessary for their final implementation. Firstly, good access to new recreation and education areas is needed. Especially low-income neighbourhoods need affordable public transport and good bicycle routes that connect them not only to destinations within the city, but also to rural areas and regional parks. Another approach is to further integrate green and blue spaces in the city fabric. During the redevelopment of inner-city neighbourhoods, the surrounding areas should be taken into account and benefit from these developments. Especially low-income areas should be supplied with inner-city recreational areas, educational institutions and the possibility to engage in urban farming. A possibility to implement these ideas are inner-city industrial areas. Because of their proximity to low-income neighbourhoods the redevelopment of industrial sites offers the chance to create high quality recreation areas and integrate the population of surrounding areas in activities like urban farming. Since our project focused on the rural land, further research and strategies are needed on the combination of urban farming and recreation areas in South Holland and their value for the urban population.

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AGRI-FOOD SECTOR
WATERMANAGEMENT
CONTESTED SPACE
URBANISATION

APPENDIX

A. INDIVIDUAL REFLECTION

ILSE VAN DEN BRINK

Research and design are two phenomenon which on the are said to be very different. Research is defined as "the study of a subject, especially in order to discover new facts or information about it." (oxford dictionaries, 2020), whereas design can be discribed as explorative and innovative, going further than the methodological and theoretical body of knowledge (Rosemann, 2000)

Rob Roggema (2016) divides the design process into three phases: the pre-design, the design and the post-design phase. In each phase the designer encounters a different interaction between design and research. The first pre-design phase is all about understanding; defining task, context and potential avenues for design interventions. The design phase emphesises the interactive and reflective approach to designing. In the post-design phase, reserach and design are split; design follows the route of presentation through drawings and schemes, research outputs follow acedemic publishings and debates.

The first two phases; pre-design and design, quite accurately explain how research and design interacted in this project. In the pre-design phase, we started off by analysing the region of South-Holland and the systems of agri-food production, water management and urbanisation, and relating these systems to theories such as agriculture on salinized soil, water retention and the compact city.

In the design phase, these concepts led us to work in the strategy of landscape based regional design, which Nijhuis (2017) describes to be the "strategy that shapes the physical form of regions using the landscape as the basic condition". But, since this is a student project, the interactive element in the design phase cannot be used to it's full potential. This is taken into account in the strategy to achieving this vision, but could have been integrated in more detail.

I would say that another part of this design phase is the aspect of 'research throught design' as explained by Wilkie, Gaver, Hemment & Giannachi (2010). They say that research through design has two important aspects; looseness; being the number of targeted outcomes that designer allows, and openness; where a project is opened up to the public and allows them to be involved. In this project we say that we want to keep the possibility for involvement and change, while on the other hand we place only one main outcome in our design, where the agri-food production system is changed drastically and leaves a landscape with dense production functions in all synergy spaces between agriculture, water and urban area's.

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GOVERNANCE IN THE 'GROWING SMALLER' REGIONAL DESIGN

CAS GOSELINK

Strategic spatial planning, more specifically the regional design approach, employs design and spatial representations of a plausible future for regions, in order to gain insight in negotiating and exploring territorial changes. This proces through design tries to improve alignment between government and society (Balz & Zonneveld, 2015). The governance aspect deals, amongst others, with the processes, performances and coordination in the system of rules and decisions made by the government.

In our regional design proposal, based on the Dutch networked governance model of partnerships and dialogues, we tried to combine both top-down and bottom-up processes. By creating interdependancies between government and societal actors, participation is an important part of the decision-making process, and ensures that procedural justice has a place in this system. An example of this combination of top-down and bottom-up development can be seen in the timeline (figure 4.1.1.1, p. 94-95). The seaside aquaculture project, one of the strategic projects of the proposal, has already started with private bottom-up initiatives on the small scale. We propose to combine this proces with top-down instruments like regulations, subsidies and incentives, in order to stimulate and speed up the development process with the combined forces of government and local knowledge (figure 4.3.1.5, p. 112-113).

It is known that participation boosts governance processes, by creating understanding, adding legitimacy and the likeliness of delivering more effective results (Rocco, 2020)[1]. In our project, we have focussed on getting people acquainted with new systems and landscape based changes, in order to create an understanding and gain support. Knowledge is constructed in communication between actors, for which we have created the specific landscape typology of Agriculture Knowledgescapes (figure 4.4.1.7, p. 124-125). The knowledge of stakeholders is taken into account, by participation the strategy is more likely to deliver effective results. This is one of the reasons why both the combined bottom-up/ top-down development of the seaside aquaculture project, and the participatory development of the agriculture knowledgescape are the two strategic projects.

KNOWLEDGE IS CONSTRUCTED IN COMMUNICATION. THROUGH PARTICIPATION, THE GOVERNANCE PROCES IS MORE LIKELY TO DELIVER EFFECTIVE RESULTS

The government tries to achieve the goals and guidelines set in policies through the creation and adaptation of the decision-making-environment in which actors develop, also called second-order-design (Adams & Tiesdell, 2012). We propose to use a variety of planning instruments in order to create the environment in which our vision can be implemented. By guiding the development, we try to activate actors to participate in the development through a.o. fiscal measures like subsidies (figure 4.3.1.5, p. 112-113). Also, we try to enable actors to participate, by connecting them to eachother in the early stages of the development proces (figure 4.3.1.6, p. 114).

Through these processes, development strategies and planning instruments, we have integrated governance in our regional design proposal.

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[1] Source originating from Brightspace TU Delft (not publicly accessible)

KAROLINA TATAR

Regional design is a collaborative decision-making process which is to enable joint pursuit in a certain favorable direction (Balz 2020). Part of it is the necessity "to accept decisions made through a network organization, including decisions that may depart from generic policy." (Albrechts, 2004) that is why it is so hard to make far-reaching transformations. Actually, the world is developing slowly and steadily over the majority of the time. Only sometimes anomalous, a new factor can cause rapid changes (van Raak 2020). Those factors are pressures which undermines the current order and makes it obsolete. With that in mind we looked for that kind of potential which could help us to make a transition towards circularity in the South Holland Province. We realised that this pressure will be a climatic crisis that will push a spatial battle between Agriculture, Urban settlements and Water- to extreme but to be even able to use this catalyst to influence decision-makers, proper planning tools must be used. Just as we were taught some of them "may be better suited to affecting some forms of change than others" (Tiesdell 2005) and make a start -**THE VISION** is the most suitable one from the menu.

With all that knowledge we knew how important the tool would be for us and that it must be a brave one. In our vision the South Holland in 2100 is a resilient waterscape where water, agriculture and urbanisation work in unison ensuring safe and healthy conditions for both society and environment. This story about such a far future, based on research and knowledge, shows a desirable perspective to give a reason for steps that need to be taken already today. This is a universal signpost towards socio-spatial justice based on key goals and arguments (environmental safety, livability of human settlements and productiveness) that different interest groups could not undermine (Dabrowski 2020).

The vision allowed us to set the first, strategic steps and areas for intervention to start a the process; vurbnable Farmers and residents of Goeree-overflakkee would be already willing to develop and implement methods of producing food integrated with water if this is a step towards a profitable and safe flood protection system. Also, the inhabitants of cities and agricultural areas in the Randstad would be more inclined to create hybrid spaces as it is the only way to gain benefits while avoiding the consequences of the climate crisis.

THE VISION WHICH INCLUDES THAT KIND OF SHARED INTEREST WOULD ALLOW US TO CONVINCE ACTORS TO CHOOSE -FROM VARIOUS POSSIBLE AND BENEFICIAL OPTIONS - EXACTLY THOSE ONES THAT ARE NECESSARY TO BUILD CIRCULAT ECONOMY AND SUSTAINABLE FUTURE OF THE PROVINCE.

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SIMON BOHUN

GROWING SMALLER

We came up with the name "growing smaller" while thinking about the goals of our project. The work "growth" refers to the fact that the province has to deal with a growing population and a growing food demand. But more importantly, the region's society should "grow" and flourish in spite of other pressures. Simultaneously, the province will need to limit itself. Population and economy will need to grow on a smaller amount of land in favour of giving back space to water and nature.

REGIONAL TRANSITION

To make our strategy towards this vision implementable, the theory of transition management, explained in Roel van Raak's (2020 February 26) lecture, was very useful to us. Transitions can be defined as "changes from one socio-technical system to another" (Geels, Schot 2007. p. 399). Transition management comprises actions that intentionally influence this process (Van Raak, 2020).

Based on these transition theories, we chose two strategic projects that could help with testing and implementing "niche-innovations" (Geels, Schot 2007. p. 399) in the dominant regime. But socio-technical transitions go beyond technical innovation. Since a wide range of stakeholders needs to get involved to influence transition processes (Van Raak 2020), governance is a crucial topic in our strategy.

GOVERNANCE

As Patsy Healey (1992) argues, urban planning is experiencing a "communicative turn", a change from hierarchical to "planning through debate". In line with transition theorists, she envisions the change of systems as a democratic process (ibid. p. 156). Marcin Dąbrowski (2020) explained in his lecture that this shift increases the complexity of projects and makes the consideration of actors and their attitude towards the project even more important. This results in the problem of contemporary urbanism education that real-life processes are hard to simulate in a course. Writing about the importance of communication during to a nation-wide quarantine (due to the corona pandemic 2020) is even more paradox.

Admittedly, in some situations the complexity of the project overwhelmed us. But using various methods of stakeholder mapping helped us to envision the application of the project in a practical situation. We thought of the motives of actors, put them in relation to each other in a wide range of drawing and included them in different phases of our project. And beyond that, in our second strategic project, we put a focus on public participation as a means of spatial justice. To achieve their regional implementation we included not only information of other stakeholders, but also aimed at co-production between scientists, farmers and the population.

GROWING AS A TEAM

To sum up, I believe that we have learned a lot about the incorporated of governance in regional design projects, despite the extraordinary circumstances of this quarter. Working in a team might give us some insight in the complexity of communication in urbanism. This was especially true after the announcement of strict measures against the corona virus. Nevertheless, I believe that we have learned to grow while being limited in our ways of communication.

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ZHE HOU

For the urbanists, one of the challenges we must face is to plan for the future. We can't foresee the future, but our responsibility is to "build a stronger connection between educational research and real-world problems" (Amiel & Reeves, 2008, p.34) through a systematic and scientific research framework. Nowadays the world situation is becoming more and more complicated, and the probability of uncertain events is greatly increased. For example, the impact of the coronavirus on global cities has exposed many serious problems in urban planning and governance. In this context, the method of design by research is becoming more important. In our project, we did research both on the existing model and potential methods in water management, agri-food production and urbanization to find potential for designing more resilient landscapes. For example, by optimize the current agri-food sector and add the seaweed sector to close the cycle, we create a more circular agri-food sector which is more efficient and less space-demanding, so that we can use the saved space for resilient planning.

Through mutual evaluation of research and design we constantly reflect on the design and supplement the research in the process of improving vision and strategies. For example, according to the vision concept, we put forward six landscape typologies to be implemented in the transitional areas. However, the specific locations of these typologies are lack of firm basis. Therefore, we have supplemented the research on terrain, flooding area, agricultural area, dense population area, etc. Research, design, evaluation, and revision are integrated as a circular process to achieve a satisfying balance between our ideas and realization. (Plomp, 2017, p.13)

In my view, our plan can still improve from the following aspects:

1. Who will pay the bill for the strategies for benefiting disadvantage groups and promoting spatial justice? We plan to place agriculture hubs in low-income neighborhoods as a catalyst to improve the livability. How to design a cooperative mechanism as a platform to involve multiple stakeholders?

2. How to improve existing policies to protect the transitional landscapes from becoming the exclusive grassland of specific stakeholders?

In conclusion, on the one hand, the method of research by design improves the resilience of spatial planning strategies in our project. On the other hand, our project has been improved through a circular process of research, design, and evaluation. Throughout the learning process of this project, my greatest gain is learning how to organize research and design process systematically. Research by design is like building a castle. The most important thing is to have a clear blueprint in mind, that is, clear logic for organizing research and design. Then you will find that even the castle is not there, the castle is already there.

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