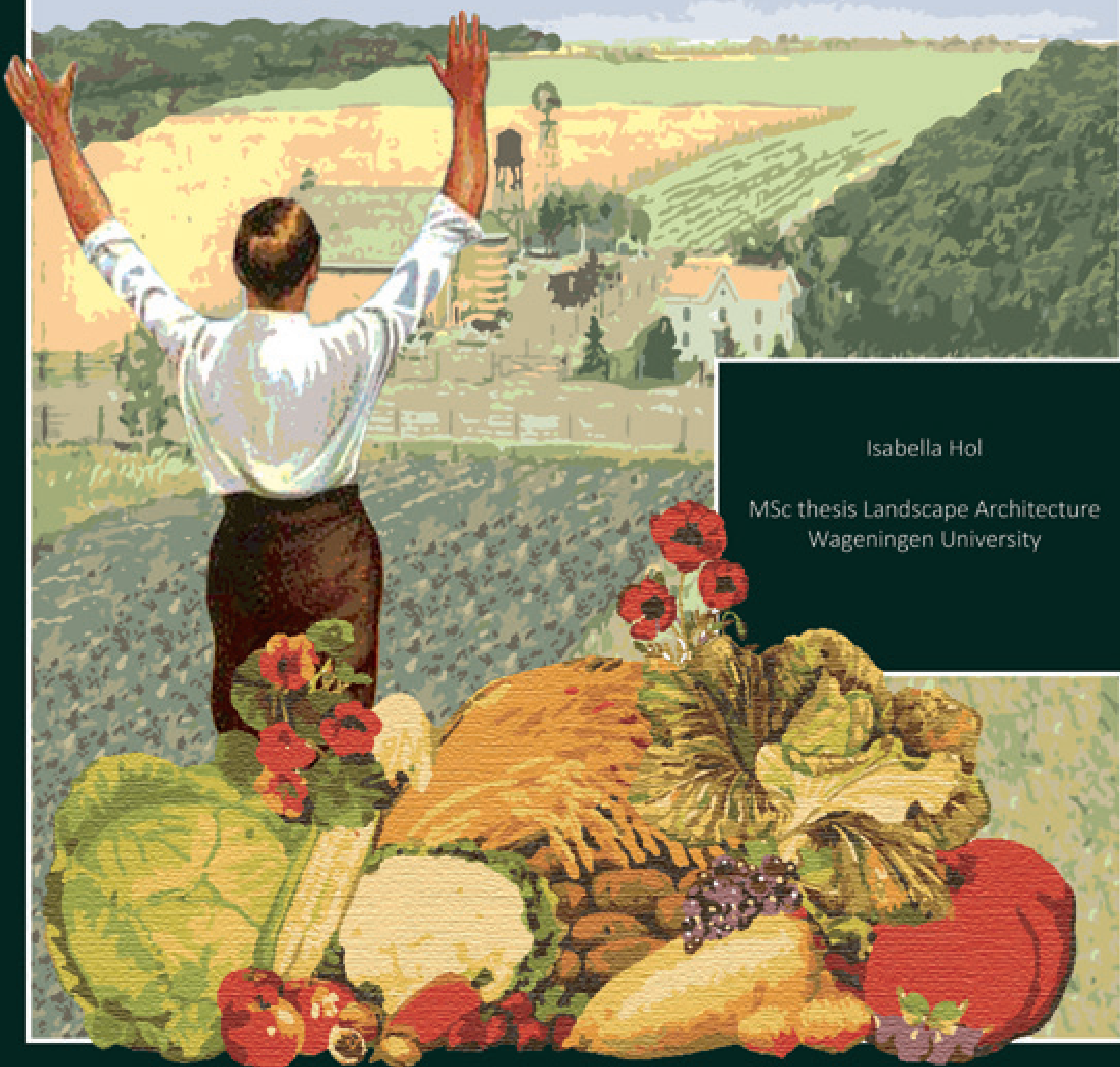
Permanent Polder Food

Exploring permaculture theory and cultural food heritage values for the landscape design of a sustainable city region food system in the Haarlemmermeer



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MSc thesis Landscape Architecture
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ABSTRACT

The emergence of global food systems transformed food regions into mono-functional production landscapes. These landscapes cause cultural fragmentation, environmental deterioration and an undermining of regional autonomy. Food related organizations and institutions call for the urgency to strive against these conventional food systems by creating sustainable food systems instead. This challenge requires new, adaptive and holistic approaches which are currently lacking. With their new role as agro-architects, landscape architects can play an essential role in the development of sustainable food systems that guarantee the protection of cultural and environmental values, whist ensuring the livelihood for farmers.

This thesis focuses on the development of design principles which can be used to create new, sustainable food systems in city region landscapes. Three theoretical concepts were used to set the foundation for this research: city region food system, cultural food heritage, and permaculture; encompassing the three pillars of sustainability: environmental, social, and economic. The food region Haarlemmermeer was used as a case study to deploy this theoretical knowledge into design practice, as Haarlemmermeer specific design guidelines were developed. Subsequently, these guidelines were applied and tested in designs to provide input for a sustainable food system in the Haarlemmermeer. From these designs, a number of recurring patterns and matching guidelines were observed on multiple scale levels. Guideline interconnections were made to subsequently generalize these into eleven design principles. These principles provide landscape architects with practical tools for the creation of sustainable food regions worldwide.

Keywords: *global food system, sustainability, agro-architect, city region food system, cultural food heritage, permaculture, design guidelines, design principles*

PREFACE

This thesis is the final step of the MSc program Landscape Architecture at Wageningen University and Research. During my studies in Wageningen, my interest was increasingly drawn to the design of sustainable food landscapes, because they include a certain degree of urgency and functionality. As a landscape designer I think this is important and I see it as a challenge to combine these functional qualities with aesthetic landscape values to achieve a sound design. The food-track courses that I followed during my masters, and in particular the "Ecological Design and Permaculture" course, together with an increasing public interest in sustainable (cyclic) agriculture, have strengthened this interest.

As a consequence, this theme was further expressed in my master's thesis, in which I looked for possibilities considering the design of sustainable, regional food landscapes. The knowledge gained from previous bachelor's and master's education at Wageningen University has been of great value to fuel the research in this thesis. Another source of knowledge and inspiration were the sessions with my two supervisors Kevin Raaphorst and Sjoerd Brandsma. Although the process was not always easy, they remained positive and helped me stay focused and to strive for the best possible result. That is why I would like to seize this moment to thank them. In addition, I want to express a moment of thanks to Gabriëlle Bartelse, who enthusiastically motivated me at the beginning of this thesis to get started with my fascination on sustainable food landscapes.

Furthermore, I would like to thank Yvonne Lub and Barbara Luns (Podium van architectuur), and Kathrin Hannen for introducing me to the Haarlemmermeer, Pieter Boone who involved me at a food workshop and field trip in the Haarlemmermeer, and experts Kees van Veluw and Anne van Delft for providing me with in-dept knowledge on permaculture, and cultural food heritage in the Haarlemmermeer. I also want to thank all the other experts who provided me with their expertise during the thesis process.

I would also like to thank my thesis room buddies for the meaningful discussions and the relaxing coffee breaks! A special thanks goes out to Merel Gerritsen, with whom I jointly started this thesis process. Thank you for your advice, the helpful discussions, and the mental support when needed.

Last but not least, I would like to give a special thanks to my family who always supported me during this thesis period and during my entire study, my boyfriend who was always there for me, and my friends for their endless support.

With this thesis I hope to inspire and challenge others to contribute to a more sustainable interpretation of our future food system.

CONTENTS

INTRODUCTION

"Cooking is the landscape in a pan"

- Josep Pla (Garcia-Fuentes et al., 2014, p. 160) -

1.1 FOOD SYSTEMS AT RISK

GLOBAL FOOD SYSTEMS

Over the centuries, mankind changed its way of life from self-sufficient systems towards interdependent globalized systems, visible in almost all aspects of life. In this thesis I will focus on this globalization effect in relation to our food system.
"*For the first time in human history, more people now live in urban areas than in rural ones"* (Jennings et al., 2015, p.5). Inhabitants of these urban areas consume over 75% of the world's resources. In feeding all these people, globalized food systems originated, through which consumers are supplied with a year-round, constant availability of low priced, diverse food products (Wiskerke, 2015). The production of these products is no longer driven by local cultures, but by the economies of scale, taking place far outside the city borders (Wiskerke, 2015; Steel, 2008). Cultural food landscapes become fragmented and site-specific landscape characteristics disappear (Antrop, 2004). As consumers feel less connected with the origin of their food, a dichotomy arises between rural and urban life, resulting in a *'food from nowhere'* character (Antrop, 2004; Weis, 2007; Wiskerke, 2015).

Philip Lymbery, Chief Executive of Compassion in World Farming, argues that: *"factory farming is not – as some contend – an efficient, space-saving way to produce world's food, but rather a method in which the invisible costs are actually far higher than the savings"* (Van der Zee, 2017). Upscaling processes have resulted in mono-functional production landscapes (Academie van Bouwkunst, 2017). These monocultures are specialized in a few crop varieties, causing a loss in many other varieties and therewith, a degradation in biodiversity. Besides, the farmed varieties often require excessive amounts of agro-chemicals, due to their sensibility to pests and diseases. These chemicals induce a deterioration of the soil and threaten our food security (Viljoen et al., 2005; Van der Zee, 2017).

Aside from the deterioration effects in terms of environment and traditional food landscapes, global food systems contribute to the destruction of our regional autonomy and economy. Regional markets are being outcompeted and dependency on global connections creates vulnerability in withstanding a sudden (food)crisis (Baraggia, 2016; Steel, 2008).

Globalization processes have created new food landscapes over the years. These systems often stand in the service of economies of scale, whereas previous landscapes deteriorate, both culturally, environmentally and economically. There is an urgency to strive against these conventional food systems and create more sustainable ones instead. As Hilal Elver, the UN rapporteur for the right to food stated: *"we need to move away from industrial agriculture towards agro-ecological models"* (Van der Zee, 2017). Though, a completion of this new food system, based on agro-ecological models, is still vague and urgently calls for a new strategy.

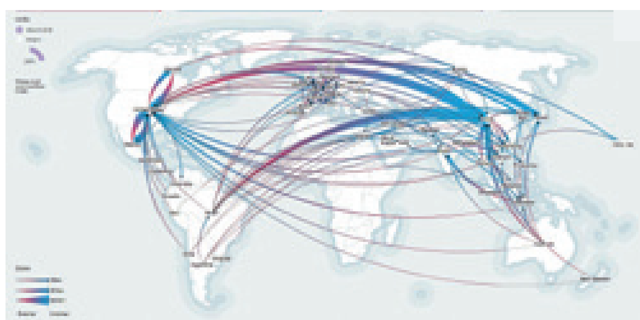


Figure 1.1: import/export of agricultural products worldwide (Chatham House, 2017)

TOWARDS A REGIONAL FOOD SYSTEM

When looking at the spatial configuration of our current food system, we can see that the original connection between urban and rural areas was lost into a highly complicated system of food flows worldwide (figure 1.1). The Food and Agriculture Organization of the United Nations promotes a more sustainable system to restore rural-urban connections and reinforce regional autonomy, the so called: city region food system, defined as: *"the complex network of actors, processes and relationships involved in food production, processing, marketing and consumption, and related waste, in a given geographical region. A flow of people, goods and ecosystem services exists across this regional landscape. This rural-urban continuum fosters interdependence of rural and urban economies"* (FAO, 2016, p.2).

INCLUSION OF CULTURAL FOOD HERITAGE

Although traditional food landscapes have often no value in global food systems, they can be highly useful in creating a sustainable landscape. When site specific cultural food characteristics are valued and transformed into a form of heritage, they can be deployed as promotor of a certain region and create a 'sense of belonging' (Bessière, 2013; Di Giovine & Brulotte, 2014). In this way, revitalizing cultural food heritage strategies offer possibilities in the realization of a sustainable culture.

POSSIBILITIES OF PERMACULTURE

Permaculture is the shortened term for permanent agriculture, defined by Bill Mollison as: *"the conscious design and maintenance of agriculturally productive eco-systems which have the diversity, stability, and resilience of natural ecosystems"* (Mollison, 1988, p. ix). It is based on design which: *"works with, rather than against nature"* (Althouse, 2016, p.10). Aside from this main function of sustainable food production, ancient- and current permaculture practices also take into account site specific cultural values such as local community- and economy building and the creation of knowledge (Van Bemmel et al., 2017). The use of this holistic approach differentiates permaculture's worldview from the conventional system of 'thinking in different disciplines' (Ferguson & Lovell, 2013; Steel, 2008; Wheeler, 2012). As Carolyn Steel mentions in the epilogue of her book Hungry City:

"*Permaculture is the farming of the future: farming that renews itself, that works with the land, not against it, that harnesses nature's own ecosystems, and crucially, that allows people to live on the land if they want to"* (Steel, 2008, p. 309).

The field of landscape architecture can easily be linked to the philosophy of permaculture since: *"the core of permaculture is design"* (Mollison, 1988). As landscape architect Keni Althouse describes: *"Landscape architects use the design process every day and there the potential exists to involve permaculture design principles into their process"* (Althouse, 2016, p. 16). The implementation of permaculture's design principles could contribute to the creation of an environmentally responsible landscape design. Vice versa, landscape architecture can contribute to the field of permaculture; as permaculture often lacks aesthetic qualities, landscape design can assist in realizing them. With this, both fields raise each other to a higher level of quality, creating both functional and beautiful places (Althouse, 2016).

In most cases, permaculture involves small-scale applications and lacks implementations on the regional/business scale (Suh, 2014; Holmgren, 2007). It is stated that: *"this lack of data for a business perspective forms the largest weakness of permaculture and prevents it from already playing a more impactful role in the agrifood transition"* (Van Bemmel et al., 2017, p. 17).

1.2 PURPOSE STATEMENT

In the search for a more sustainable food system, possibilities can be found within different fields of knowledge. The city region food system beholds capabilities of restoring regional economies, whereas the use of cultural food heritage and permaculture theory offers a range of solutions considering cultural and environmental qualities. When combining these different fields, a new strategy can be explored in terms of a holistic and sustainable food landscape, contributing to the demand of new agro-ecological models, In my thesis I will research this proposed strategy and test its capability of outcompeting our current economies of scale, whilst improving the environmental and cultural quality of our food landscapes.

ROLE AS AGRO-ARCHITECT

For the field of landscape architecture I see a great opportunity in this growing need for new, sustainable food landscapes.
Throughout history, the farmer has been the most important designer of our food-landscapes. Though, with the process of globalization, farmers alone are not capable anymore of managing this system in a sustainable, responsible manner. As director of the Dutch cooperation of agroforestry states: *"there is need for an agro-architect who works with the design of productive food landscapes"* (van Druenen, 2018). With this new role as agro-architect, landscape designers can play an essential role in structuring regional food landscapes in which cultural and environmental values are guaranteed whilst farmers can flourish in profitable, yet sustainable food production. As 'design around food' is still a relatively new and unexplored part of landscape architecture, this research provides an enrichment in the art of landscape design.

1.3 RESEARCH LOCATION

For this research, a case study location will be used to explore possibilities in solving the knowledge gap. As this knowledge gap covers quite a holistic and utopian-like nature, it is important how this will reflect upon the chosen case study location. Emphasis is put on the exploration of general solutions for sustainable food systems in regional landscapes. This means that the chosen location is not focused on improving that particular food region, though it is used as a means to solve the general knowledge gap and show possibilities of new, sustainable food system implementations. In this way the research contributes both to an improvement of the case study food system, whereas the final, generalized outcomes contribute to an improvement of regional food systems worldwide. To ensure this process of generalization, it is important that the case contains a representative location considering the city region food system landscape.

Since this research explores sustainable food production methods, there is a need for actual surface to build upon. Therefore, the case study area will focus on the actual countryside where the majority of food is produced. Besides, attention will be paid to the transition zone between these production lands and the city, where linkages need to be found to re-connect consumers with their surrounding food system. Urban areas will mainly be used as input for consumers- and region characteristics, whereas the countryside covers actual surface for design implementations. The case study scope is figuratively shown in the pie slice out of the city region food system landscape (figure 1.2).

The case study site for this research is located in the Metropolitan Region of Amsterdam (MRA). Within this city region landscape, I will focus on the production lands of the Haarlemmermeer, encompassing all aspects of the study scope (figure 1.3).

Figure 1.2: general case study scope

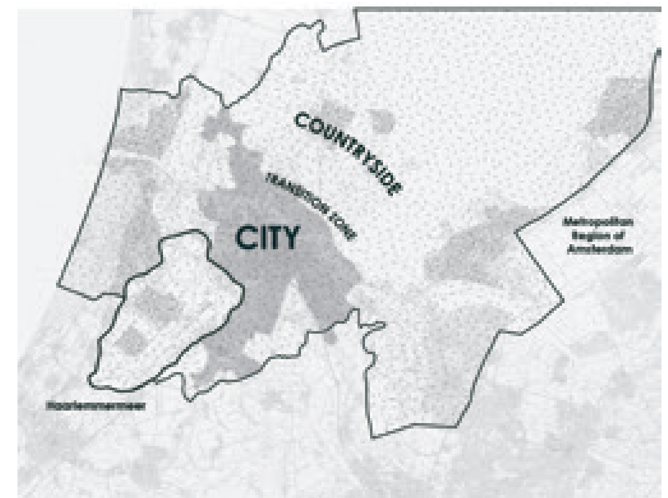


Figure 1.3: research case study scope: MRA and Haarlemmermeer

METROPOLITAN REGION OF AMSTERDAM

The metropolitan region of Amsterdam encompasses dense urban cores, gradually shifting into semi-urban areas, urban edges, and rural food production lands. As can be seen in the analytical maps of the 'Evidence-based Food System Design' (figure 1.4) all links/components of the food supply chain system (production – processing – distribution – consumption – disposal) are present in the metropolitan region of Amsterdam (Van Bossum, 2018). The food production lands are optimized for efficient food export within the conventional, unsustainable global food system. This results in problems such as fresh water shortage, soil subsidence, salination, nature reduction, a lack of urban-rural connections, urban spread, destruction of traditional landscape structures and disappearance of small businesses (Provincie Noord-Holland, 2014). With the rise of these problems, interest grew in both business- and policy bodies to improve MRA's food system and develop a sustainable example for the world (de Boer et al., 2014), matching the ambitions of this thesis.

HAARLEMMERMEER

As I focus on the possibilities considering food production it is valuable to look at the potential productivity of different types of food within the MRA (figure 1.5). As can be seen, the peat meadow areas hardly fulfil added value in terms of potential productivity (max. 20%). Currently these lands are mainly covered with grassland for livestock farms, as other type of food production is hardly profitable. The coastal areas are characterized by their sandy soil and cannot compete with the more productive clay soils in the reclamation lands. Within these lands, the Haarlemmermeer beholds the highest productivity level for the different types of food production, giving it the potential of becoming the food-engine of the MRA. Besides its high potential productivity, the Haarlemmermeer is situated in an adjacent position with the urban edge of Amsterdam and Haarlem, meeting the requested study scope. Also, the Haarlemmermeer beholds some of the most representative problems within the MRA, such as salination, soil deterioration, fresh water shortage, urban spread and nature reduction (Provincie Noord-Holland, 2014).

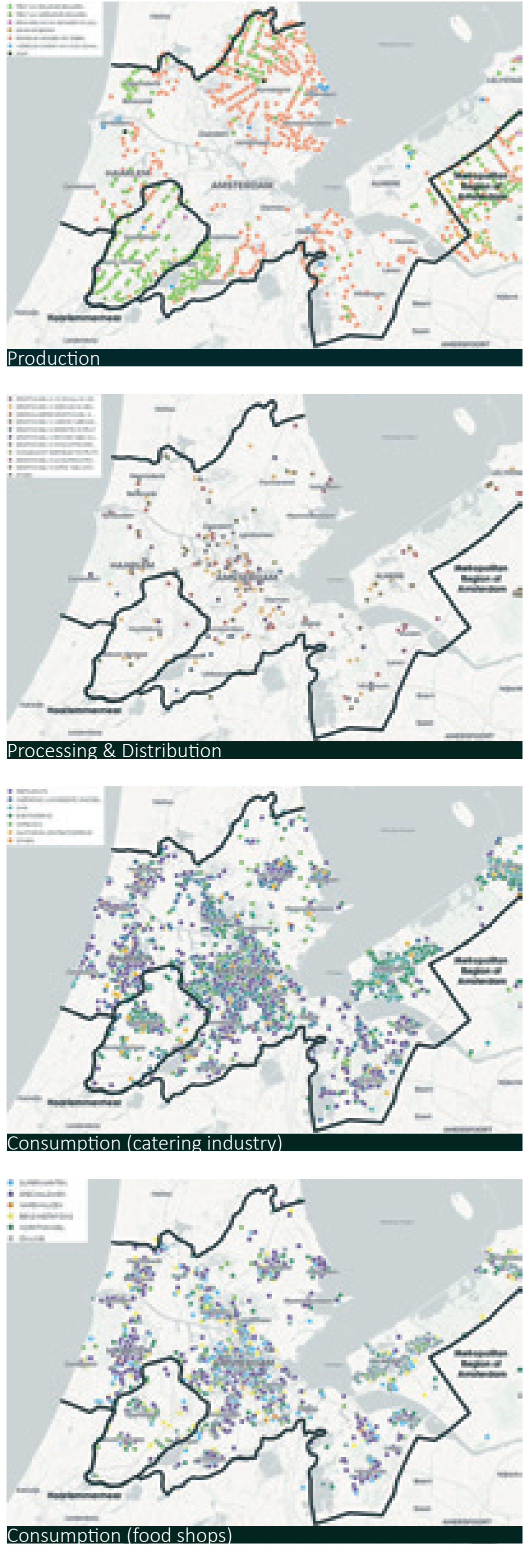


Figure 1.4: links/components of the food supply chain in the MRA (Van Bossum, 2018)

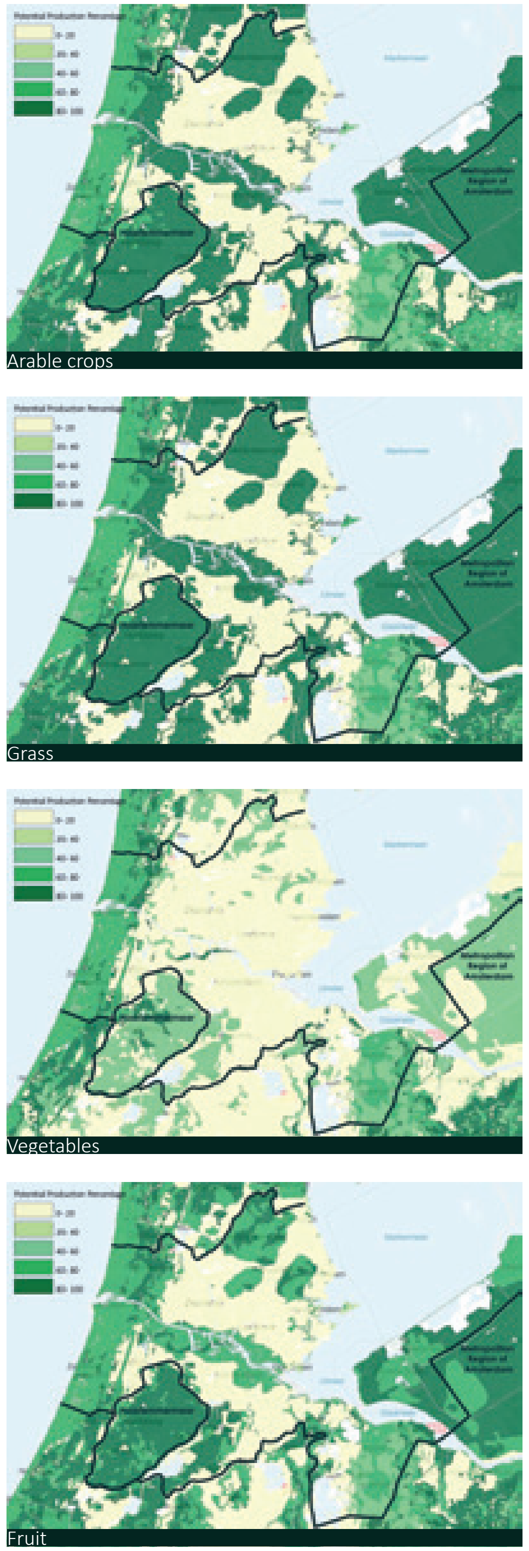


Figure 1.5: potential production percentages per different food product in the MRA (RIVM, 2017)

Within the Haarlemmermeer, the airport of Schiphol covers fairly dominant influences and land use surface. The polder design, resulting from this thesis, serves as a means to explore possibilities for new, sustainable regional food systems worldwide. As the average food region does not encompass airports of such scale, and as this field of knowledge does not fit the focus of the research, this element within the Haarlemmermeer is not treated with a great level of importance. In the case study design it will be slightly included, but it will be omitted in the general outcomes.

1.4 RESEARCH OBJECTIVE & QUESTIONS

The overarching objective of this thesis is to design principles which can be used to create a new, sustainable food system for the city region landscape. In this research, this will be done by combining the theories of the city region food system, permaculture, and site specific cultural food heritage. Insights gained during this research will be used and tested through a design for the Metropolitan Region of Amsterdam, with the Haarlemmermeer as regional focus site. This design will lead to both case study specific design guidelines, and generalized design principles, applicable by landscape architects in different food regions. The design principles can be seen as universal, whereas the practices will vary per situation and place (Althouse, 2016).

To reach the objective and therewith fill the identified knowledge gap, research questions have been made. The sub-research questions and sub-design question contribute to answering the main research question that overarch the entire research.

MAIN RESEARCH QUESTION

What design principles are needed for creating a sustainable food system for the city region landscape, using permaculture theory, in combination with site specific cultural food heritage values?

SUB-RESEARCH QUESTIONS

1. How sustainable is the current food system in the city region of the Haarlemmermeer?

2. What Haarlemmermeer specific cultural food heritage values are suitable to strengthen a sustainable food system for the city region landscape?

3. How could permaculture theory be scaled up into implementations for the city region landscape of the Haarlemmermeer?

SUB-DESIGN QUESTION

4. How to design guidelines for the redesign of the city region Haarlemmermeer into a sustainable food system landscape?

RESEARCH APPROACH & METHODS

"Research is a formalized curiosity. It is poking and prying with a purpose."

- Zora Neale Hurston (Wikiquote, 2019) -

2.1 THEORETICAL FRAMEWORK

As stated by the objective, this research combines three theories; the city region food system, permaculture, and site specific cultural food heritage. This section will elaborate on how these theories will be used.

CITY REGION FOOD SYSTEM LANDSCAPE

To ensure a holistic design approach and overcome traditional sectoral approaches, the food system must be described and understood in an integrated, systemic way. It must behold both essential system-components, as well as flows between them. A theory that covers these requirements is developed by researchers of the Landscape Architecture Chair at the Technical University of Berlin. Here, the 'City Region Food System (CRFS)' is used. This planning approach is promoted worldwide by the UN-Habitat and the FAO (Kasper et al., 2017). In this thesis, I will use this concept to elucidate the meaning and aims of a sustainable city region food system landscape. The different components and flows of this CRFS can be used as an analytical framework and leading structure to analyse what a food-system for the city region landscape constitutes.

CULTURAL FOOD-HERITAGE

A research on cultural landscapes over time tells a lot about how certain places were used in both physical - and invisible practices. In theories this is described as tangible and intangible identities of cultural heritage (UNESCO, 2017; Taylor, 2017) Tangible identities relate to physical features, whilst intangible identities can be found in ideologies and cultural traditions (Taylor, 2017). For this study, specific focus lays on the food aspect of cultural heritage. Cultural food heritage will be researched through both tangible- as well as intangible values. Food landscape changes over time are analysed and cultural food heritage is valued in its ability to contribute to the restoration of deteriorating food landscapes, turning them into sustainable ones.

PERMACULTURE

The theory of permaculture beholds the creation and maintenance of 'agriculturally productive eco-systems' (Suh, 2014). This makes permaculture an important tool in researching the design for a sustainable food-system. The practice of permaculture design was further developed by Bill Mollison as: *"A system of assembling conceptual, material, and strategic components in a pattern which functions to benefit life in all its forms. It seeks to provide a sustainable and secure place for living things on this earth"* (Mollison, 1988, p. ix). He elaborated this definition with design principles, inherent in permaculture designs for any scale and climate (Mollison, 1988). As current permaculture designs mainly take place on the garden-scale and there are hardly regional examples, this research beholds the challenge of exploring upscaling capacities of permaculture principles.

CONNECTING THEORIES

In this thesis, the pre-mentioned theories will be used in equal importance. Separately seen, the theories do not encompass exceedingly new insights. However, it is the combination that makes it interesting to achieve the overarching aim of creating a sustainable food system for the city region landscape (figure 2.1).

Figure 2.1: theoretical framework

DESIGN PRINCIPLES

By translating research outcomes into generic design principles, knowledge can be transferred to work beyond one specific case, towards a more generalized set of situations. Through this generalization, a stronger link can be achieved between design and research (Prominski, 2017). Two advantages of the use of design principles in the design process are mentioned by Prominski (2017): *"First, they speed up reflective practice through preselected, recommended suggestions and avoiding getting locked in the design process. Second, they allow designers to apply the principle to any specific design case where individual creativity is mandatory"* (Prominski, 2017, p.196). This openness, unlike prescribed solutions, leads to unique and site-specific results (Prominski, 2017). However, he also emphasizes how design principles cannot automatically be seen as a guaranteed recipe for success, operable by non-designers. They must cover a sense of abstraction that guides design, while leaving space to adapt them to specific situations. Hence, design principles do not automatically guarantee a good design and skilled landscape architects are needed to apply them in correct ways (Prominski, 2017).

In this research, results from the case study design will be used to obtain site specific design guidelines to create a sustainable food system for the city region landscape of the Haarlemmermeer. Subsequently, these guidelines will be abstracted into general design principles to guide landscape architects in creating sustainable food systems for different city region landscapes.

2.2 RESEARCH FRAMEWORK

Figure 2.2 shows the general research framework used for this thesis. It consists out of two main parts; the general part, dealing with research on sustainable food landscapes, and the site specific case study part, dealing with the Haarlemmermeer. Each sub-research question is answered by a combination of results from both parts. First, knowledge generation starts within the general part, in which I execute literature studies on all three theories of a sustainable city region food system, cultural food heritage and permaculture. Gained knowledge on how to analyse these different theories in a specific region is used in the case study part through a variation of approaches and methods. The sub-design question is answered by the accumulation of site specific analysis knowledge, in combination with theoretical knowledge. This results in preliminary design guidelines for the case study location, sub-divided per scale level. These preliminary guidelines serve as main ingredient for the design phase. At last, these results are evaluated and generalized to conclude with answering the main research question. The research ends with a critical discussion and reflection.

RESEARCH VS DESIGN

With its practical approach, landscape design aims for a systematic acquisition of knowledge on specific practical objectives. Practical research is used to create verifiable knowledge that explains the different outcomes of design (Nijhuis, 2015). As stated by Nijhuis, the spatial composition of landscape design provides: *"a basis for knowledge-based design, where knowledge of landscape architectonic compositions is the prerequisite for the formulation of new designs"* (Nijhuis, 2015, p. 42). In practicing landscape design research, one can obtain design principles,-knowledge, and -insights that can be used in creating/refining designs. It can be stated that research in landscape design beholds the key point of landscape architecture (Nijhuis, 2015). Considering this thesis, the integration

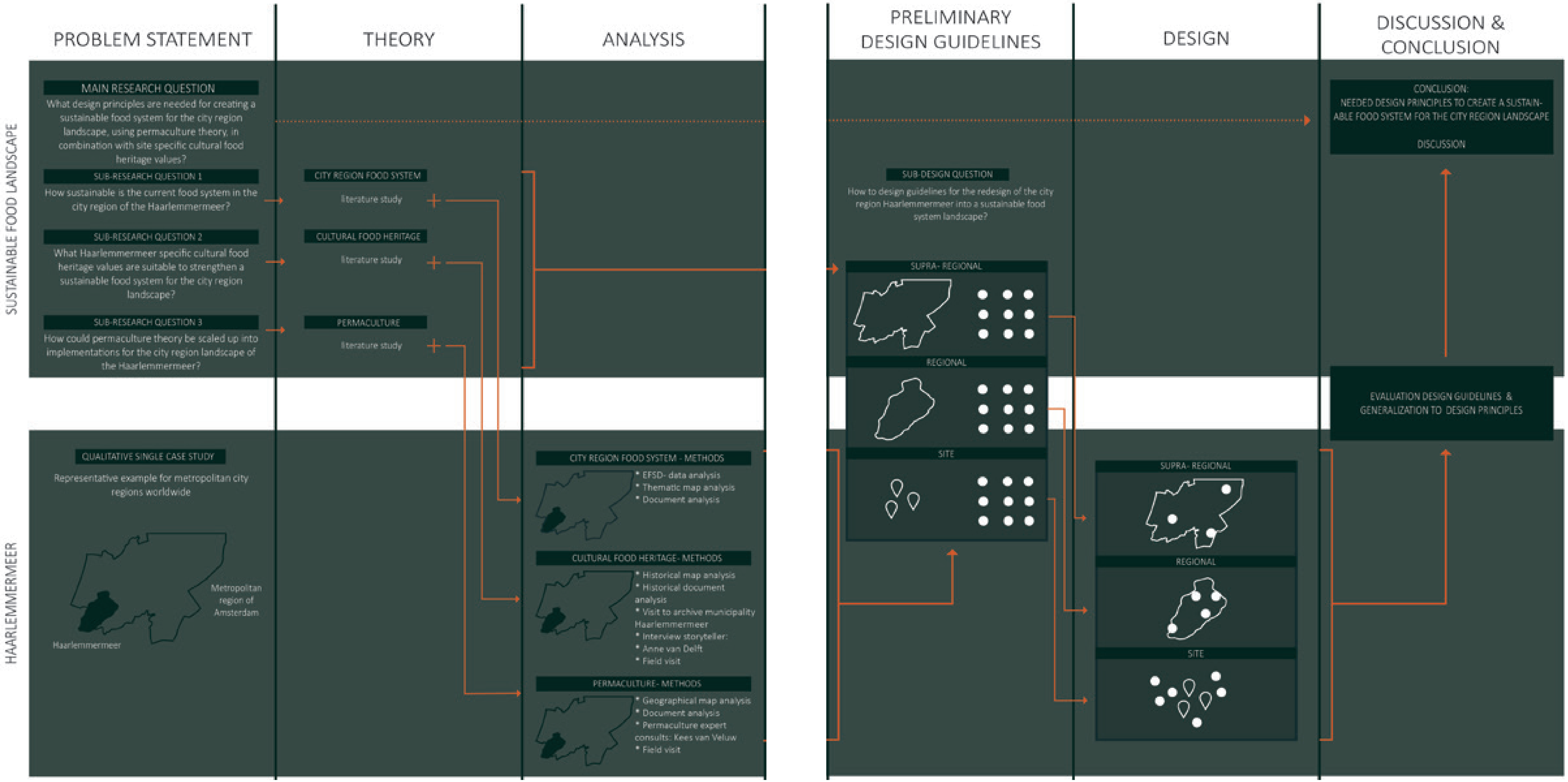


Figure 2.2: research framework

of research and design takes place with the use of a *Research Through Designing* approach (Lenzholzer et al., 2017).

WORLDVIEW

This research is characterized by a process of knowledge accumulation through pluralistic approaches. It aims for the realization of a 'fully' integrated design outcome; a process that beholds the worldview of pragmatism (Lenzholzer et al., 2017). *"The strength of a pragmatic approach is that the qualities of various knowledge claims and methods can enhance and complement each other"* (Lenzholzer et al., 2013, p. 125). Because of the big research scope, a variety of knowledge is used and needed to collect valuable data from. Part of this data lies within the workings of nature and therefore needs a more post-positivistic type of knowledge. Whereas other data relates more to context embedded, socio-cultural issues, related to constructivist types of knowledge (Lenzholzer et al., 2013). The final aim for a sustainable food-system for the city region landscape considers peoples' immediate living environment and requires big changes and action. This change will be executed within the case study and can be considered a type of transformative process (Lenzholzer et al., 2013). With the use of these various types of knowledge, the pragmatic worldview includes the strength to create design principles with useful and design-relevant knowledge (Lenzholzer et al., 2017).

QUALITATIVE SINGLE CASE STUDY

As part of the different theories is related to site specific values, I decided to test their possibilities in the form of a qualitative single case study. A case study is defined: *"a well-documented and systematic examination of the process, decision making and outcomes of a project that is undertaken for the purpose of informing future practice, policy, theory and/or education"* (Swaffield, 2017, p. 106). With this single case study approach, I question conventional food system theories and aim to explore new ones. In combining existing theories on city region food systems, cultural food heritage and permaculture within the single case study, general design principles for future practices will be developed. With the strategy of 'analytical generalisation' (Swaffield, 2017) the case will serve to add to universal theoretical knowledge. *"Hence theory develops inductively, as evidence accumulates"* (Swaffield, 2017, p. 108). The case study scope of the city region landscape is carefully chosen so that it can be compared with other cases worldwide. In this way one can learn from, and reflect upon its differences and similarities in different contexts (Swaffield, 2017).

With the use of a single case study, most data sources are placed within their natural setting and researched by the researcher herself as a key instrument. Multiple data sources and perspectives are applied and identified. Subsequently they assist in the establishment of a holistic picture of the study (Creswell, 2014). These features shape the qualitative nature of this single case study.

RESEARCH THROUGH DESIGNING

With the input of theoretical knowledge, followed by the process of a case study design to create generic design principles, new knowledge will be generated to applicate in design practices. This strategy belongs to the practice of *Research Through Designing* (RTD). It covers research processes in which design is actively involved and beholds the essential research component (Lenzholzer et al., 2017; Prominski, 2017). One of the basic principles of the RTD-process is the iterative process of testing and evaluating the design in circular loops (Lenzholzer et al., 2017). RTD can help to: *"bridge the utility gap of academic knowledge and applicability"* (Lenzholzer et al., 2013, p. 126). Within the general practice of RTD, the initial phase of this thesis belongs to the practice of Research For Design (RFD). In this practice, research outcomes are used to inform the design process (Lenzholzer et al., 2017).

To illustrate the essential role of design in my thesis research, I used the representation of a design process-model by landscape architect Rudi van Etteger (figure 2.3). This models contains a phase of analysis, to serve as input for scientific knowledge/RFD. In my research, this phase is practiced through literature study and site analyses. Gained knowledge provides input for the design of prototype solutions and some first models on the case study site. This phase often includes a step back into the analysis phase, as more specific questions arise considering the site. Such type of iterative reflection is pointed out by the circular loops shown in the scheme. The different models are transformed into a final plan for the site, including details. Reflection on this final plan provides general design principles that can be used beyond the specific site (Van Etteger, 2017).

The model shows how design is integrated through all parts of a research-design process. It covers the leading structure throughout this thesis (see appendix A for a better resolution of the scheme).

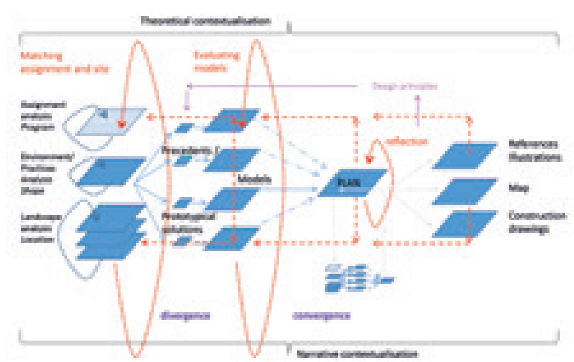


Figure 2.3: design process model by Rudi van Etteger (van Etteger, 2017)

2.3 METHODS & MATERIALS

The answer to each sub-research question is divided into a theoretical part and a case study part. The different data collection/analysis methods, data and data sources attached to these parts are shown in figure 2.4. The answer to the sub-design question is gained from different design methods (figure 2.5).

DATA COLLECTION / ANALYSIS METHODS

Within this thesis, design is used as the main method to practice research. This is visible throughout the whole research, expressed through the use of sketches, models, maps and other types of visualisations.

For the theoretical parts of each sub-research question, the data collection method of literature study will be used. The case study part will be answered through elaborated site analysis, consisting of data analysis, thematic map analysis, document analysis, field observations, semi-structured interviews and expert consults. The data collection method of field observation will provide this research with contextual descriptions of the observable and characteristic elements within the field setting (Silva et al., 2015). Observations can be schemed within the cultural-historical perspective of the landscape architect and will be noted through photographs and field notes (appendix C & D). The semi-structured interview method is used to gain focused insights into how people perceive the topic of cultural food heritage within the case study region. The data source of this interview is an expert on food-heritage in the Haarlemmermeer: storyteller Anne van Delft. The interview will be guided by a set of predetermined, open-ended questions (appendix F) driven by the responses of the interviewee (Silva et al., 2015). The expert consults are used to gain knowledge on the implementation of permaculture in regional settings, and their economic feasibility. Permaculture expert and -teacher at the WUR: Kees van Veluw, will consult me on these matters.

SUB-RESEARCH QUESTION 1: How sustainable is the current food system in the city region of the Haarlemmerm

THEORETICAL PART

Data collection/analysis method	Data	Data source
Literature study	*Articles, books, websites etc.*	*(online) libraries*

CASE STUDY PART

Data collection/analysis method	Data	Data source
EFSD- data analysis	*EFSD (Evidence based Food System Design)*	*EFSD- project (WUR et al.)*
Thematic map analysis	*Maps on food system components*	*EFSD- maps, GIS map database*
Document analysis	*Articles, books, websites etc.*	*(online) libraries*

SUB-RESEARCH QUESTION 2: What Haarlemmermeer specific cultural food heritage values are suitable to strengthen a sustainable food system for the city region landscape?

THEORETICAL PART

Data collection/analysis method	Data	Data source
Literature study	*Articles, books, websites etc.*	*(online) libraries*

CASE STUDY PART

Data collection/analysis method	Data	Data source
Historical map analysis	*Historical maps on (food) development*	*Topo tijdreis, Beeldbank Noord-Hollands archief*
Historical document analysis	*Articles, books, websites etc.*	*(online) libraries*
Archive visit	*Historical books (photographs)*	*Archive municipality Haarlem-mermeer*
Semi-structured interview	*Transcripts + documents*	*Storyteller Haarlemmermeer: Anne van Delft*
Field visit	*Photographs + field notes*	*Researcher*

SUB-RESEARCH QUESTION 3: **How could permaculture theory be scaled up into implementions for a city region landscape?**

THEORETICAL PART

Data collection/analysis method	Data	Data source
Literature study	*Articles, books, websites etc.*	*(online) libraries*

CASE STUDY PART

Data collection/analysis method	Data	Data source
Geographical map analysis	*Geographical maps*	*GIS map database, municipality Haarlemmermeer*
Document analysis	*Articles, books, websites etc.*	*(online) libraries*
Expert consult	*Transcripts + e-mails*	*Expert on permaculture: Kees van Veluw*
Field visit	*Photographs + field notes*	*Researcher*

Figure 2.4: methods & materials 1

SUB-DESIGN QUESTION : How to design guidelines for the redesign of the city region Haarlemmermeer into a sustainable food system landscape?

DESIGN PART

Design method	Data	Data source
Design guideline generator	*Theory- and analysis outcomes*	*Thesis research (chapter 3 + 4)*
Design for the case study	*Design guidelines*	*Thesis research (chapter 5)*

Figure 2.5: methods & materials 2

THEORY

"There are no economies without ecosystems, but there are ecosystems without economies…"

- The economics of ecosystems and biodiversity (Brasser et al., 2015, p.36) -

3.1 SUSTAINABLE CITY REGION FOOD SYSTEM

FOOD SYSTEMS OVER TIME

To understand the necessity of creating more sustainable systems, it is worth recalling history and take a look at the role food played in city region landscapes over time. Prior to the industrial revolution, the absence of advanced machinery, effective preservation techniques and high capacity transport systems, forced people to grow food close to their homes. Cities developed around the co-existence of food and living. Boundaries of urban development were restricted by people's access to food production (Howe et al., 2005). In 'Der Isolierte Staat' Von Thünen tried to grasp this food-led urban development by structuring agricultural land use patterns. His model is based on the principle of declining food production intensity with an increasing distance to the market (figure 3.1). This principle is led by the financial model of decline in economic rent, with increasing distance from the city and associated increased transport costs (Sinclair, 2017).

Due to the development of advanced production technologies and transport systems during the Industrial revolution, advantages of distance became less important. Cities developed dense urban settlements and people were separated from direct contact with food production, taking place outside the city boundaries. The disappearance of food production from the city centres resulted in people's alienation from nature. This 'lack' of nature was slightly compensated by the initiation of allotment gardens and public parks in the city (Howe et al., 2005). However, the trend of urbanization developed considerably to our current situation in which urban land (or expected urban land) is much more valuable than rural land. Also transport costs to the market are no longer a determining factor. This resulted in an agricultural land use pattern in which we see an increasing intensity of food production with distance from advancing cities (figure 3.2), showing the exact reverse of Von Thünens 'Isolierte Staat' (Sinclair, 2017).

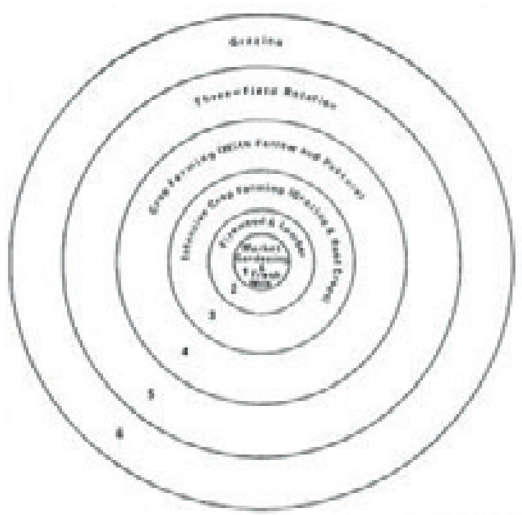


Figure 3.1: 'der Isolierte Staat' by von Thünen (Sinclair, 2017)

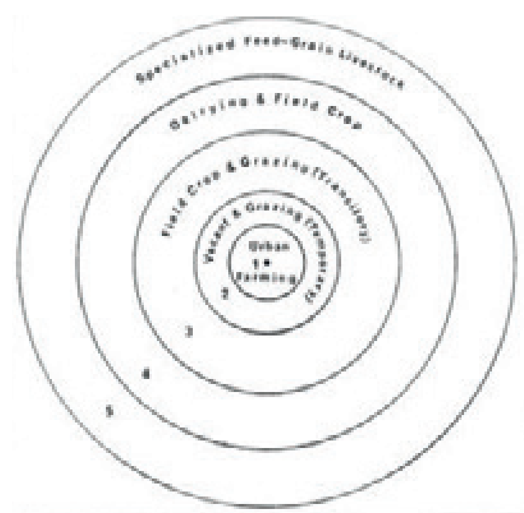


Figure 3.2: re-interpretation of 'der Isolierte Staat' (Sinclair, 2017)

THE CITY REGION FOOD SYSTEM DEFINED

Drawn from the previous overview we can state that the history of urbanism and agriculture is intricately intertwined, they cannot exist without each other. However, current trends show quite the opposite as city expansion and food production develop fairly independent from each other (Viljoen & Wiskerke, 2012).

There is urgent demand for a new food system that will restore the balance between rural and urban linkages. The food and agriculture organization of the United nations (FAO) proposes a food system on the city regional level, to reduce complexity in food flows, and to convert the system to a practical level that can be used to restore urban-rural linkages (FAO & RUAF Foundation, 2015). This new system is further developed by researchers of the Landscape Architecture chair at the Technical University of Berlin as the 'City Region Food System (CRFS)' (Kasper et al., 2017). This planning approach is promoted worldwide by the FAO and UN-Habitat and can be defined as:

"The complex network of actors, processes and relationships involved in food production, processing, marketing and consumption, and related waste, in a given geographical region. A flow of people, goods and ecosystem services exists across this regional landscape. This rural-urban continuum fosters interdependence of rural and urban economies" (FAO, 2016, p.2).

TOWARDS A SUSTAINABLE CRFS

Based on the vision of the FAO, six design ingredients are stated to achieve a sustainable city region food system. The overarching topic of these ingredients are the pillars of sustainability, namely: social-, economic and environmental improvement. Considering these elements together, we can develop an integrated approach for different regional landscapes, in which flows of goods, ecosystem services and people are managed (Baraggia, 2016; Forster et al., 2015).

DESIGN INGREDIENTS TO ACHIEVE A SUSTAINABLE CITY REGION FOOD SYSTEM:

• **Increase food-acces;** all inhabitants in the city region should have access to safe, nutritious, affordable and sufficient food, supported by a regional food culture that promotes well-being, equity and social cohesion (Baraggia, 2016; FAO, 2016).

• **Generate decent jobs and income;** a regional economy should be created in which local entrepreneurs find fair jobs and income opportunities, to reinforce regional autonomy (FAO, 2016).

• **Increase resilience;** this design ingredient promotes resilience against sudden disasters, by creating independence from distant supply sources and therewith, from the global market (Baraggia, 2016; FAO, 2016).

• **Foster rural-urban linkages;** this beholds a promotion of urban-rural relations in terms of ecological-, social-, and economic interactions. All sort of flows should be connected to create inclusiveness amongst different actors, prevent waste products, and to promote closed cycles (FAO, 2016; Kasper et al., 2017).

• **Promote ecosystems and natural resource management;** this design ingredient refers to a preservation of biodiversity, a reduction in energy consumption and a promotion toward closed energy/ product cycles. Therewith we aim to reduce the ecological footprint of our food systems and minimize environmental impact (Baraggia, 2016; Bohn & Viljoen, 2010; FAO, 2016).

• **Support participatory and inclusive governance;** in order to achieve the 'ingredients' stated above, there is a need for policy focused on food. This food policy should cover transparent regulations on the regional food chain. Food can herewith become a trigger for addressing broader issues (Dubbeling et al., 2017; FAO, 2016).

THE SPATIAL CONFIGURATION

A sustainable city region food system consists of five main components, following the stages of a food chain: production, processing, distribution, consumption and waste disposal. Aside from their consecutive order, these components are mutually connected through multiple food flows (figure 3.3). Each of the different components includes its own characteristics and possibilities in terms of a sustainable approach, based on the six design ingredients.

PRODUCTION

This component includes both the actual land/space on/in which food is produced, as well as the actors realising this production. It mainly takes place in rural areas, though some initiatives take place in the city (urban agriculture, agro parks, vertical farming etc.). This component is very dependent on different input-resources to create the concerning food product. The more food production is integrated with urban systems and its resource flows, the more closed cycles can be created (Kasper et al., 2017).

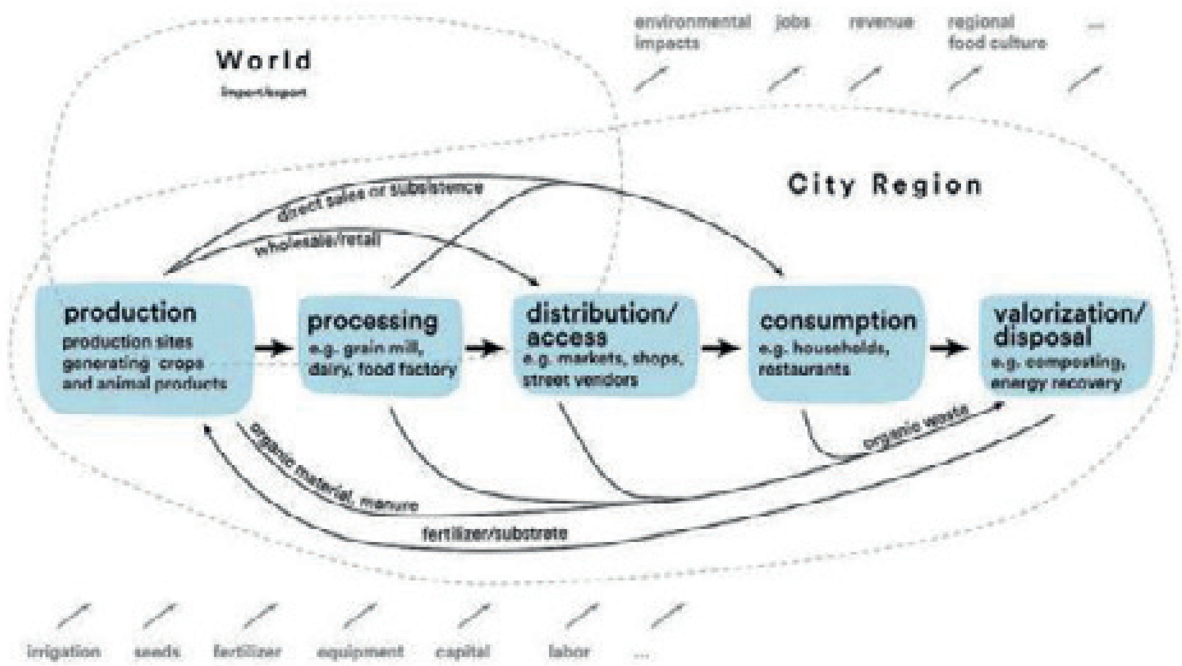


Figure 3.3: spatial configuration of the City Region Food System (Kasper et al., 2017)

PROCESSING

This component describes: *"the transformation process of agricultural products, comprising methods of preservation, industrial food processing, and food preparation"* (Kasper et al., 2017, p.1013). Its location is often nearby the production site, though this is not requisite. It depends on the type of product and mode of agricultural production (Kasper et al., 2017). Connecting a processing site to a production site helps to reduce their environmental impact in terms of energy/fuel use (Brannen et al., n.d.). The type(s) and amount of material used to process food is also a matter to take into account when assessing the degree of sustainability.

DISTRIBUTION

Distribution is described as: *"the process of transport of raw and processed food from food production and/ or processing sites to consumers, including wholesale and retail"* (Kasper et al., 2017, p.1013). Both transport as well as actual sale sites are part of the spatial expressions of distribution. Sale sites embody food access points for consumers, shaped in different market types (Kasper et al., 2017). In making this component more sustainable, we need to think in terms of transport efficiency (reducing the amount of trips and miles) and transport diversification (Brannen et al., n.d.).

CONSUMPTION

Consumption includes: *"the preparation of food, food culture aspects, and the transformation into organic waste"* (Kasper et al., 2017, p.1013). In moving towards more consumption sustainability we can think in terms of information and education on healthy and sustainable food, and accessibility to food sale-points. Providing public institutions with healthy and sustainable meals are policy-driven initiatives that have the capability of reaching big platforms and therewith inspire others in consuming more sustainably. These initiatives can also provide a market for regional farmers, reinforcing a regional economy (Brannen et al., n.d.).

WASTE

This component refers to all waste products coming from each component in the food system. Due to this big range, waste takes place on multiple different scales, from industrial dumping sites to household level. Waste can either be disposed, or re-used as an input-source (Kasper et al., 2017). When improving sustainability-levels, there is a lot to gain in this component. We can think of sustainable packaging, fewer uses of fossil fuels by reducing transport miles and using sustainable energy sources, and re-using waste products; output=input (Brannen et al., n.d.). Also there should be more flexibility in laws, supporting rejected food-sale, or redistribution by food Banks. When it comes to household waste, there is a need for better education on the consumers' responsibility towards their consuming habits and waste production (Baraggia, 2016). A useful model to apply in effective waste disposal is Moerman's ladder, starting with the prevention of food waste, followed by options for optimal use of residual waste streams (Wiskerke, 2015):

1. Use for human food
2. Conversion to human food
3. Use as animal feed
4. Raw material for the industry
5. Transforming into fertilizer through fermentation (+energy generation)
6. Transforming into fertilizer through composting
7. Input for sustainable energy
8. Incineration
9. Dumping

BOUNDARIES WITHIN THE SYSTEM

The boundaries of a city region food system are site-specific and very much dependent on different criteria, taking place in that region. Criteria such as social coherence, natural conditions, jurisdictional boundaries and connections with its surroundings, but also more practical criteria can set limits to a food system (Dubbeling et al., 2017). In setting a regional food-system boundary, these criteria can be very useful. Though it is important to keep in mind that certain components within a food system, might be located outside the 'set boundaries,' while still being part of the city region food system (Kasper et al., 2017).

"The land and what it can grow defines the perimeters of a food region. It puts food at the centre of identifying what is possible and moves us away from the market considerations as the dominant parameter for defining food sourcing and supply chains" (Dubbeling et al., 2017, p. 3-4).

This quote encompasses the flexible an diverse approach that is needed per different city region. We need to look for region specific perimeters when defining possible food production. Although, this does not mean that everything needs to come from within the region. It is very important to stay connected with the 'outside' world, as we might need additional food out-/input from it. As Louise Fresco claims: *"Shorter food-chains are not per definitions healthier and more sustainable than long food-chains. They are important to show people where there food comes from. I am a supporter of visible chains, but this does not mean that everything has to come from the neighbourhood"* (Speksnijder, 2018). Therefore it can be stated that a regional food system should foster interdependence, while keeping track of, and (if necessary) using, developments taking place outside its borders. This way, regional food systems can cooperate with global food systems in a complementary and sustainable way (Speksnijder, 2018).

ANALYTICAL APPROACH FOR A CRFS

When designing a sustainable CRFS, it is important to start with an overview of the current situation. One needs to investigate the system spatially through analysing all processes, actors and flows taking place in each food system component. Some important steps to take, when analysing the current food-system encompass (Kasper et al., 2017):

- Structure resource- and process flows, and make them visible
- Localize actors and their role in the food system
- Remark problems and discuss potential changes
- Identify possible synergies between components/sectors

Useful questions to ask during this analytical process (de Zeeuw & Dubbeling, 2015) :

What food is produced in the region, where and by whom?
Which input resources are used, where are they produced and by whom?

Where is agricultural land use threatened by city extension?
Where is suitable space available in the city, and what type of production can take place here?
What are the main critical issues related to food processing for the development of a sustainable agro-food system in the city region?

Where are food distribution points located?
Where do access problems occur and why?

What kind of food is consumed in this region, by whom and how much?
What is the impact of these consumption patterns in terms of health?
How affordable are the food prices?
Which groups are insecure of food security and where do they live?

What are the sources and volumes of waste?
What are the energy uses and GHG emissions in our food-system components?

3.2 CULTURAL FOOD HERITAGE

CULTURAL FOOD LANDSCAPES OVER TIME

When researching the development of cultural food landscapes throughout history, we can distinguish three main epoch, proposed by geographer Marc Antrop:

TRADITIONAL FOOD - LANDSCAPES

This epoch contains pre 18th century landscapes, beholding complex histories which are still (partly) visible through preserved structures and remnants. These structures often symbolize unique identities that were given to them by locals. Traditional landscapes represented people's homeland, places they often put much effort and work in (Antrop, 2005). In terms of food, traditional cuisines are based on the logic of proximity, or as Catalan writer Josep Pla describes: *"cooking is the landscape in a pan"* (Garcia-Fuentes et al., 2014, p.160). In traditional food landscapes, products from the immediate environment were sold on nearby markets and used in local dishes. Through this relation, each region was identified by a characteristic landscape, matching food cultures and cuisine (Garcia-Fuentes et al., 2014).

REVOLUTION AGE - LANDSCAPES

This epoch consists of landscapes from the 19th century to World War II. New landscapes replaced traditional ones, causing breaks with past cultures and societies. These new landscapes where driven by changing economies and demographics such as intensification- and innovation in agriculture, overseas trade and land reform (Antrop, 2005). These new methods ended the logic of proximity. Local markets and traditional cooking lost their importance and where replaced by big supermarket chains (Garcia-Fuentes et al., 2014).

POST MODERN - LANDSCAPES

These landscapes arose after World War II, they are guided and characterised by processes of urbanization and globalization. These processes often cause completely new landscapes, while deteriorating nature and culture within previous ones. This lack of integration and care for traditional landscapes causes visible breaks in continuity with the past and a disjunction of the landscape and rural life. The countryside becomes: *"a place for living instead of a place for making a living"* (Antrop, 2005, p.30). Local markets and cuisine are perceived as: *"mere anachronistic vestiges of the past"* (Garcia-Fuentes et al., 2014, p.160). The countryside, once covering the essential role in a community, seems nothing more than a rural residue (Antrop, 2005).

"The main difference between traditional and new landscapes resides in their dynamics, both in speed, and scale, as well as the changing perceptions, values and behavior of their users" (Antrop, 2005, p.25).

DEFINING CULTURAL FOOD HERITAGE

In order to understand cultural heritage in its relation to food, we first need to define the meaning of cultural heritage. Anthropologist Edward Burnett Tylor described culture as: *"that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society"* (Jokilehto, 2005, p.4). When a certain culture is perceived as worthy of protecting, it is described as cultural heritage (Jokilehto, 2005). Heritage consists of both tangible and intangible elements, valued differently per culture (UNESCO, 2017; Di Giovine & Brulotte, 2014).

"How we eat, and what we eat, and when we eat, and with whom we eat, all uniquely vary from place to place, group to group, time to time – thanks to longstanding geographic, economic, social, and cosmological differences throughout the world" (Di Giovine & Brulotte, 2014, p.1).

As mentioned in this quote, food plays an important role in shaping local cultures. Food brings people together and when it induces emotions and experiences with the past, it can be transferred into a form of heritage (Di Giovine & Brulotte, 2014). Food related memories and traditions linked to a place can promote a sense of belonging and identity, and thereby distinguish one place from others. To resume, we can define cultural food heritage as: *"the set of material (tangible) and immaterial (intangible) gastronomic elements linked to production, the agricultural sector and a collective regional heritage"* (Bessière, 2013, p.279).

PURSUING CULTURAL FOOD HERITAGE VALUES

In terms of indication and preservation, tangible food-heritage is easy to grasp, and protection often takes place through restoration measures. Though this is way more complicated in the field of intangible food heritage, which asks for different approaches of indication and preservation. Intangible food-heritage is created by environmental- and social conditions, formed over long periods of time, often designed to outlive its creators. This makes it highly dependent on preservation methods such as the archiving and documentation of values, and the protection of its carriers (Bouchenaki, 2003). Assistant Director General for Culture at UNESCO: Mounir Bouchenaki proposes a method with three design ingredients to enable both tangible as well as intangible values to be preserved and developed (Bouchenaki, 2003). In this research, this method will be used to set the base for pursuing cultural food heritage values in a regional food landscape.

DESIGN INGREDIENTS TO PURSUE CULTURAL FOOD HERITAGE VALUES

- **Put tangible heritage in its wider context;** e.g. relating it to communities to enable greater weight to its values (Bouchenaki, 2003).

- **Translate intangible heritage into 'materiality';** e.g. in forms of museums, film/audio records or archives, strongly dependent on the type of intangible heritage (Bouchenaki, 2003).

- **Support practitioners and the transmission of skills and knowledge;** e.g. UNESCO's project of 'living human treasures' initiated in 1993, to give heritage practitioners official recognition and support to ensure transfer of their knowledge/skills to next generations (Bouchenaki, 2003).

When using this method, it is important to acknowledge how tangible and intangible cultural food heritage values are intrinsically connected to each other (Munjeri, 2004). In order to read tangible cultural food heritage, one needs to understand its context and underlying values: the non-physical; intangible. In this way, intangible food heritage can be used to embody and interpret tangible manifestations (Bouchenaki, 2003; Munjeri, 2004). As former member of the UNESCO World Heritage Committee, Dawson Munjeri describes: *"Intangible heritage it is a tool through which the tangible heritage could be defined and expressed (thus) transforming inert landscapes of objects and monuments, turning them into living archives of cultural values"* (Munjeri, 2004, p.18).

DEPLOYING CULTURAL FOOD HERITAGE VALUES TO PROMOTE SUSTAINABLE FOOD REGIONS

The recognition of food as driving force for cultural heritage is quite recent as it was not until 2010 that UNESCO first designated some country specific food and cuisines as 'intangible cultural heritage' (Garcia-Fuentes et al., 2014).
This recognition of food as cultural heritage is seen as a contra-reaction to the McDonaldization of the food industry, and the safeguarding of local 'protected marks'. Though, looming pitfalls to keep in mind, and prevent within this development, are the pirating of food brands and the museumifying/commercializing of cultures and regions. The pitfall of museumifying is strongly related to the general belief that heritage belongs only to the past and that it should be safeguarded and unchanged; the beauty of the dead and obsession with the last present (Bessière, 2013). In European perspective, heritage is too often seen as a matter of fragile materiality, instead of focussing on the intangible spirits they represent (Vecco, 2010). This European belief seems to forget that heritage is in constant change and evolves with time. Past traditions need to be reinterpreted and reproduced in the future, giving cultural heritage the important role as connector of past and present (Bessière, 2013).

"If food today is considered to be a locus of inter-cultural exchange that contributes to the construction of social identities , then it could also be considered as an important resource for rural development strategy" (Bessière, 2013, p.275).

Instead of treating cultural food heritage in the two extremes of either museumifying or destruction and industrializing it, we should find a way of using it as source for positive action to create sustainable regional environments. Associate professor in sociology at the University of Toulouse II: Jacinthe Bessière proposes: *"a process of heritage promotion centred on the rural enterprise"* (Bessière, 2013, 285). An equilibrium between conservation and endless adaptation is aimed for, also called: *heritagisation*. In this way, food traditions can be preserved and integrated in a certain region in promoting qualitative and sustainable supply chains connecting producer and consumer in the same physical space. Food-or agro tourism is a possible driving force in stimulating this development as tourism includes a revitalising ability to 'rescue' and strengthen deteriorating rural areas. In promoting local identities and creating awareness, agro tourism helps to re-connect urban centres (where the tourists often come from) with rural hinterlands, (where food production takes place) so that sustainable urban-rural linkages are reinforced (Bessière, 2013).

Creating coherence between valuable elements of cultural food heritage can help to reinforce the legibility of a landscape, and enhance its identity (Antrop, 2005). This can be combined with earlier mentioned implications of food-tourism, place branding, or indications of intangible food heritage. Such developments may help both inhabitants and tourists to read the landscape and attach themselves to it (Belasco, 2014; Sammells, 2014). In this preservation and development of cultural food heritage, one should control its functionality in changing spatial contexts, and allow new interpretations to evolve (Antrop, 2005).

ANALYTICAL APPROACH FOR CULTURAL FOOD HERITAGE VALUES

An important added value of the analysis on cultural food heritage compared to a normal site analysis, is that it tells us why a landscape looks like it does and how it evolved over time, instead of only showing its current features (Taylor, 2017). In his chapter on cultural landscape meanings and values, Landscape architecture professor Ken Taylor proposes an analytical approach, useful when investigating tangible and intangible cultural food heritage meanings and values within a given (food) region:

• Identify and document cultural landscape resources; *"identify the type of cultural landscape and its setting, and document landscape history"* (Taylor, 2017, p.222).
• Assess landscape characteristics; e.g. cultural traditions, land uses and activities and natural elements (Taylor, 2017).
• Analyse/evaluate; *"analyse inherent values and evaluate cultural significance"* (Taylor, 2017, p.224).

Questions to ask when researching tangible values (Taylor, 2017, p.219):

What has occurred?
When did it occur?
Where did it occur?

Questions to ask when researching intangible values (Taylor, 2017, p.219):

Who has been involved in shaping the landscape over time?
Why did they do what they did to shape the landscape and continue to do so?

3.3 PERMACULTURE

A BRIEF INTRODUCTION

The concept of permaculture finds its origin in ancient Oriental agricultural wisdom and traditions. Within the beliefs of Taoism and Buddhism for example, one can find thousand years old wisdom expressions that form the basis for current (Western) permaculture ethics. Around 1978, environmental scientists and designers Bill Mollison and David Holmgren were the first Westerners to transfer these traditions of permanent agriculture into a new *science-based design theory for sustainable living environments*, opposing globalized forms of agriculture. They called it permaculture; a combination between ancient wisdom from traditional farming systems, and modern technological and scientific knowledge (Suh, 2014).

These ancient cultures lived in balance with their surrounding environment and they survived for a longer period of time than any other experiments in civilisation (Holmgren, 2007). Mollison claimed that mankind has forgotten to expand self-regulating systems and instead created destructive ones (Mollison, 1990a). So in the transition to a sustainable living environment we must consider these ancient beliefs and practises as valuable examples for the future (Holmgren, 2007). With this belief, Holmgren and Mollison presume permaculture as nothing new. Rather it arranges and recombines existing knowledge in a different way towards more sustainable systems (Ferguson & Lovell, 2013; Mollison, 1990b).

THE MEANING OF PERMACULTUE

Permaculture theory has evolved to embody what is meant by a permanent/sustainable culture, defined as: *"A system of assembling conceptual, material, and strategic components in a pattern which functions to benefit life in all its forms. It seeks to provide a sustainable and secure place for living things on this earth"* (Mollison, 1988, p. ix). It focuses on working with nature, approaching everything as a positive resource, looking at systems in all their functions (of yield) and thoughtfully observing the effects everything has on its environment (Mollison, 1990b; Mollison, 1990c). Permaculture encompasses a completely different approach compared to the insatiability and destruction we often see in global food systems, or as Bill Mollison describes it: *"A basic question that can be asked in two ways is: What can I get from this land, or person? Or What does this person, or land, have to give if I cooperate with them? Of these two approaches, the former leads to war and waste, the latter to peace and plenty"* (Mollison, 1990a, p. 3).

Developing a sustainable culture lies within the core of permaculture theory. It is a form of development that meets present needs, without making concessions in the needs of future generations (Sherriff, 2005). This core is subdivided into the three ethics of permaculture, beholding a holistic approach of planet-people-profit, matching the pillars of sustainability (Althouse, 2016; Van Bemmel et al, 2017; Hansmann et al., 2012; Mollison, 1990b):

• Care for the earth; provision for all diverse forms of life to continue and multiply
• Care for people; provide people with resources, necessary for existence
• Fair share; setting limits to consumption, redistributing surplus, and making sacrifices for the future.

“overconsumption leads to overexploitation of natural resources, leading to environmental degradation that in turn harms humans themselves” (Suh, 2014, p.82).

These permaculture ethics are seen as universal, though they are implemented in diverse ways, depending on different landscape characteristics (Holmgren, 2007; Suh, 2014). Each place asks for different methods, creating possibilities for a variety of farming systems to apply, e.g.: nature-inclusive agriculture, food forests, agroforestry systems or agro-ecology. With the consequences of climate change and changing consumer demands, conventional farms are advised to incorporate (part of) the sustainable permaculture ethics to guarantee a profitable business on the long run (Van Bemmel et al., 2017).

“Permaculture is at a stage where it is moving away from its grassroots origins, and is viewed as a way of thinking that offers practical solutions for real-world problems” (Van Bemmel et al., 2017, p.9).

PERMACULTURE DESIGN INGREDIENTS

To implement above-mentioned permaculture ethics in reality, ten design ingredients were defined to serve as an organised framework in realising this vision (Holmgren, 2007). They are selected from various disciplines such as environmental science, energy conservation and landscape design (Mollison & Slay, 1988).

DESIGN INGREDIENTS TO ACHIEVE A PERMACULTURE SYSTEM

- **Relative location**; every element is placed in relationship to another so that they can assist each other
- **Each element performs many functions**
- **Each important function is supported by many elements**
- **Efficient energy planning;** through zones and sectors
- **Use of biological resources;** over fossil fuel resources
- **Energy recycling on the site**
- **Small-scale intensive systems**
- **Using and accelerating natural plant succession;** to establish favourable sites and soils
- **Polycultures and diversity of beneficial species**; guilds, for a productive interactive system
- **Use of edge and natural patterns**

Subsequently, I will go more into detail about how these design ingredients can be implemented when designing a permaculture system, and which questions need to be researched when analysing this prospective system.

RELATIVE LOCATION

Working relationships between different elements (including ourselves) are created so that one’s output is the other one’s input and so that needed inputs are supplied from within the system. To achieve this in the best possible way, basic element characteristics in the system need to be discovered and visualized (figure 3.4), questioning (Mollison & Slay, 1988, p.6):

- *Of what use are the products of this particular element to the needs of other elements?*
- *What needs of this element are supplied by other elements?*
- *Where is this element incompatible with other elements?*
- *Where does this element benefit other parts of the system?*

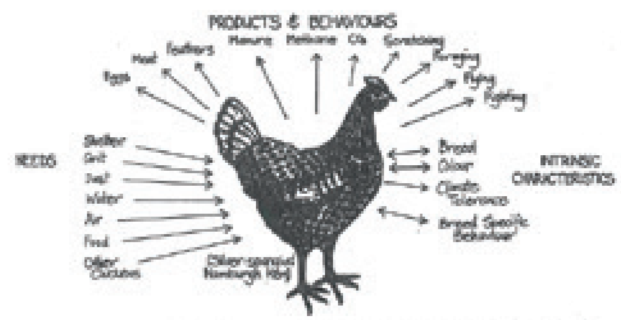


Figure 3.4: characteristics of a chicken (Mollison & Slay, 1988)

EACH ELEMENT PERFORMS MANY FUNCTIONS

An element needs to be placed and chosen so that it performs multiple functions. For example the pond as an element, functioning for aquatic crops, habitat for waterfowl/fish farming, a source of irrigation water, fire control, light reflector and watering livestock. Some of the most common functions an element can fulfil:

Windbreak - Privacy - Trellis - Fire control - Mulch - Food - Animal forage - Fuel - Erosion control - Wildlife habitat - Climate buffer - Soil conditiner (Mollison & Slay, 1988)

To work with this design ingredient, one can use the element characteristics discovered in the previous design ingredient of relative location, enriching it with a species index, indicating (Mollison & Slay, 1988, p. 8):

- *Form: life style; shape*
- *Tolerances: climatic zone; shade or sun tolerance; habitat; soil tolerance; PH tolerance*
- *Uses: edible; medicinal; animal forage; soil improvement; site protection; coppicing; building material; etc.*

EACH IMPORTANT FUNCTION IS SUPPORTED BY MANY ELEMENTS

This design ingredient supports the fact that important basic needs (food, water, fire protection, energy etc.) are guaranteed in multiple ways. For example the function: water storage, which can be taken care of by different elements such as storage tanks, dams, swales and ponds (Mollison & Slay, 1988). In pursuing this design ingredient, one can use the species index resulting from previous design ingredient.

EFFICIENT ENERGY PLANNING

When looking carefully at efficient ways for energy use, we can spare the environment and save money, generating an efficient economic design. To achieve this, animals, plants and structures need to be placed in different zones and sectors. Which element is placed in which sector or zone is determined by local factors such as access, market, local climatic quirks, slope, special soil conditions and areas of special interest (Mollison & Slay, 1988).

In zone planning: “*Areas that must be visited every day are located nearby, while places visited less frequently are located further away”* (Mollison & Slay, 1988, p.9).
A zone is decided by (Mollison & Slay, 1988, p.9):
1) The number of times you need to visit the element
2) the number of times the element needs you to visit it
Resulting in a general subdivision of zones (figure 3.5):

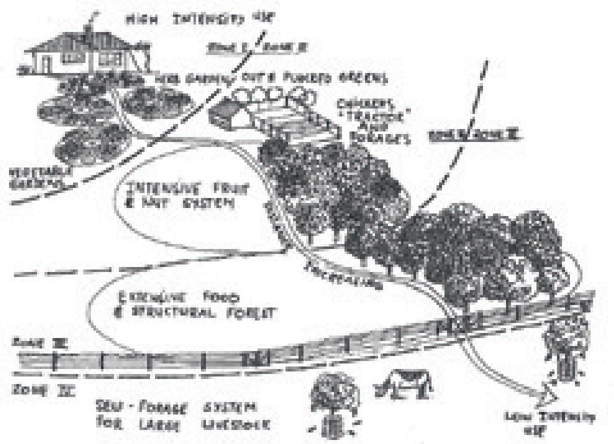


Figure 3.5: efficient zone planning (Mollison & Slay, 1988)

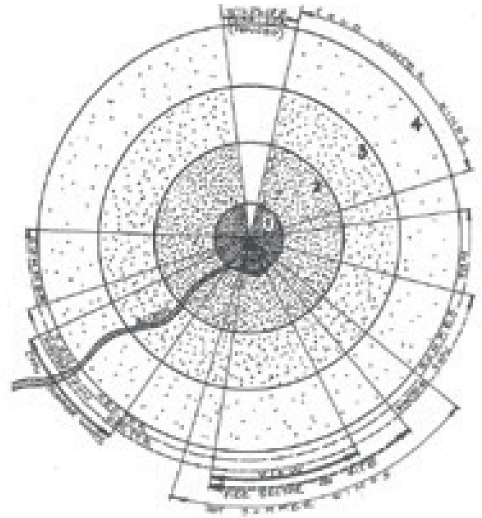


Figure 3.6: sector planning (Mollison & Slay, 1988)

Zone 0 - centre of activity
Zone 1 - most intensively-used fields/ glasshouse/vegetable garden
Zone 2 - intensively used, small animal forage/orchards
Zone 3 - main crops/orchards/ranges for lager animals
Zone 4 - semi-managed/semi-wild, forest management and hardy foods
Zone 5 - unmanaged systems/ place for learning/observing/recreation

Sector planning is guided through wild energies coming from outside the system, such as wind, water and sunlight. Through sector planning we aim to manage these energies in our advantage. Incoming energies should be located and visualized in a basic ground plan of the site (figure 3.6), covering for example different types of wind, sun angles, wanted/unwanted views and flood-sensitive areas (Mollison & Slay, 1988).

USE OF BIOLOGICAL RESOURCES
The use of biological resources is meant to save energy and replace work on the farm. Available resources are used in positive ways and alternatives for non-biological resources are developed, such as natural pest control/ fertilizer and animal tractors. Sometimes, however, it is unavoidable to use non-biological resources in starting phases of the system (such as asphalt roads). This is tolerated as long as it is used and managed to enable long-term sustainability (Mollison & Slay, 1988).

ENERGY CYCLING
This design ingredient beholds the aim of creating a self-supporting, circular system, independent from global trade and distribution. There is plenty of energy to be saved in terms of transport, marketing and packaging. Energy can come from outside the system, as well as from within. In a good design, energy is recycled, caught, stored and used in all its features (Mollison & Slay, 1988). Time schedules of these energy cycles can vary greatly, some only take a day, while others can last for months before the cycle is completed (Mollison, 1990b).

SMALL-SCLAE INTENSIVE SYSTEMS
"If we cannot maintain or improve a system, we should leave it alone, thus minimizing damage and preserving natural complexity" (Mollison & Slay, 1988, p. 19-20). This permaculture vision of 'enough' strikes with conventional strategies of 'never enough.' Permaculture states to use as much land as needed to provide for a living, leaving the rest alone. In this way, the system can be designed to best advantage, using the least amount of human labour to create self-sufficiency (Mollison & Slay, 1988).

ACCELERATING SUCCESSION AND EVOLUTION
Most conventional farming systems produce constant levels of annual crops, thereby keeping their vegetation at its herb/weed level. In fact, this practice is constantly putting back the natural system and the processes of natural succession is stopped. Contradictory, permaculture aims to direct and accelerate succession and evolution by allowing species to develop towards their climax stage. This means that annual crops are hardly used in permaculture designs, instead perennials and trees are most common (Mollison & Slay, 1988).

DIVERSITY
"Although the yield of a monoculture system will probably be greater for a particular crop than the yield of any one species in a permaculture system, the sum of yields in a mixed system will be larger" (Mollison & Slay, 1988, p. 24). In a diversified agricultural system, different food is produced in different times throughout a year. This creates independency form global markets and resilience in times of sudden crisis. Another important benefit of diverse systems is the number of functional connections between species: guilds (Mollison & Slay, 1988). Some of the most important guilds are (Mollison, 1979; Mollison, 1990a; Mollison, 1990c):

To benefit plants	To benefit man	To benefit animals
* Reduce root competition	* Culinary associates	* Ground foragers
* Assist pest control	* Excursions	* Pioneer bulldozers
* Create open soil conditions	* Educational courses	* Manure producers
* Provide mulch	* Rental	* Gas producers
* Provide nutrients	* Labour exchange	* Concentrators of nutrients
* Provide physical shelter	* Investment + self-pick market	* Pest control
	* Speciality market	* Pollinators of plants
		* Cleaning water
		* Short grazers
		* Guarding dogs/ducks
		* Hawk kites
		* Draught animals

To the general public, diversity has the image of being messy. *"In order to promote and design landscapes with ecological quality, such as permaculture gardens, designers need to start translating ecological patterns into cultural language that people will recognize as maintained, well cared for, and attractive"* (Althouse, 2016, p. 23). Landscape architect Joan Nassauer developed eight cues to reach this (Althouse, 2016):

- Mowing
- Use flowering trees and plants with lots of colour
- Place houses and wildlife feeders in the landscape
- Use bold patterns
- Design plants in lines, rows and trim shrubs
- Implement architectural details
- Add foundation plantings

EDGE EFFECT
Edges cover the interface of multiple different mediums, they define areas and break them into parts. When different mediums meet, resources from both systems interact and ecological productivity increases. Some edges even have their own unique species. In nature, edge-system are often the most productive ecological systems. Edges can be created through several shape-manipulations (figure 3.7) (Mollison & Slay, 1988).

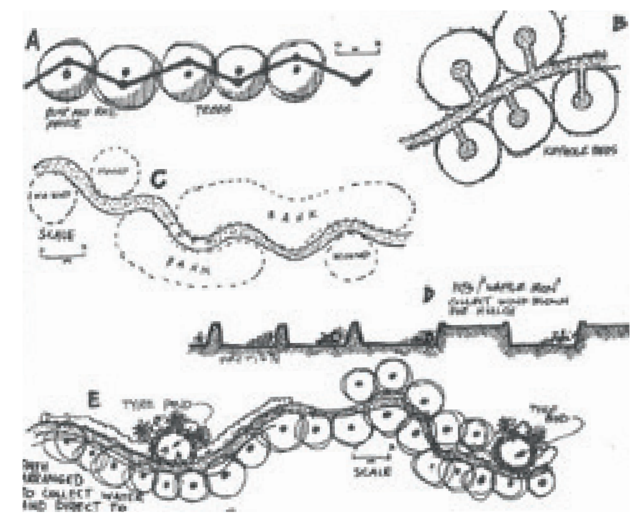


Figure 3.7: different edge patterns (Mollison & Slay, 1988)

UPSCALING PERMACULTURE

Although one of permacultures design ingredients includes the implication of small-scale intensive systems, it needs to be linked to an effective business model to generate transition potential and to shift away from its grassroots profile (Van Bemmel et al., 2017). Holmgren and Mollison refer to large-scale permaculture as an oxymoron because it can never gain self-sufficiency. However, they also claim that the limit of self-sufficiency is hard to define in physical limits since it depends on the capability and manpower available to control it (Mollison, 1979; Suh, 2014) The potential of upscaling permaculture is supported by the idea that development and the application of knowledge knows no limits in quantity, or as Mollison states: *"The only limit on the number of uses of a resource possible within a system, is in the limit of the information and the imagination of the designer"* (Mollison & Slay, 1988, p. 32).

To illustrate the economic feasibility of a permaculture system, I compared the output of different permaculture based farms with conventional farms that practise industrial agriculture (figure 3.9). The results of this comparison are based on average outcomes of 1 ha food production land, with no specification on the type of soil. As the exact outcomes might differ per type of soil and management, the proportion will likely be approximately the same. This results in a very positive outcome in terms of economic feasibility as the permaculture system provides food for more than double the amount of people compared to industrial agriculture. Also a more diverse and calorie-rich diet is provided and the farmers' incomes are higher.
An important side note considering the income sum is the fact that start-up – and maintenance costs, multiple crop rotation harvest (often used in conventional systems) and additional incomes (often generated on permaculture farms) are not taken into account.

When applying a permaculture system, it is important to acknowledge its different time vision compared to industrial agriculture. As industrial agriculture is focused on short term profit, it tries to ensure a stable yield each season, with annual crop harvest. However, this unsustainable way of farming reinforces a deteriorating soil quality, resulting in a decreasing yield in the long term. Permaculture, on the other hand, focusses on long term profit. It takes more time to establish a stable harvest system, though the harvest quantity and diversity develops exponentially as favourable soils are created (figure 3.8). However, to still generate a stable income in the start-up years of a permaculture system, it is profitable to use part of the land to farm annual cash crops, such as quinoa (Van Bemmel et al., 2017; Boulestreau, 2016).

The labour intensiveness of permaculture systems is cited most frequently in questioning its economic viability. Though, this point of critique could be turned into an opportunity as work is created for the development of new harvest machines, adapted to the new niches. An interesting contribution to this revenue model is the integration of sustainable farm cooperations. As medium-sized permaculture farms tend to have higher production costs, efficiency can be achieved in a joined stage of processing and marketing, practiced by the cooperation. With this shared responsibility comes shared risk, reinforcing the resilience of the system (Shepard, 2013).

Aside from this bottom-up process of change, there is a need for more influential change from above. It is up supermarkets to create flexible platforms for the sale of (less predictable) permaculture certificated products. And policy-makers need to initiate more aggressive measures and stewardship towards permaculture based systems and marketing (Van Bemmel et al., 2017) (Suh, 2014).

PRODUCTION IN YEARS

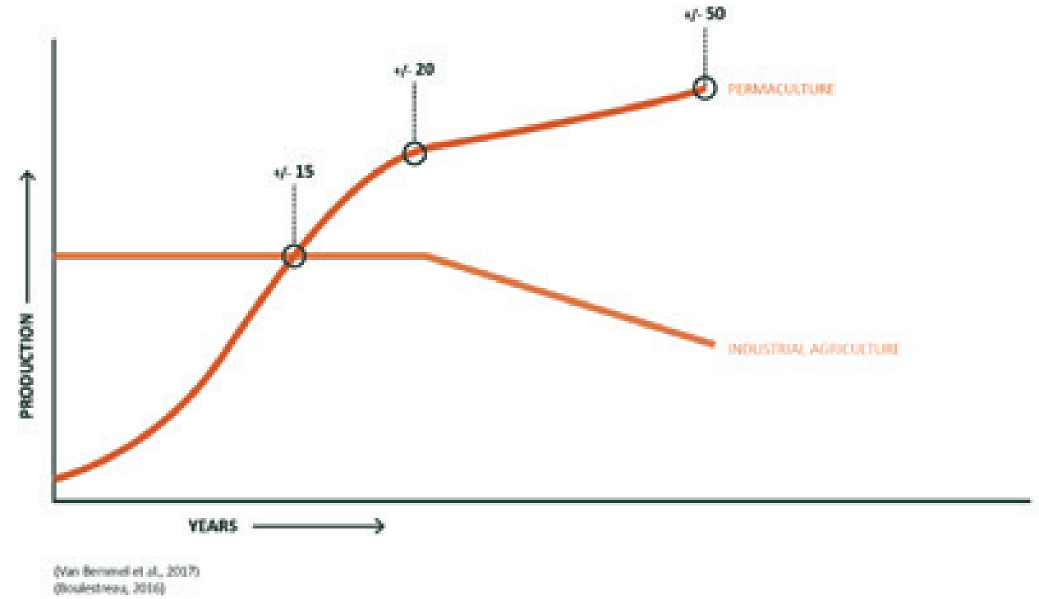


Figure 3.8: production in years comparison of permaculture-based agriculture vs industrial agriculture, based on: (Van Bemmel et al., 2017; Boulestreau, 2016)

Figure 3.9: output comparison of permaculture-based agriculture vs industrial agriculture

3.4 CONNECTING THEORIES

The pre-described theories are mutually connected through their spatial configuration of the aimed for sustainable city region food landscape. This relation is figuratively shown in a re-interpretation of the landscape layer model. In the current food landscape we observe how the global food system discards the cultural- and natural-layer, resulting in autonomous monocultures and cultural fragmentation. Urban spread and occupation acts dominating and ignores the consequences it has on the underlying layers (figure 3.10). With the convergence of the three sustainable theories in this research, a re-interpretation of the current landscape layer model is represented (figure 3.11). This model shows a sustainable food landscape with interaction between the layers. These different layers reinforce each other in achieving a regional food system, founded on a permaculture-based farming system, and structured by recognized cultural food heritage values.

When this new landscape layer model is adapted and a sustainable food landscape arises, a fruitful revenue model originates, capable of out-competing the conventional food landscape; see infographic on next page (figure 3.12). This infographic shows a summary of visible- and invisible- costs and profits within both a sustainable food system, as well as a conventional food system. These costs and profits derive from gained knowledge on pre-described theories. Whilst conventional food systems show mainly costs, sustainable food systems consist of a majority in profits. Visible costs consist, for example, of transport- and pesticide costs. Invisible costs can cover loss in biodiversity and consumer-food alienation. Invisible profits can consist of an increase in biodiversity or more consumer awareness on regional food production. Visible profits consist of features such as harvest wage and proceeds from group excursions.

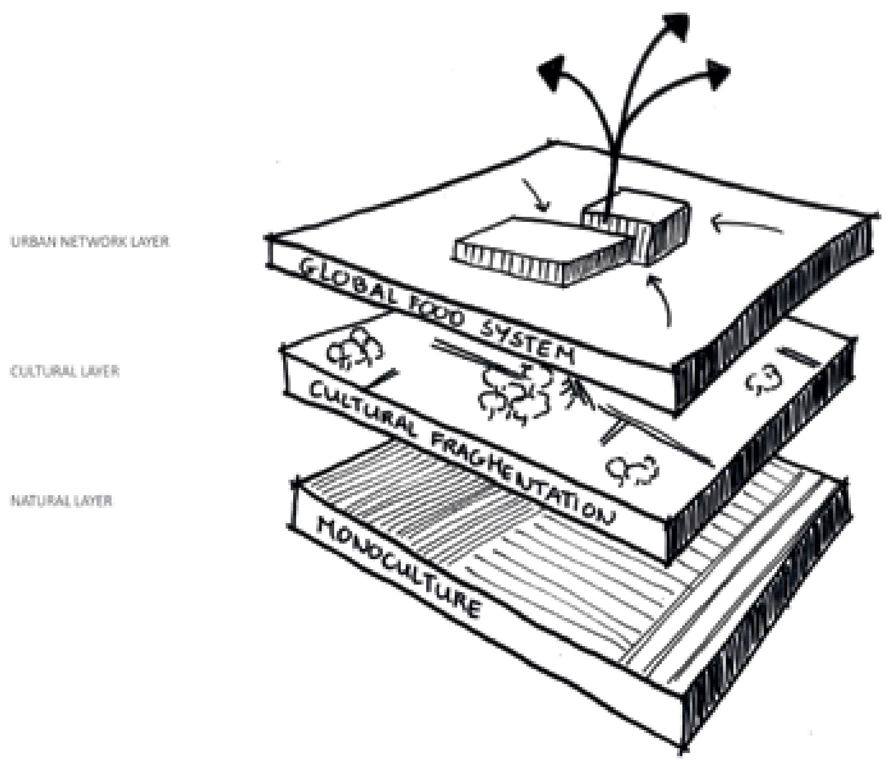


Figure 3.10: current food landscape layer model

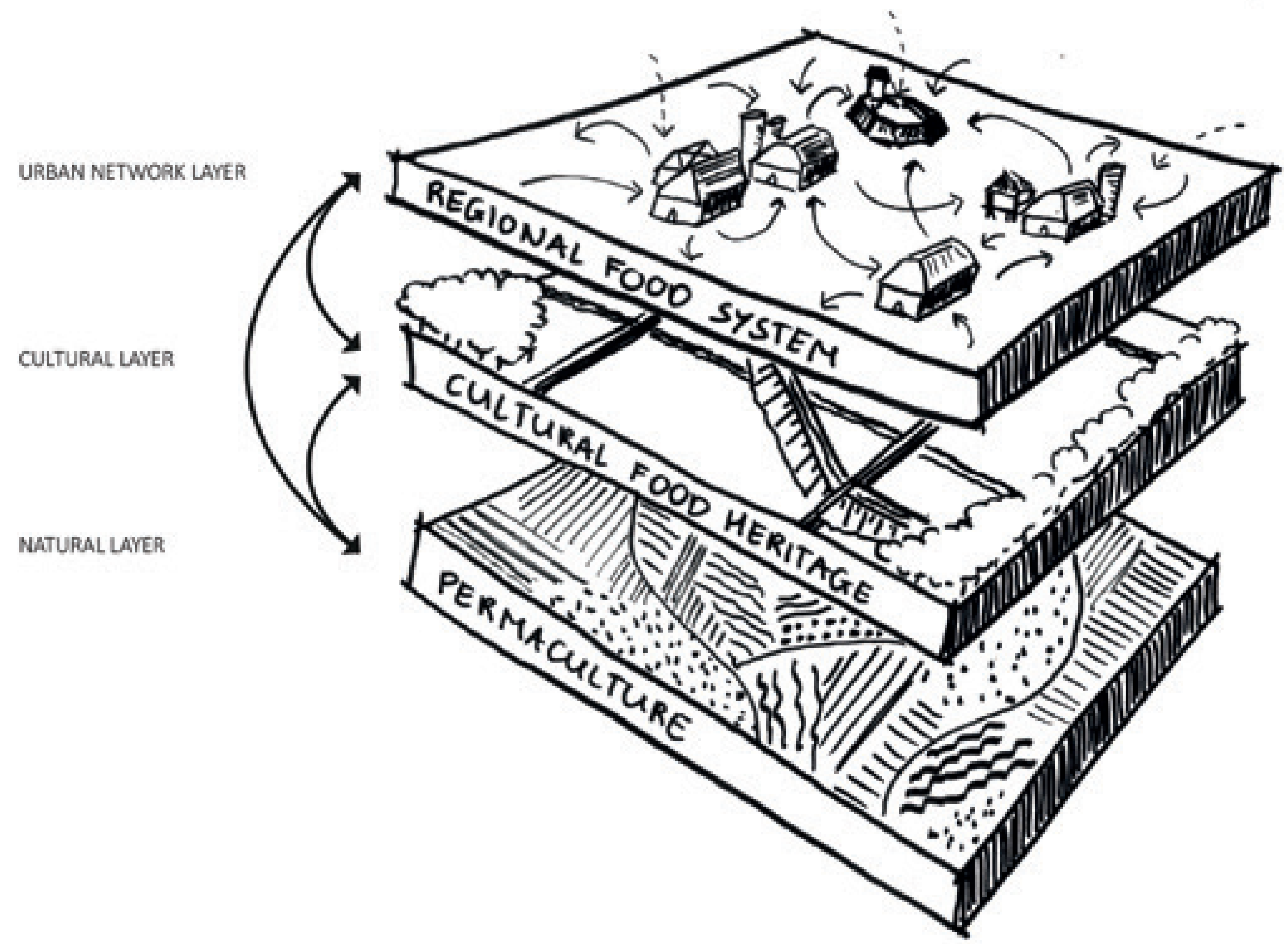
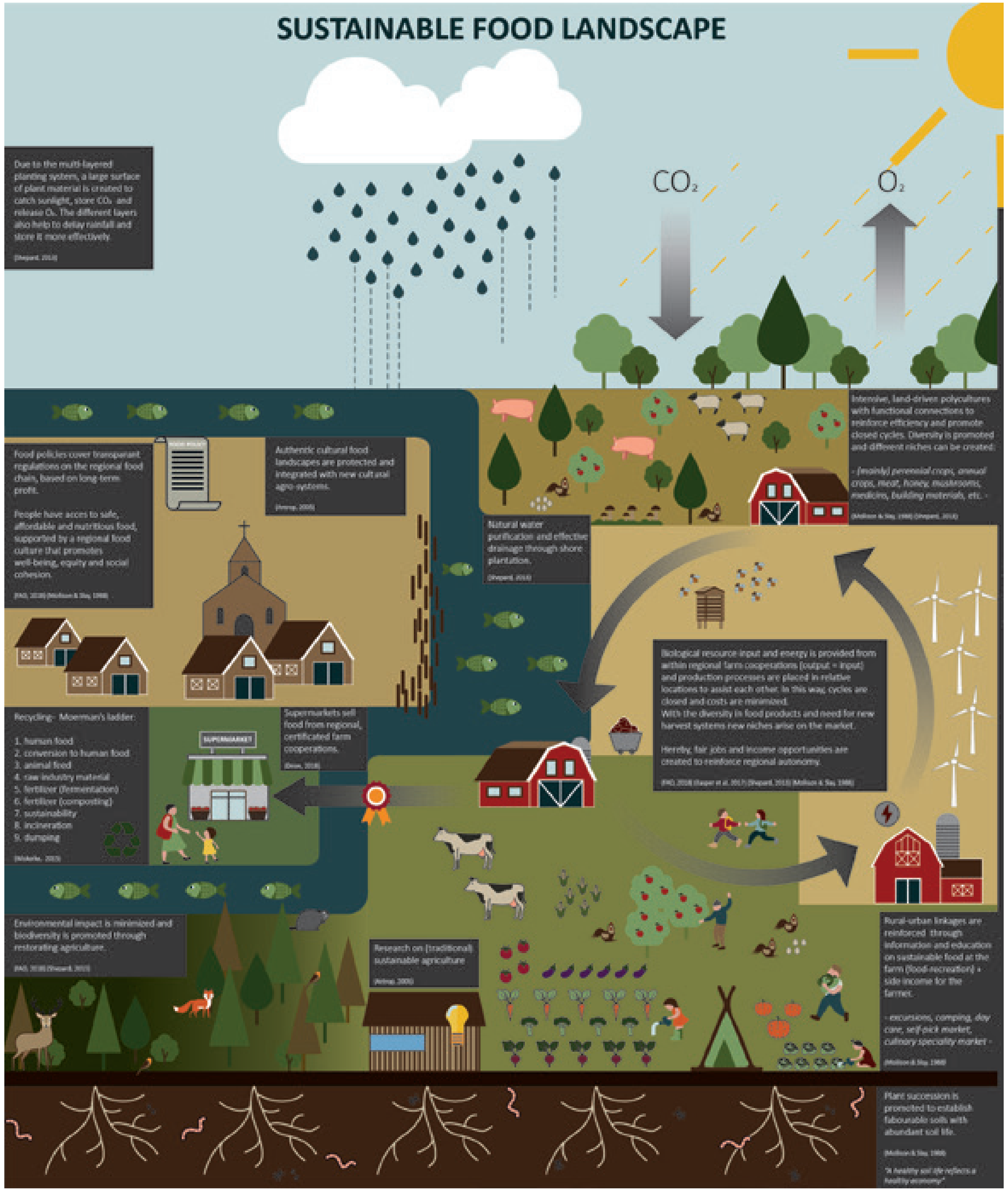
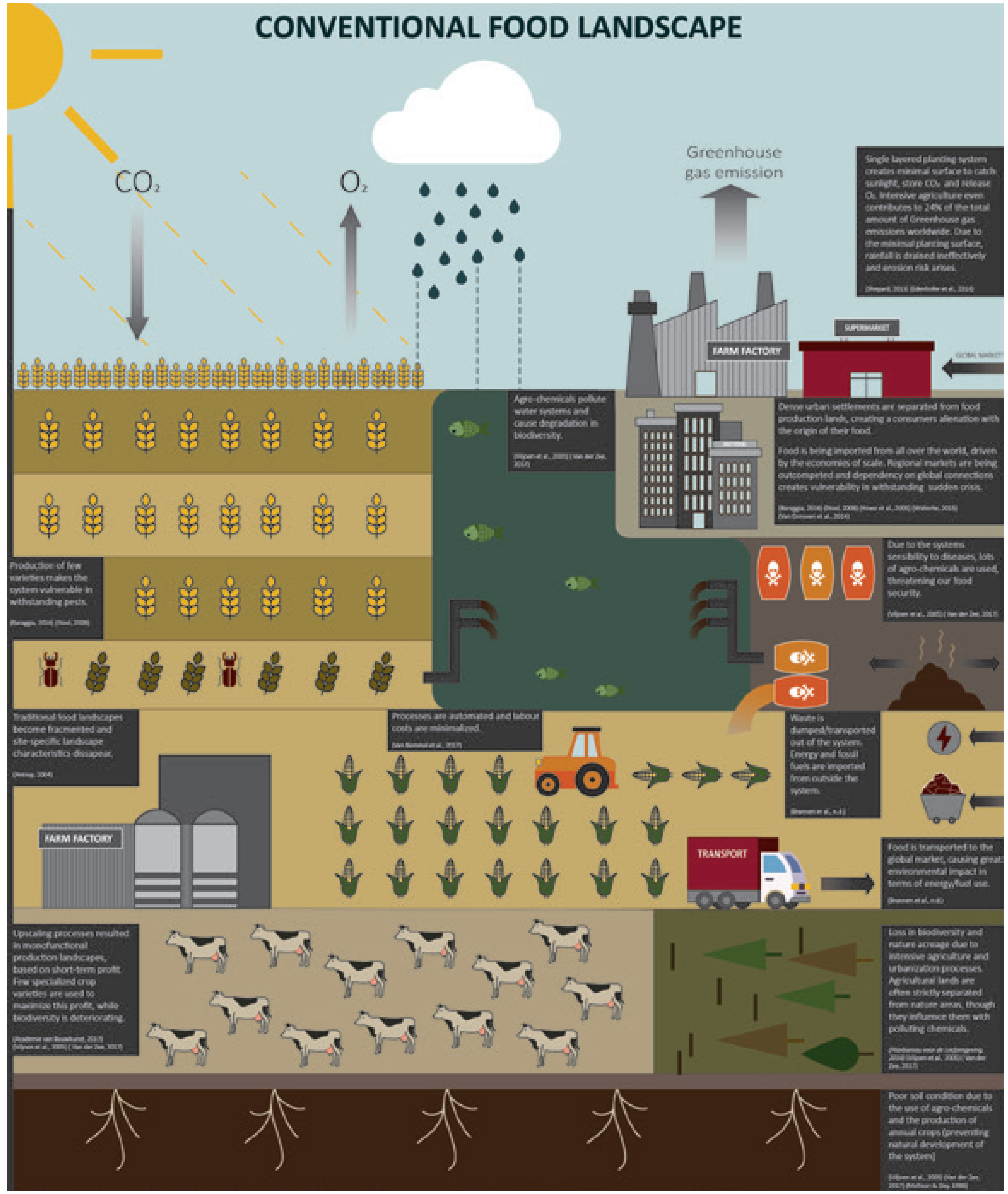


Figure 3.11: re-interpreted; sustainable food landscape layer model

Figure 3.12: infographic summarizing visible- and invisible- costs and profits within a sustainable food system vs a conventional food system →


SUSTAINABLE FOOD LANDSCAPE
CO2
O2
Due to the multi-layered planting system, a large surface of plant material is created to catch sunlight, store CO2 and release O2. The different layers also help to delay rainfall and store it more effectively.
Food policies cover transparent regulations on the regional food chain, based on long-term profit.
People have acces to safe, affordable and nutritious food, supported by a regional food culture that promotes well-being, equity and social cohesion.
Authentic cultural food landscapes are protected and integrated with new cultural agro-systems.
Natural water purification and effective drainage through shore plantation.
Intensive, land-driven polycultures with functional connections to reinforce efficiency and promote closed cycles. Diversity is promoted and different niches can be created:
- (mainly) perennial crops, annual crops, meat, honey, mushrooms, medicins, building materials, etc. -
Biological resource input and energy is provided from within regional farm cooperations (output = input) and production processes are placed in relative locations to assist each other. In this way, cycles are closed and costs are minimized.
With the diversity in food products and need for new harvest systems new niches arise on the market.
Hereby, fair jobs and income opportunities are created to reinforce regional autonomy.
Recycling - Moerman's ladder:
1. human food
2. conversion to human food
3. animal feed
4. raw industry material
5. fertilizer (fermentation)
6. fertilizer (composting)
7. sustainability
8. incineration
9. dumping
SUPERMARKET
Supermarkets sell food from regional, certificated farm cooperations.
Environmental impact is minimized and biodiversity is promoted through restorating agriculture.
Research on (traditional) sustainable agriculture
Rural-urban linkages are reinforced through information and education on sustainable food at the farm (food-recreation) + side income for the farmer.
- excursions, camping, day care, self-pick market, culinary speciality market -
Plant succession is promoted to establish favourable soils with abundant soil life.
"A healthy soil life reflects a healthy economy"


CONVENTIONAL FOOD LANDSCAPE
CO2
O2
Greenhouse gas emission
Single layered planting system creates minimal surface to catch sunlight, store CO2 and release O2. Intensive agriculture even contributes to 24% of the total amount of Greenhouse gas emissions worldwide. Due to the minimal planting surface, rainfall is drained ineffectively and erosion risk arises.
FARM FACTORY
SUPERMARKET
Agro-chemicals pollute water systems and cause degradation in biodiversity.
Dense urban settlements are separated from food production lands, creating a consumers alienation with the origin of their food.
Food is being imported from all over the world, driven by the economies of scale. Regional markets are being outcompeted and dependency on global connections creates vulnerability in withstanding sudden crisis.
Due to the systems sensibility to diseases, lots of agro-chemicals are used, threatening our food security.
Production of few varieties makes the system vulnerable in withstanding pests.
Traditional food landscapes become fracmented and site-specific landscape characteristics dissapear.
Processes are automated and labour costs are minimalized.
Waste is dumped/transported out of the system. Energy and fossil fuels are imported from outside the system.
FARM FACTORY
TRANSPORT
Food is transported to the global market, causing great environmental impact in terms of energy/fuel use.
Upscaling processes resulted in monofunctional production landscapes, based on short-term profit. Few specialized crop varieties are used to maximize this profit, while biodiversity is deteriorating.
Loss in biodiversity and nature acreage due to intensive agriculture and urbanization processes. Agricultural lands are often strictly separated from nature areas, though they influence them with polluting chemicals.
Poor soil condition due to the use of agro-chemicals and the production of annual crops (preventing natural development of the system)

ANALYSIS

"The nation that destroys its soil, destroys itself"

- Franklin D. Roosevelt (Steel, 2008, p. 37) -

4.1 CASE STUDY CONTEXT

Within the Metropolitan Region of Amsterdam a rough division can be made between seven landscape units: coastal dunes, reclaimed land, peat areas, the 'Vechtregion', the Heuvelrug, build areas and the water defence lines (figure 4.3 and appendix B). Each of these units beholds its unique characteristics and landscape structures, explaining cultural developments over time. Like most historical cities, Amsterdam's urban development has always been in close relation with food. As described by Von Thünen, production sites were based on their shelf life and closeness to the urban core, as they were responsible for the provisioning of a fresh and diverse diet.

The size of lands surrounding Amsterdam and other urban cores used to grow proportionally with the growing populations. The 'Stelling van Amsterdam', designed in the 19th century, is a very literal example of this vision. Besides its most known function as water defence line, it covered an ingenious, and equally important food system that would ensure Amsterdam's nutrition in times of siege. The area range within the Stelling included enough agricultural lands to provide one million citizens with food for half a year (figure 4.1) (de Boer et al., 2014). Currently, the Stelling van Amsterdam mainly consists of fortresses. The most visible and spatial structure is to be seen in the Haarlemmermeer in the shape of the *'Geniedike'* (figure 4.2).

Figure 4.1: Stelling van Amsterdam, connecting the different landscape unities

Figure 4.2: Geniedike in the Haarlemmermeer (oneindig Noord-Holland, 2019)

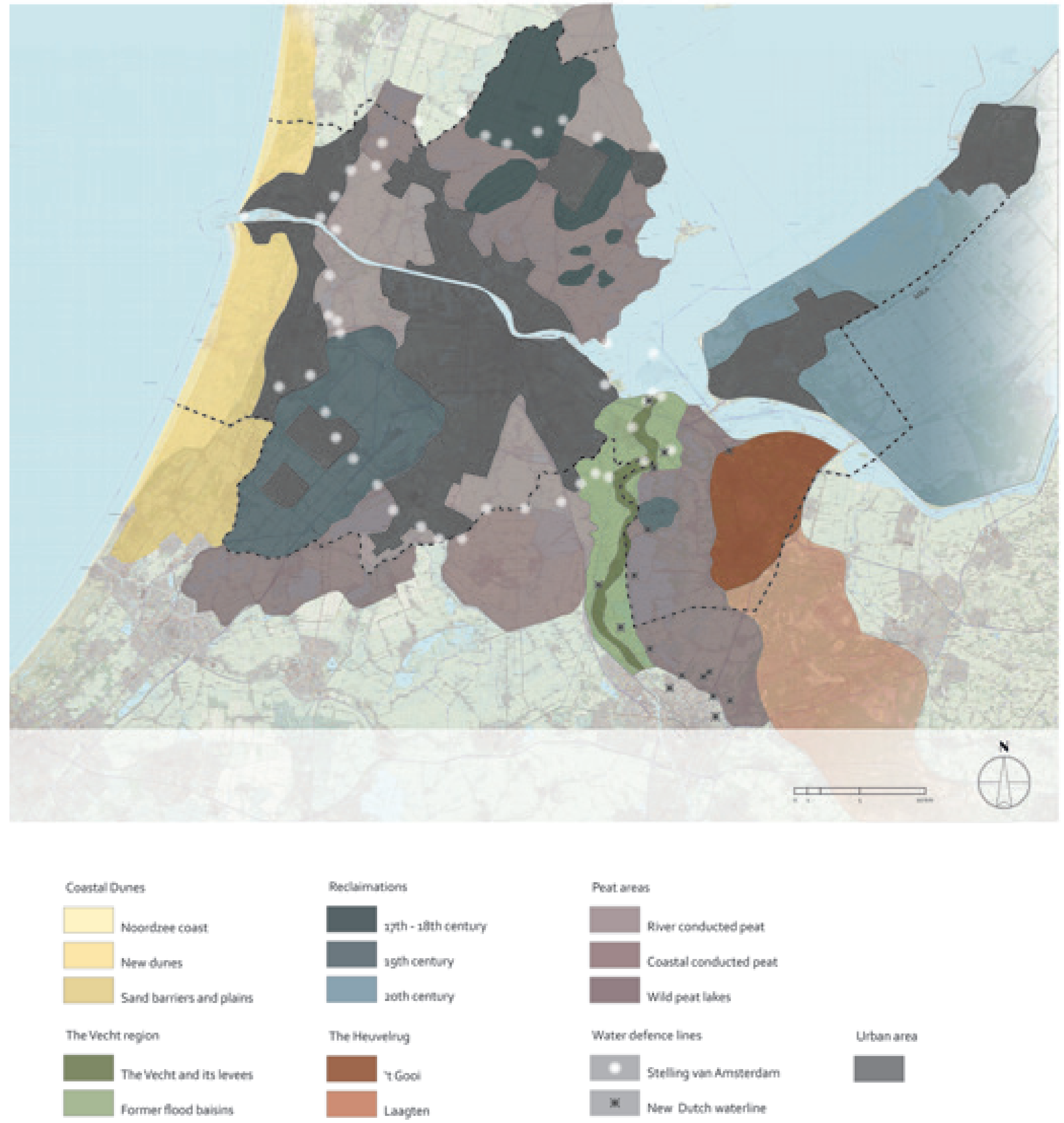


Figure 4.3: different landscape unities in the metropolitan region of Amsterdam (see appendix B for further explanation)

Nowadays, upscaling processes and global trade have created a system of intensive monocultures and anonymous farming. Within the MRA, mass food production takes place in the most favourable landscape unities of reclaimed land and peat areas (figure 4.4). These lands behold a surface of around 61.560 ha, covering five main food products: grain, potatoes, beets, maize and grass for livestock (figure 4.5). These

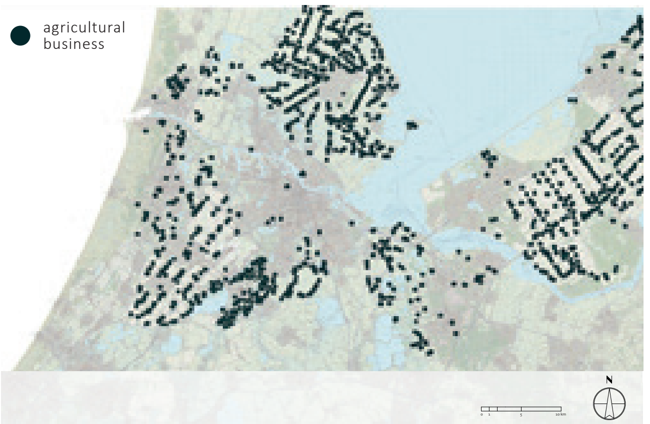


Figure 4.4: food production sites, based on: (Van Bossum, 2018)

products are transported to consumers all over the world, leaving no connection with its surrounding urban cores. An average dinner in Amsterdam, has travelled over 33.000 kilometres, while there is plentiful of productive land in the nearby region to fulfil this task. In times of sudden crisis or transport calamities, the current system would only be able to provide Amsterdam with a food supply for four days (de Boer et al., 2014).

However, the soil composition shows a diverse pattern which offers opportunities for a greater diversificaiton in types of food production (figure 4.6). When adapting the factsheet numbers of the comparison permaculture

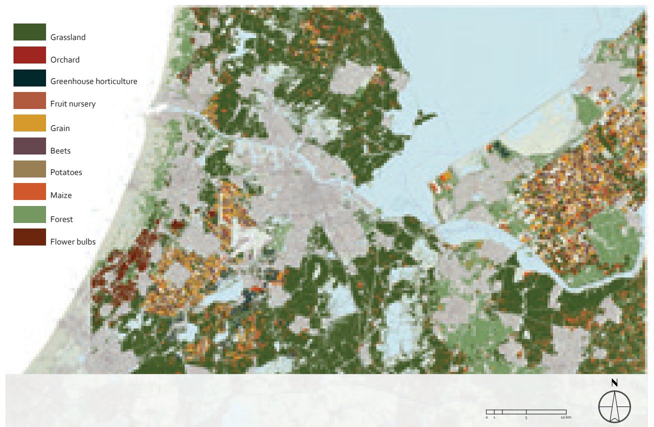


Figure 4.5: land use map (ArcGIS, 2018)

system vs industrial agriculture (figure 3.9), these possibilities can be transferred into numbers.
This interpretation shows how a permaculture- system, based on the diverse soil pattern results in a system capable of feeding more than two and a half times the number of people it can feed now (figure 4.7).

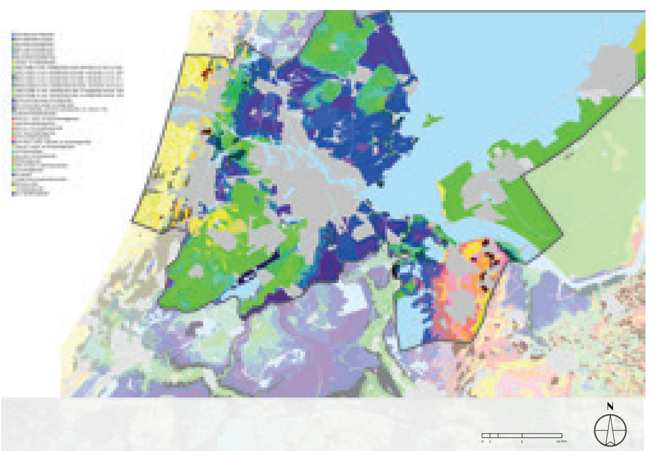


Figure 4.6: soil map (PDOK, 2017)

Figure 4.7: new vs current revenue model

4.2 LANDSCAPE ANALYSIS HAARLEMMERMEER

This part will elaborate on the most important landscape characteristics and -problems considering 'food' in the Haarlemmermeer. It starts with an historical overview of the polder's development, providing interesting insights for valuable cultural food heritage. Consequently it will go more into detail about the geographical situation, including urgent problems threatening the food system. These insights will be used as input for city region food system-, and permaculture system based solutions.

HISTORICAL DEVELOPMENT

Going back into the history of the Haarlemmermeer (figure 4.8), we do not have to go far back in time to see a completely different appearance, as the flat polder landscape used to be an impetuous lake. First this lake was divided into three smaller ones: Leidsche meer, Spieringmeer and Oude meer. These wild waters swallowed their surrounding land until, in 1790, one big lake of 18.000 ha emerged: the Haarlemmermeer. Prosperous settlements arose alongside the lake, profiting from fishery, trade and the joy the water provided; swimming in summer, iceskating in winter and relaxing boat trips (Steenbergen et al., 2009; Boekel, 1872).
Though, this position had a downside as the lake grew in size and 'swallowed' more land into the water every year. No surprise the lake was called the waterwolf; always hungry for land (Boekel, 1872).
Jan Adriaansz Leeghwater was an hydraulic engineer, and the first to speak about the reclamation of the Haarlemmermeer. Subsequently, scientist Nicolaas Amuel Cruquius and politician Frederik Godard van Lijnden van Hemmen pursued this ambition (Boekel, 1872). On March the 22 in the year 1839, a proposition that combined these different manuals was approaved by the government. The goal of this reclamation was to ward off danger, whilst bringing the influential side effect of agricultural land acquisition.

First, one began with the construction of a Ringvaart and Ringdijk; a canal and dike, following the natural form of the lake. This structure included a length of almost 60.000 metres, built within 8 years' time (finished in 1848). After this, the water had to be pumped out of the lake and transported to the North sea. For this, three pumping stations with steam engines were used, given the names of the initiators of the polder reclamation; Leeghwater, Cruquius, Lijnden. On the first of July, 1852, the lake was emptied and 831.839.501 m3 water was thrown out. An area of 18.000 ha was created on approximately -4.5 metres below sea level (Ter Veen, 1925; Boekel, 1872).

When the submerged area was cleared of water, the polder was divided into modules. Within these modules one could find sections, subsequently divided into parcels, each with a size of 20 ha (200x1000 metres). The parcels along the edges of the polder vary considerably in shape, but are adjusted to meet this size of 20 ha. Alongside the big waterways, ribbons of farmhouses were situated, accompanied by a road and a single row of trees on each side of the it. With this spatial construction, a distance of 2 kilometres was set between each ribbon, causing a lack of spatial interaction between the farms. More centralized settlement was planned in two towns, intersecting with the Hoofdvaart: Hoofddorp and Nieuw-Vennep. (Steenbergen et al., 2009).

Once the framework of the polder was established, it was time to assign owners to the plots. The so called domestic settlers came from all over the Netherlands to settle as a farmer in the Haarlemmermeer. Each colonist brought his/her own culture and traditions, resulting in a variation of building styles and production methods, often accompanied by charming farm-names. (Ter Veen, 1925)

"De tallooze landbouwdeskundigen, welke in die dagen de Haarlemmermeer bezochten, waren verbaasd over de vele landbouwstelsels, daar toegepast. De Haarlemmermeer leek een groot proefveld, waar men de beste wapenen zocht in den strijd om het bestaan" (Ter Veen, 1925, p. 50).

In the early years, life in the polder was difficult and many settlers suffered from poverty. There was no governance to control the polder's establishment, wilderness had to be mined and water was difficult to control. Given the role of pioneer in this new piece of land, the struggle for existence was severe.
Combined with the lack of a shared past, the immigrants were joined by a common endeavour to focus on the future in a rather practical and individualistic manner (Ter Veen, 1925).

"De harde strijd houdt allen wakker. Wie verliest, aanvaardt de gevolgen en verdwijnt. Zij die winnen blijven. De beweeglijkheid den kolonisten eigen, vergemakkelijkt deze geestesselectie. Het zijn de ontwaakten onder de boeren, die zich het best aan de nieuwe omgeving aanpassen. Een nieuwe geest is vaardig over hen, een geest van durf, van initiatief" (Ter Veen, 1925, p. 116).

In 1855, the Haarlemmermeer gained the status of a municipality in the province of Noord-Holland. A polder, unified by the symbolic battle cry, and matching badge: *"Gevulde koornaren, opwassende uit de schuimende baren!"* (Boekel, 1872, p. 71). Around 1890, the colonization period came to an end and a more stable community was developed.

The land had a predominant purpose of agricultural production in the most effective way. The most practical and enterprising farmers had remained and started to experiment with new crops and production methods.

The Haarlemmermeer was the first area in the Netherlands were the steam engine plow was used to cultivate farmlands. Through time this resulted in a landscape of highly mechanized farms. Most farmers chose to produce a few profitable crops (wheat, oats, peas, and beets) and cattle breeds (pigs, cows and horses), resulting in an overall annual revenue of over £ 2.000.000. Compared to the £ 2.000 that fishery on the former lake would produce, the polder lands reached a very high standard of agriculture (Van Paasen, 1955; Ter Veen, 1925; Boekel, 1872).

THE STORY OF THE SETTLERS

Many of the original farm roads with accompanying settler farms have been fragmented and demolished by new functions such as infrastructure or urban expansion. Part of this unique variety of settler farms is still visible in the Haarlemmermeer. These farms have often maintained their original name and architecture, telling more about the origin of its first settlers. Through archive studies, these remaining farms have been structured and visualized in a map of the current situation (figure 4.9). These roads with accompanying farms (and names) are beautiful tangible remnants that tell the intangible story of the first settlers in the Haarlemmermeer.

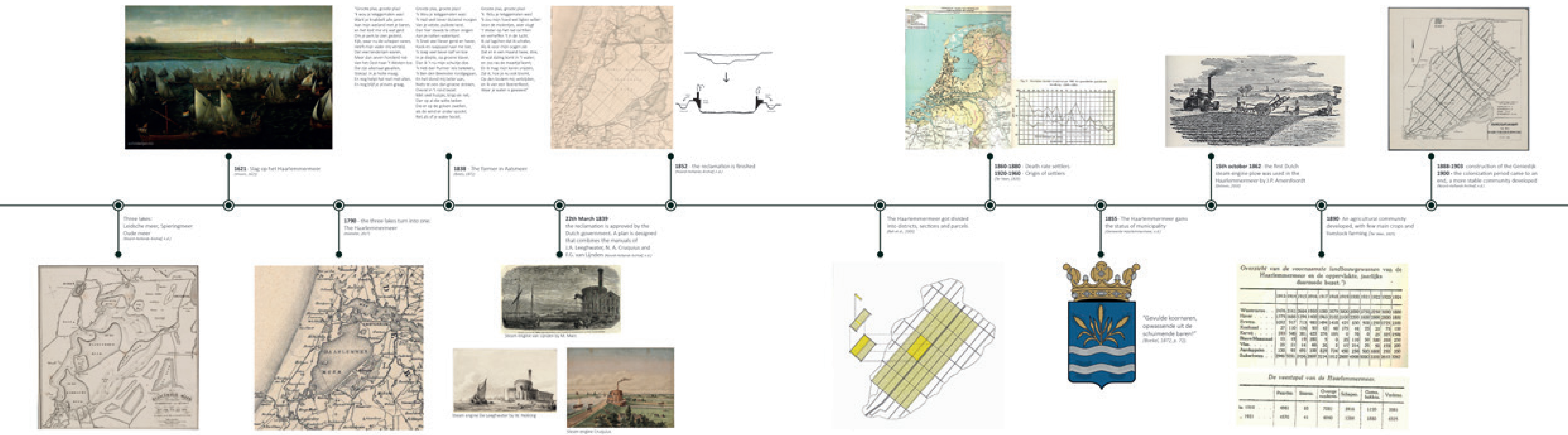


Figure 4.8: timeline historical development Haarlemmermeer

'Commandeurshoeve' -Zuid-Hollandse boerderij- (van Diemen & Floris, 1987)

'Harstee' -herenboerderij- (van Diemen & Floris, 1987)

'Hoop op zegen' -Noord-Hollandse stolpboerderij- (van Diemen & Floris, 1987)

' Acht geeft meer dan Duizend' -Friese stolpboerderij- (van Diemen & Floris, 1987)

'Tedings hoeve' -Brabantse boerderij- (van Diemen & Floris, 1987)

'Vondels Landleeuw' -Limburgse boerderij- (van Diemen & Floris, 1987)

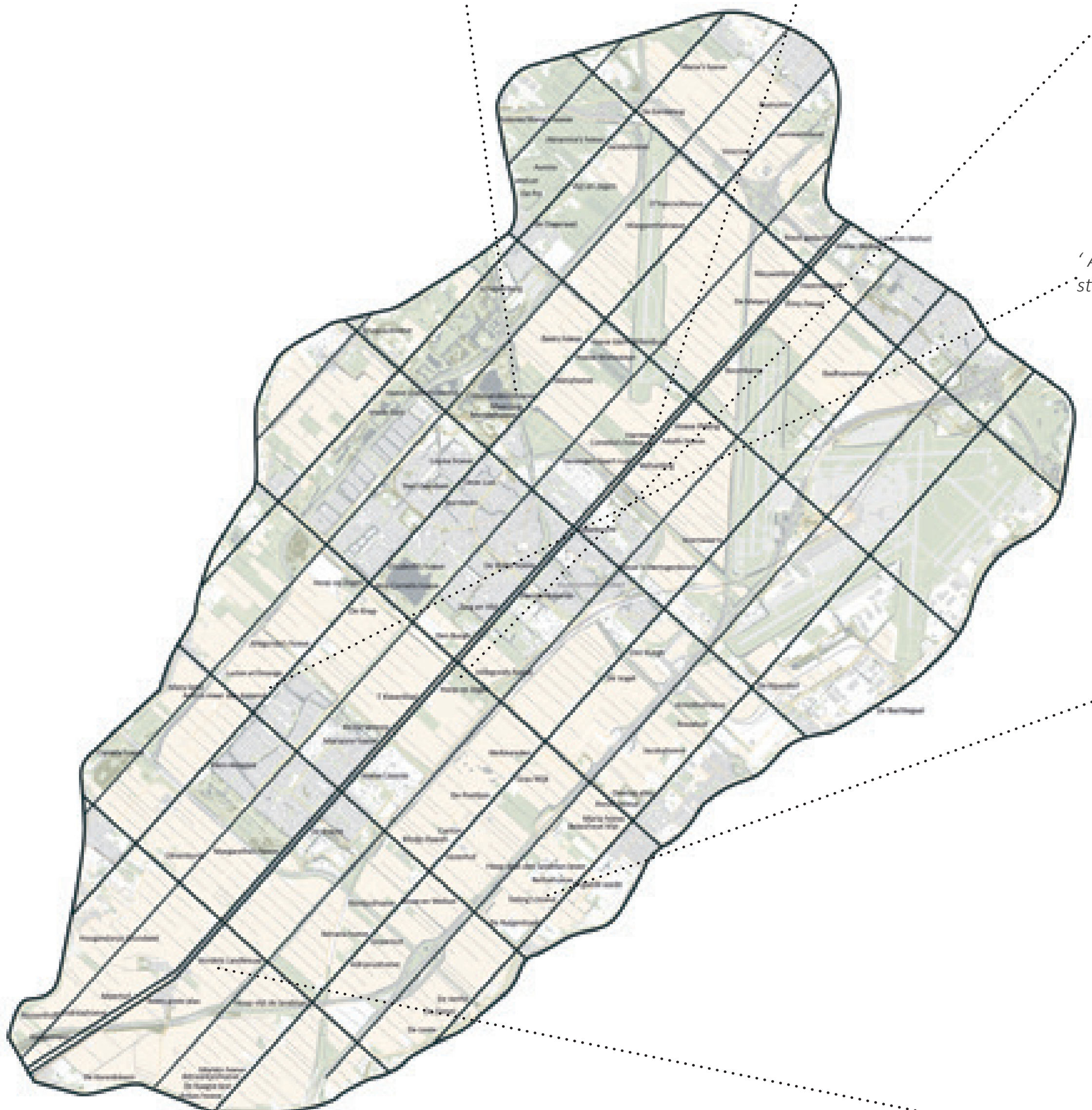


Figure 4.9: remaining historical farms in the Haarlemmermeer (van Diemen & Floris, 1987), see appendix E for the complete list of farms

SOIL

Geographical processes through history caused various sediment accretions that created a diverse soil patterns, typical for the Haarlemmermeer (figure 4.11) (Steenbergen et al., 2009). The surface of the Haarlemmermeer mainly consists of clay and loam, with a layer of compressed peat below. Near Hoofddorp, a deviant structure is situated, with more sand towards the surface, deriving from a former tidal channel of the sea. The same type of deviant sand structures are found where former islands used to be (e.g. Abbenes). In de edges of the polder, remnants of peat areas are present, recognizable by their deviating land use patterns. (Van Pridon x De Groot landschapsarchitecten et al, 2012). Although the soil shows numerous of options for a diverse farming palette, the polder merely consists of five main food crops: grain, potatoes, beets, maize and grass for livestock. These monocultures, with their large consumption of chemical fertilizers, are mainly led by short-term economic-based systems, neglecting the most important requirement for long term productive agriculture: the soil (figure 4.12). This has resulted in a degradation of soil quality over time (Van Paasen, 1955; Ter Veen, 1925; Boekel, 1872). When these farms change into permaculture-based systems, food production can be adapted to the diverse soil pattern, resulting in a healthier soil and a diverse yield, capable of feeding more than two and a half times the number of people it can feed now (figure 4.10).

Figure 4.10: new vs current revenue model Haarlemmermeer

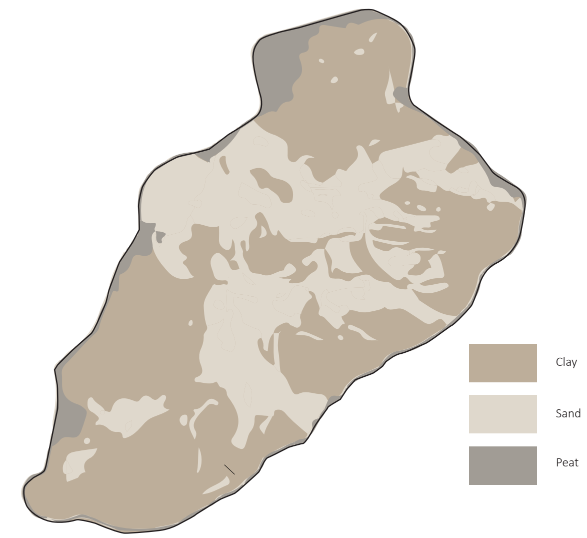


Figure 4.11: soil map Haarlemmermeer, based on: (van Pridon x de Groot landschapsarchitecten et al., 2012)

Figure 4.12: large scale monocultures in the Haarlemmermeer (image by author)

WATER

When the Haarlemmermeerpolder was designed, the Hoofdvaart represents the centre line of the polder, subdivided into smaller water ways, and subsequently into ditches surrounding each parcel. Apart from their function as separators and transport routes, the ditches were used to drain water surplus towards the Ringvaart, and subsequently to the sea (figure 4.17)(Boekel, 1872; Steenbergen et al., 2009). This drainage system is often described as a misplaced frugality since it barely meets the draining needs of the area (Steenbergen et al., 2009). It is said that at least 5% of an areas surface is required to sufficiently drain it, while in the Haarlemmermeer it covers only 4% (Ter Veen, 1925; Van Pridon x De Groot landschapsarchitecten et al., 2012). Currently, the polder is suffering from these previously created structures, comprising the basic polders requirement: water safety and water quality. With its -4.5 meters below sea level and its increase in paved surface, the polder is subject to flooding, and the small percentage (4%) of water drainage is not enough to process this in times of heavy rain. Meanwhile, in times of drought, the system lacks sufficiency to hold the water (Van Pridon x De Groot landschapsarchitecten et al., 2012).

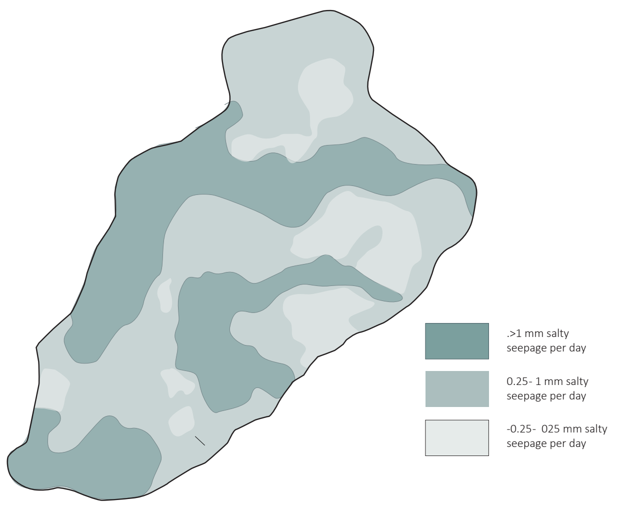


Figure 4.13: salty seepage in the Haarlemmermeer, based on: (van Pridon x de Groot landschapsarchitecten et al., 2012)

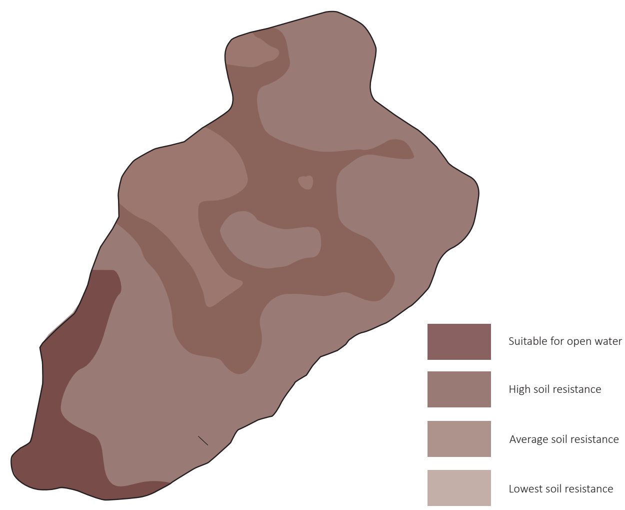


Figure 4.15: soil resistance in the Haarlemmermeer, based on: (van Pridon x de Groot landschapsarchitecten et al., 2012)

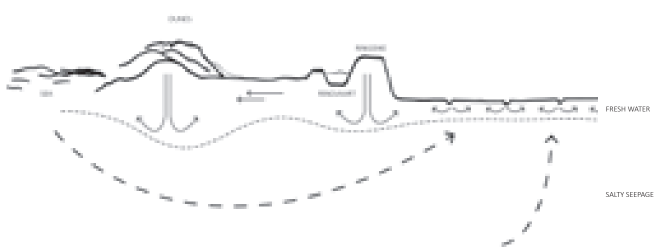


Figure 4.14: salty seepage flows in the Haarlemmermeer

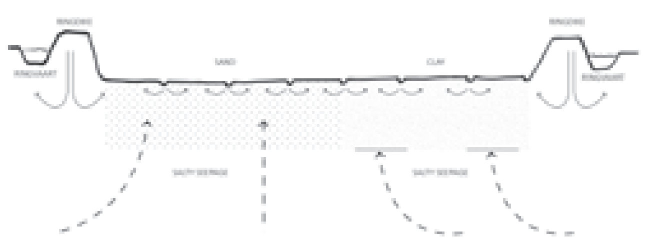


Figure 4.16: soil resistance in the Haarlemmermeer

Additionally, the low level of the polder grounds enable large amounts of salty seepage to enter the soil (figure 4.13 & 4.14). The amount of salty seepage varies strongly, depending on the type of soil and its water resistance. While the high particle density of clay offers strong resistance to seepage, the lower density of sand particles allows seepage flows to pass through (figure 4.15 & 4.16). The availability of clean, fresh water is particularly important for the agricultural sector as many crops suffer from the salinization process of the soil. Figure 4.18 shows crop tolerance compared to salinity in the soil, partly explaining the limited types of crops that are cultivated in the Haarlemmermeer (Van Pridon x De Groot landschapsarchitecten et al., 2012).

Currently, the water drainage can be described as a flushing system. In the dry summer season, large amounts of fresh water is pumped into the polder at the southern pumping station Leeghwater. Meanwhile, in the wet winter season, the excess water is drained out of the polder, at the northern pumping station Lijnden. Half of this flushing water is used to supplement the desired water level, while the other half is used to dilute the salt seepage. Especially the diluting process is highly inefficient in terms of water use. The polder requires more self-sufficiency considering fresh water storage (dependent on the soil resistance), to cover this shortage and improve the water quality. Besides such interventions, the salinization must be accepted in certain areas, e.g. by the introduction of salt-tolerant crops (Van Pridon x De Groot landschapsarchitecten et al., 2012).

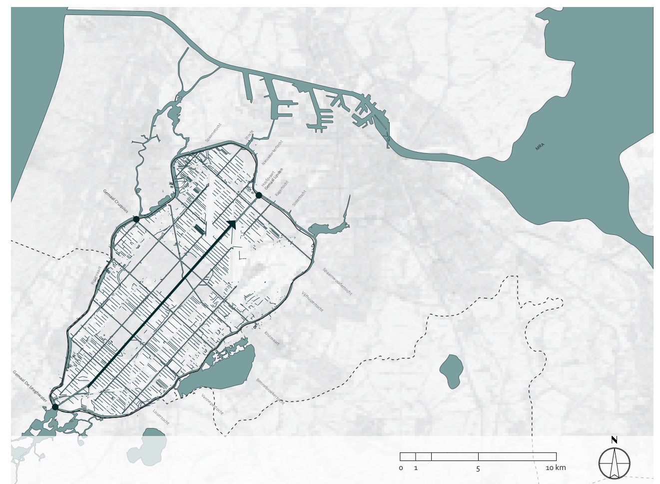


Figure 4.17: water system in the Haarlemmermeer, based on: (van Pridon x de Groot landschapsarchitecten et al., 2012)

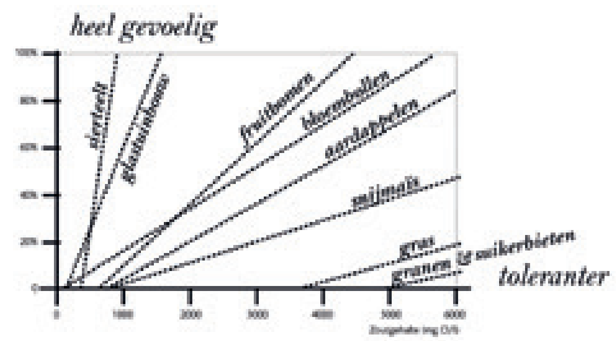


Figure 4.18: crop tolerance considering salty seepage (van Pridon x de Groot landschapsarchitecten et al., 2012)

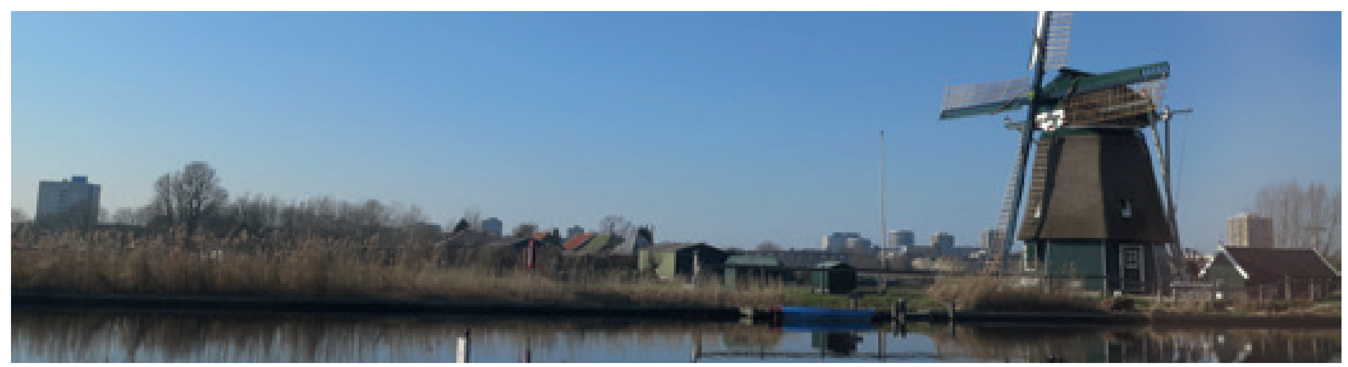


Figure 4.19: ringvaart in the Haarlemmermeer (image by author)

ECOLOGY

Haarlemmermeer's large scale monocultures and the decrease in water quality and quantity is also putting the regional ecosystem in danger. Combinations of agricultural pesticides, salty seepage and fresh water drainage lower the level of oxygen in the water, thus killing organisms (figure 4.21). Also the shape of waterways and their connections have a big influence on ecological development (Van Pridon x De Groot landschapsarchitecten et al., 2012). This lack in qualitative ecological connections is also visible on the larger scale, where nature and agriculture are still seen as two separate functions. The agricultural lands of the Haarlemmermeer create missing links in the ecological network of the metropolitan region of Amsterdam (figure 4.20) (Provincie Noord-Holland, 2014). Solutions can be found in the integration of these two worlds, reinforcing each other's values and profits.

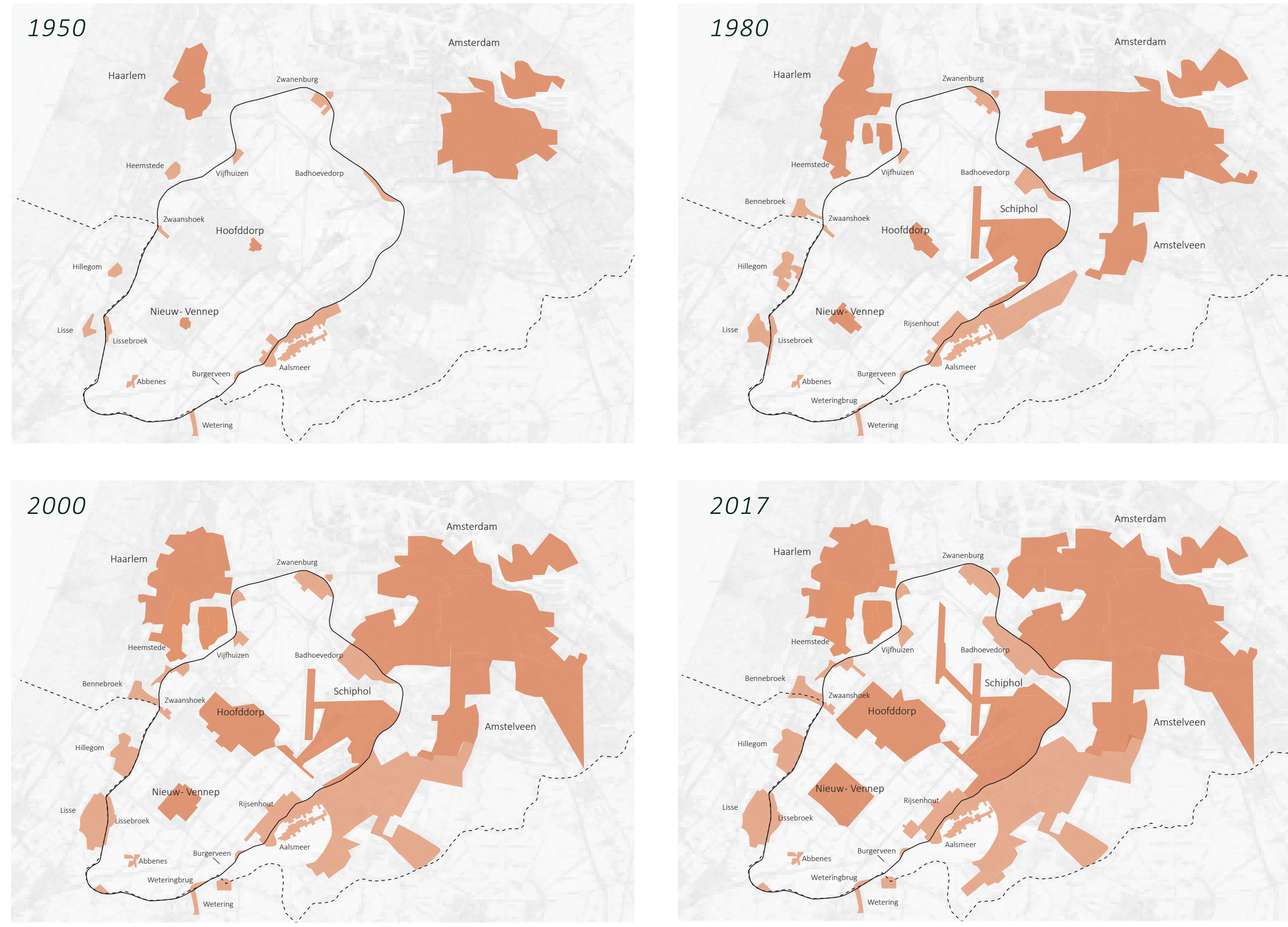
Figure 4.20: nature network and missing links around the Haarlemmermeer, based on: (Provincie Noord-Holland, 2014)

URBAN SPREAD

The polder has always been under the influence of adjacent urban cores such as Amsterdam and Haarlem. Over time, these cores have grown beyond their borders, into the polder. Also from within the polder, urban growth has taken place, and still is (figure 4.22 & 4.23). The Haarlemmermeer became a commuting area for the Randstad (Van Paasen, 1955). With this trend, the polder's original structures were fragmented and influences from Amsterdam's metropolitan scale became daily business. In an experimental design study by Steenbergen et al., a future scenario is outlined in which the development of Haarlemmermeer as a metropolitan poldercity is visualized (figure 4.24). When urban spread continues to take place, this predictive image of the future Haarlemmermeer is likely to originate, leaving no place for the polders original agricultural function.

Figure 4.21: poor water quality in the Haarlemmermeer (van Pridon x de Groot landschapsarchitecten et al., 2012)

Figure 4.22: urban expansion in the Haarlemmermeer (image by author)



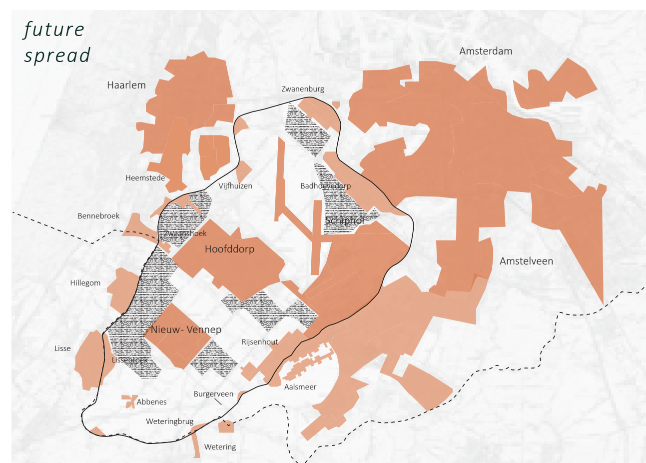


Figure 4.23: urban spread around the Haarlemmermeer, based on: (Kadaster, 2017; Provincie Noord-Holland, 2014)

Figure 4.24: Experimental future scenario: the Haarlemmermeer as metropolitan poldercity (Reh et al., 2005)

RECREATION

As Haarlemmermeer's connection with urban cores mainly consists of practical functions such as housing, work and food production, not much focus is put on its regional characteristics and qualities. This is clearly visible when we look at the recreational networks surrounding the Haarlemmermeer (figure 4.25 & 4.26). Recreational hotspots are mainly located around the polder, and main walking-, biking- and sailing- routes are often used as intermediate to get from one place to another (outside the polder).

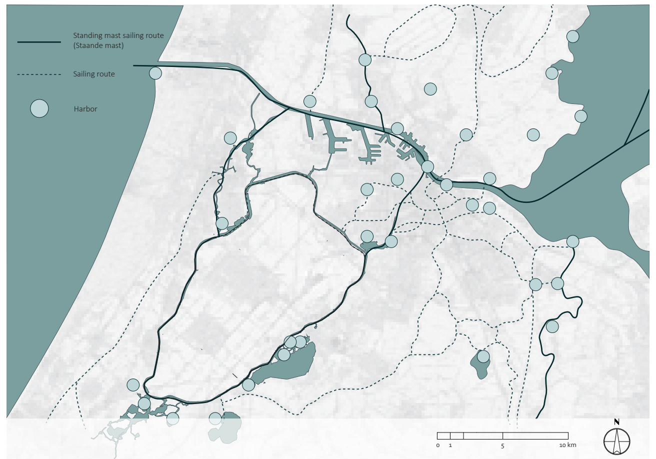


Figure 4.25: sailing routes in and around the Haarlemmermeer, based on: (Provincie Noord-Holland, 2014)

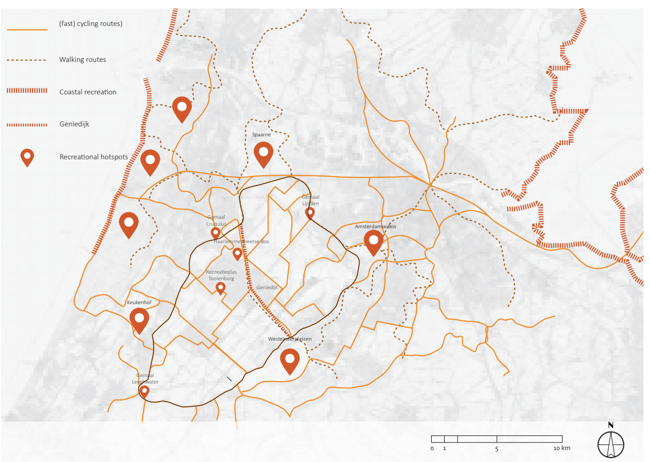
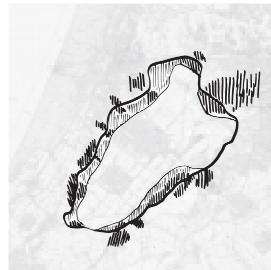


Figure 4.26: recreation in and around the Haarlemmermeer, based on: (Provincie Noord-Holland, 2014; Stichting Landelijk Fietsplatform, 2019)

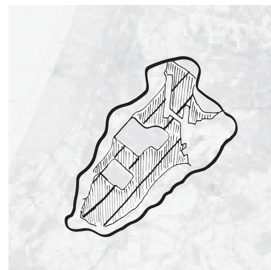
4.3 SITE COMPONENTS IN THE POLDER

In general we could say that the Haarlemmermeer can be divided into four different landscape components, each going through different development processes, characterizing the polder as a whole:

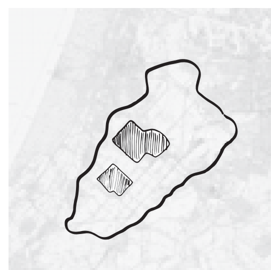
- The polder edge



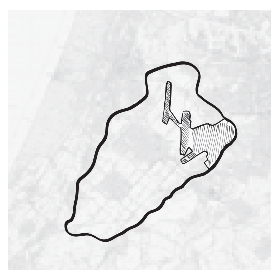
- The polder plane



- The build cores



- Schiphol



THE POLDER EDGE

The polder edge represents the oldest cultural remainder in Haarlemmermeer's history. Small villages surrounded the Haarlemmermeer and made a living out of its fishery and trade. This focus towards the Haarlemmermeer suddenly changed when the reclamation started and a Ringdijk was constructed right next to this lively edge. The villages lost their connection with the polder and had to change their orientation towards peripheral municipalities on the hinterland. They based their lifestyle and soil use on the characteristics of these varying hinterlands, and practised this on the, soil matching, edges of the Haarlemmermeer. The proximity of Amsterdam promoted vegetable growing in the North; Aalsmeer influenced flower cultivation in the East; and Lisse and Hillegom fostered flower bulbs cultivation in the West. Over time, the North has detached itself more and more from its agricultural soil use and started to focus on modern industries (Van Paasen, 1955; Ter Veen, 1925). Nowadays, these edge-villages are strongly oriented towards the urban influence of Amsterdam and became an interesting location for its city extension (Maas, 2018). Adjacent urban life and traffic constructions bring the fast developing modern life into the polder's edges. In general, the diverse type of settlements and land-uses in the polder edge strike with the structural integrity and speed of the inner landscape, disconnecting both (Van Paasen, 1955; Ter Veen, 1925).

THE POLDER PLANE

After the reclamation of the Haarlemmermeer, the polder was almost completely covered with agricultural land uses, providing the main source of income. Over time, the amount of agricultural companies has dropped significantly as it competes with urban spread. This has resulted in a large decline of agricultural lands to a current percentage of 51% (Gemeente Haarlemmermeer et al., 2011; WEnR, 2018). Over time, Haarlemmermeer's farmers expanded their markets to the global scale and simplified their production crops. Only 10% of the food producing companies (together covering 10 ha) use their direct region to sell their products. Although it is expected that only a limited part of these products will be sold on a regional basis (WEnR, 2018). With this trend, not only consumers miss the link with regional food production in the polder, but also farmers get detached from the destination of their produced food.

Dairy farmer in the Haarlemmermeer – Martin van der Peet: *"De melk van mijn boerderij gaat naar de Coöperatie Campina en gaat zo naar de hele wereld. Als baby-melkpoeder naar China of als toetjes naar Rusland? wat ze er van maken of waar het heen gaat weet ik niet"* derived from interview with storyteller Anne van Delft (van Delft, 2018).

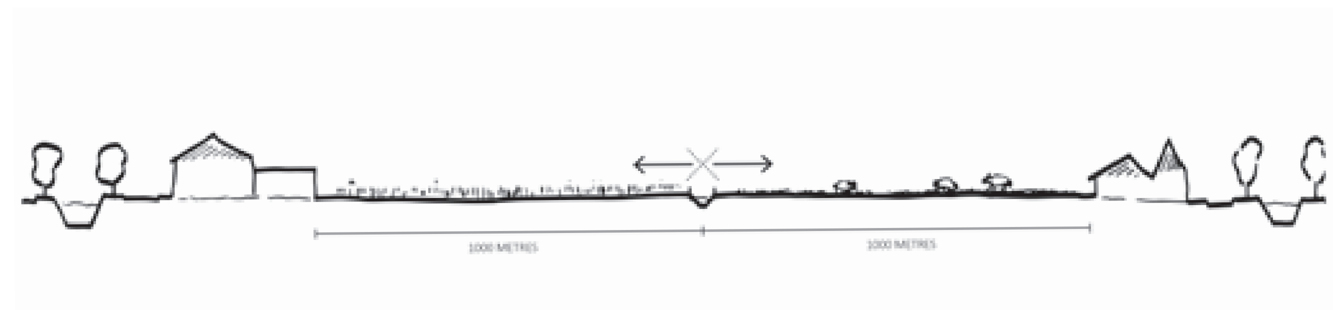


Figure 4.27: original disntance between farms; West - East

When the polder plane was designed, a strict grid of farm roads was used to create a sense of uniformity and singularity. However, this grid lacked a degree of human scale, leaving no room for spatial interaction between the farms (figure 4.27). This individualistic figuration reinforced the farmer's commercial sense towards surrounding urban areas (Van Paasen, 1955; Steenbergen et al., 2009).

"The influences of the surrounding urbanized area, have contributed to the continuation of many of the specific qualities of the farmers – individualism, commercial sense, technical skill and interest" (Van Paasen, 1955, p.2).

Lately, small scale farm initiatives are initiated as counter-reactions to globalizing food processes, to promote regional and sustainable food production in the Haarlemmermeer. 'de MeerBoeren' is an example of such an initiative (figure 4.29; MeerBoeren, 2008).

These platforms could be of valuable input when creating a sustainable food region.

Currently, the shape of the polder plane is still partly influenced by the designed polder grid and some of the old farm buildings can be recognized by their typical architecture. Though a lot of these old structures have been demolished or disrupted in time by the construction of new roads and industrial areas (Steenbergen et al., 2009).

An interesting element that strikes with the strict polder grid is the Geniedike and its associated forts. This dike was part of the 'Stelling van Amsterdam' (figure 4.28, 4.30 & 4.32). In 1996 the Geniedike was placed on the UNESCO list of world heritage, therewith it was recognized as secured element (Wikipedia, 2018a). Currently this dike is used as a green cycling lane, grazing fields, and some of its forts function as museum or art gallery (HLMR meer, 2015).

Figure 4.28: cows on the Geniedike (image by author)

Figure 4.29: sustainable-regional food platform (MeerBoeren, 2008)

Figure 4.30: fragmentation of Geniedike by A4 (Google, 2019)

THE BUILD CORES

After the polders reclamation, one decided to create two build cores: Nieuw-Vennep (former Vennerperdorp) and Hoofddorp (former Kruisdorp). Nieuw-Vennep became the village of the worker, housing families who earned their living with land-work on surrounding farms. Hoofddorp was designed to be the administrative- and agricultural core of the polder. It housed the former grain stock market and farm loan bank, making it the centre of farmers activity and trade (Van Paasen, 1955). Over time this village has outgrown its original borders, from 5.000 inhabitants in 1950 to a current population of over 75.000 inhabitants (Wikipedia, 2018).

It changed from a rural village to an urban core, housing many Randstad commuters without any relationship to the agricultural polder plane. The growing borders of these urban cores strike with the original agricultural polder structure, and changed it into a landscape of mixed structures and purposes. Within this mixed structure, the build cores offer space to localize urban influences, thus protecting the agricultural character of the polder plane. However, the balance between these urban and rural elements is labile and determined by the way surrounding influences are taken care of in the future (Van Paasen, 1955).

Figure 4.31: grainmill 'de Eersteling' in Hoofddorp (image by author)

Figure 4.32: fortress in Hoofddorp (image by author)

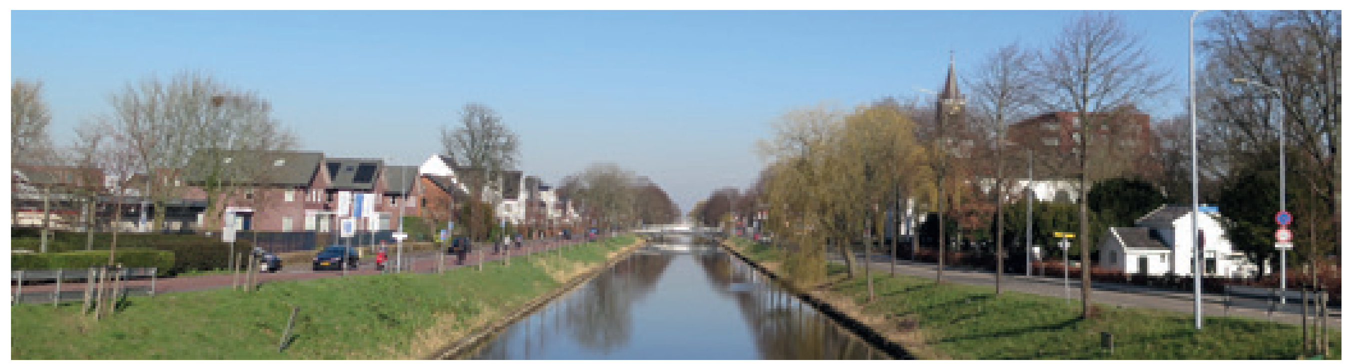


Figure 4.33: Hoofdvaart through Hoofddorp (image by author)

SCHIPHOL

With the intake of almost a quarter of the surface of the polder, Schiphol can be seen as a separate component in the landscape. The airport is one of the most important employer in the Haarlemmermeer; 30% of Schiphol's employees live in the Haarlemmermeer. With its buildings and infrastructure, Schiphol grew all over the polder, concentrated in the northern area (Overkamp, 2012). Aside from these physical structures, Schiphol exerts much influence in the whole polder by setting noise contour lines, restricting many land-use functions (figure 4.35 & 4.36). This airport influence is very specific for the Haarlemmermeer as the average metropolitan food region does not encompass such a component. In the case study design, the spatial configuration of Schiphol will be taken into account. However, the invisible regulations of the airport will not be a leading feature as this research aims to show possibilities considering food production.

Figure 4.34: flight strip of Schiphol (image by author)

Figure 4.35: noise contours around Schiphol (Groene hart media, 2017)

Figure 4.36: expansion influence of Schiphol on the agricultural lands in the Haarlemmermeer (image by author)

4.4 A SPARE LANDSCAPE

To summarize, there is a remarkable struggle considering spatial characteristics within the Haarlemmermeer polder. After its reclamation, the polder was not recognized as an area with cultural aspirations. Besides its practical agricultural function, it was seen as a colony that did not need special attention in terms of spatial organization (Steenbergen et al., 2009).

"This attitude produced a spare landscape, without Arcadian inspiration" (Steenbergen et al., 2009, p. 399).

In time, this lack of site-specific characteristics was reinforced through the enhancing orientation towards its urban surroundings. The sense of unity was lost and there was no space for region-specific developments. The Haarlemmermeer is seen as a solely productive site, employing for the Randstad (Van Paasen, 1955).

"From a contemporary perspective, the Haarlemmermeer polder was an abortive cultural landscape, and because of its location was from its very inception a prospective urban landscape awaiting development. Right to this day the polder therefore remains a landscape for new settlement." (Steenbergen et al., 2009, p. 399).

Figure 4.37: sheep grazing on the Geniedike (image by author)

SYNTHESIS
DESIGN GUIDELINES

" Boeren hebben de morele plicht om de grond die zij bij de start kregen van hun ouders, broers en zussen, beter door te geven aan de volgende generatie."

- Hans Huijbers (de Voor, 2019, p. 37) -

5.1 GENERATING GUIDELINES

This part of the research is essential because of the new knowledge that is generated by the synthesis of previous chapters; theory and analysis. This step encompasses the core of 'research through designing.' Through this synthesis, new design guidelines are created for the realisation of the aimed for sustainable food region.

At first, the most essential knowledge of both the theory- and the analysis chapter is gathered. For the theory chapter this includes the design ingredients belonging to the three different theories; city region food system, cultural food heritage and permaculture. From the analysis chapter, knowledge is gained from the three different scale levels within the case study location, respectively: the Metropolitan region of Amsterdam, the Haarlemmermeer and component sites within the Haarlemmermeer. This knowledge consists of maps, intersections, photographs and textual – more intangible – analysis features. The different scale levels used in the analysis chapter are applied in the subdivision of the guideline-loops. Each loop consists out of five stages. In the first three stages, design interventions are sketched considering each of the three theories, grounded upon analysis knowledge for that particular scale level. In stage four, all these interventions are organized by looking for combinations between them, fulfilling supportive or additional qualities. In stage five, these combinations are transformed into a set of design guidelines, specific for each scale-level (figure 5.1).

After the generation of guidelines, a final step is needed to derive to the aimed for design principles. This step needs a process of generalization and abstraction. After the guidelines have been applied in the case study design, statements can be made about their functionality and interconnectivity. Subsequently, they can be subdivided in different sets of guidelines, that can be generalized to design principles. This subdivision offers a complete palette of design principles, guiding landscape architects in designing sustainable food systems.

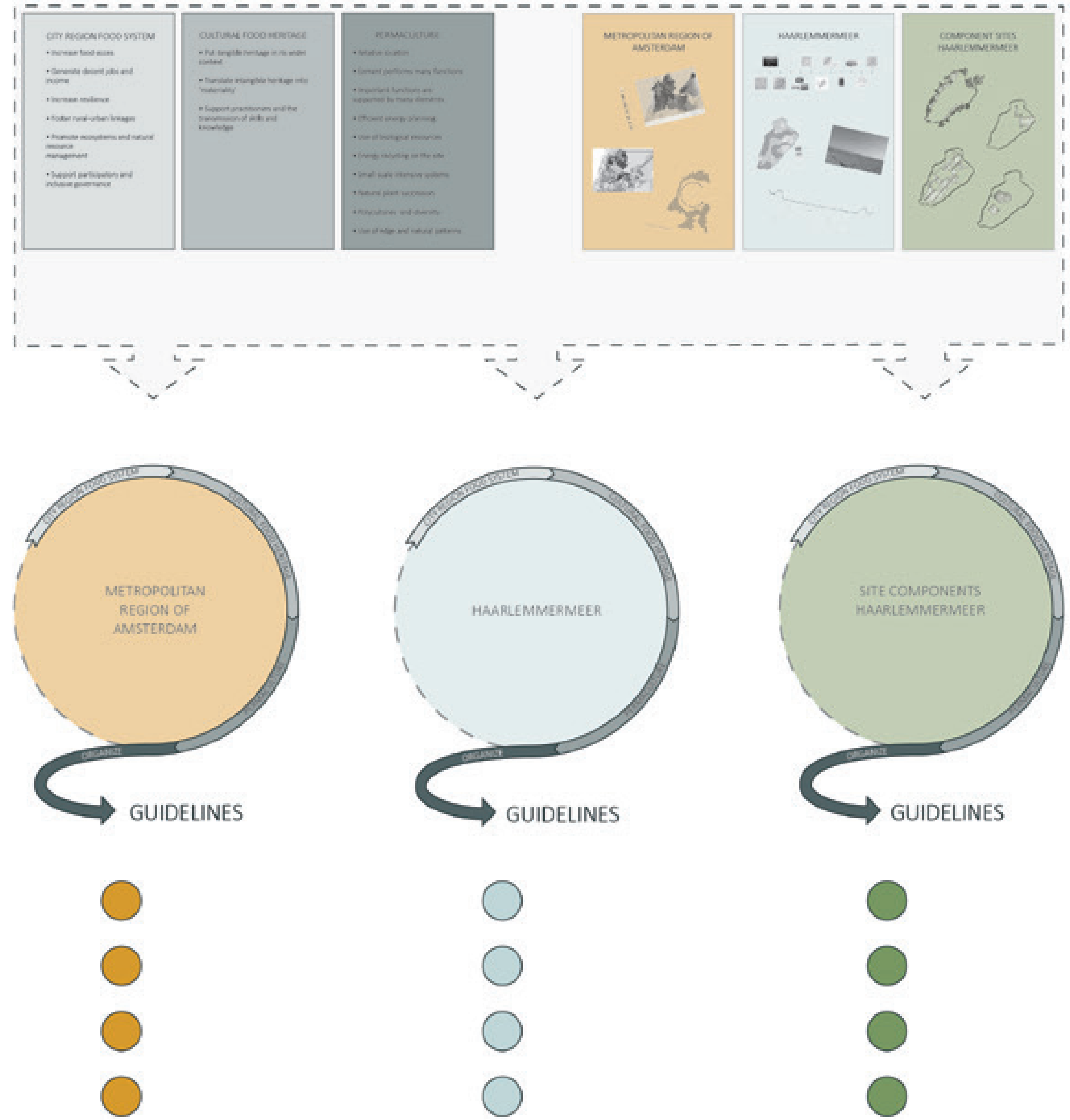
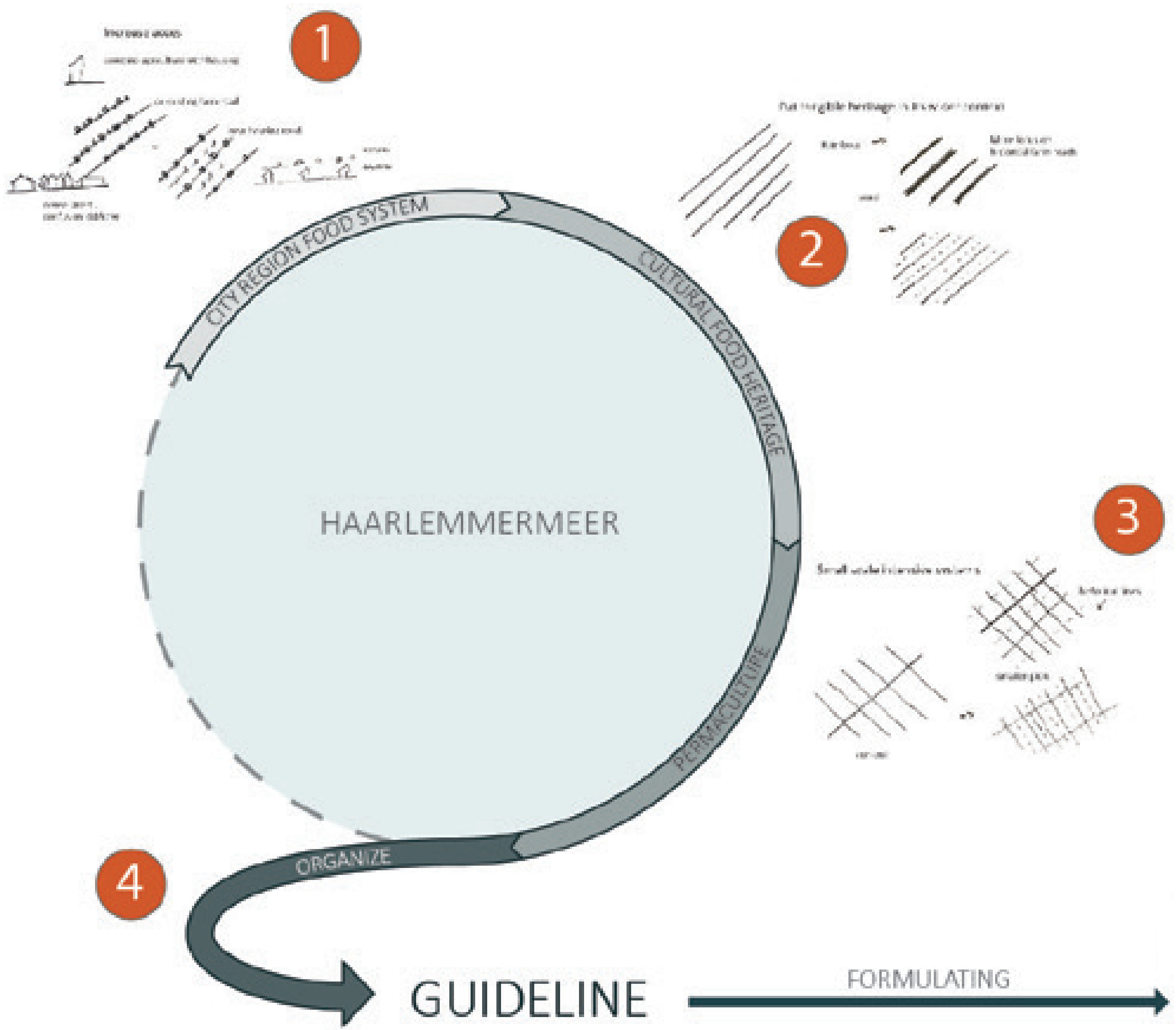


Figure 5.1: the 'design guideline generator'



To give an idea of how this method is used throughout the research, I will elaborate further on the generation of a design guideline for the Haarlemmermeer scale (figure 5.2). In the stage of 'city region food system' I looked for ways to increase access to food by integrating housing with rural areas (1). In the stage of 'cultural food heritage' I looked for a way to put the tangible farm roads in a wider context by adding parallel road structures (2). In the stage 'permaculture,' I designed options for a configuration of small-scale systems by dividing the original farm plots into smaller ones (3). These three design interventions are organized into a new design guideline (4). In this guideline, a new farm road is created parallel to the original farm roads. This new farm road divides the original farm plots into smaller ones. Also, these roads create room for new housing, inviting 'new settlers' to the polder; continuing the polders' settlers tradition. This guideline (H9) is digitalized into a final icon, which can be used in the design for the Haarlemmermeer (5).

Following paragraphs contain the result of the pre-described process of the '*design guideline generator*,' for each of the three different scale levels. The icons on the left refer to the used combination of theories; city region food system, cultural food heritage, and permaculture.

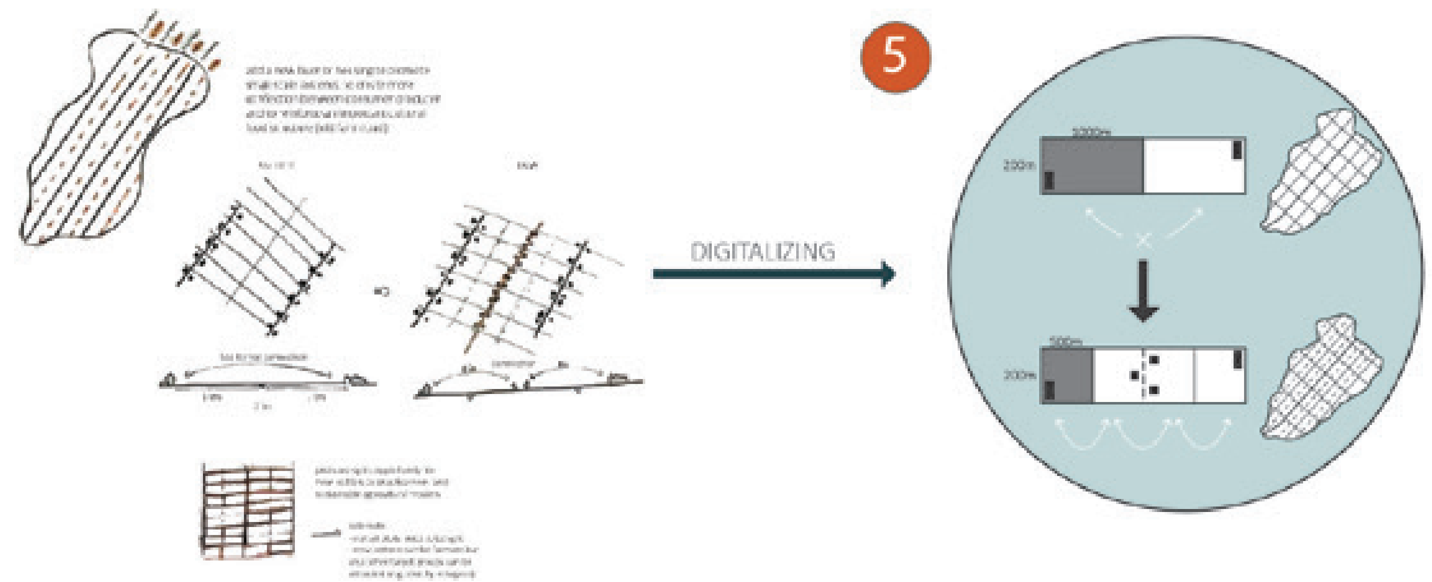


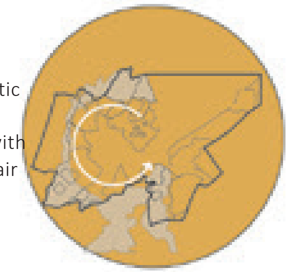
Figure 5.2: regional example of 'the design guideline generator' (see appendix G for a complete overview of design sketches)

5.2 GUIDELINES FOR THE METROPOLITAN REGION OF AMSTERDAM

M 1: food regions

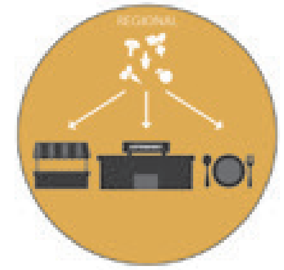
Tangible landscape unity structures are transformed into different, characteristic food regions. Each region is promoted with own food label and fair income and jobs are generated.

M 2: Stelling route



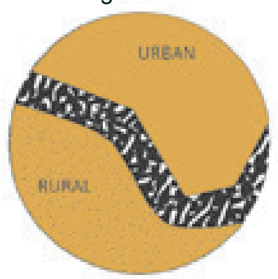
The Stelling van Amsterdam is used as recreational structure, linking different food regions. Consumers get access to the food landscape and rural-urban linkages are reinforced.

M 3: regional food sale



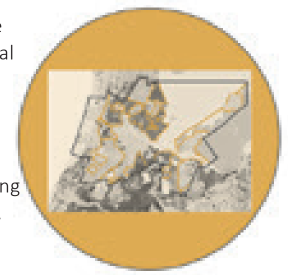
Farmers income is guaranteed and consumer-producer relations are promoted through the sale of regional food products in (super)markets and by using these products for public institution meals. Also regional resilience is promoted as markets are less dependent on global resources.

M 4: green buffer



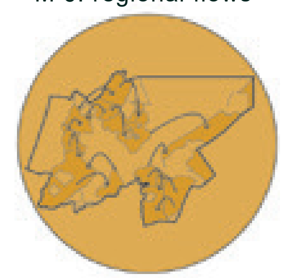
Rural-urban edges are used as multifunctional green bufferzones, preventing urban spread, promoting resilience and ecosystems, and valuing rural food landscapes.

M 5: soil related food



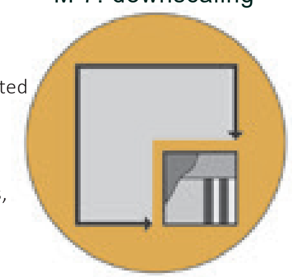
Food production is related to the natural soil pattern, creating a resilient polyculture that provides access to a diverse diet and promotes the development of new food-niches(jobs).

M 6: regional flows



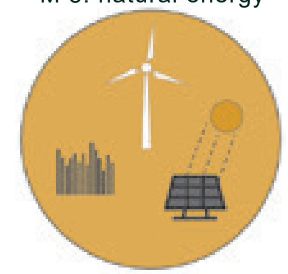
Resilience and natural resource management is created through interacting flows between food regions, promoting multifunctional-uses, recycling and closed cycle design.

M 7: downscaling

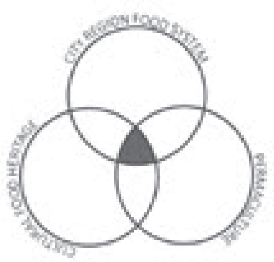


Resilience and ecosystem diversity is promoted by transforming large scale monocultures into smaller, more diverse, polycultures.

M 8: natural energy



Resilience, and independence from global resource flows, is promoted by the use of natural- and biological energy resources from the region.



M 9: rural housing

Access to the food landscape is generated by integrating small-scale housing in rural areas. Consumer-producer relations get restored and food knowledge is transmitted.

M 10: food policy

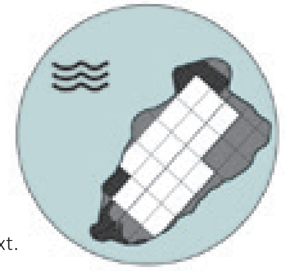
Through inclusive governance, a food policy is set up to guide and protect sustainable farming solutions in the surrounding food region.

5.3 GUIDELINES FOR THE HAARLEMMERMEER

H 1: buffer edge

The cultural structured edge is put in a wider context to serve as agricultural bufferzone and foster rural-urban linkages. It covers urban areas, water buffers and forests, based on their relation with the polders context.

H 2: water buffer

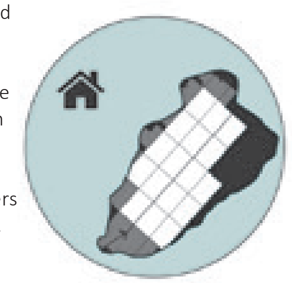


The cultural structured edge is put in a wider context to serve as agricultural bufferzone and foster rural-urban linkages. Accordingly its degree of soil resistance, it covers place for water buffers, supporting agriculture.

H 3: food forest buffer

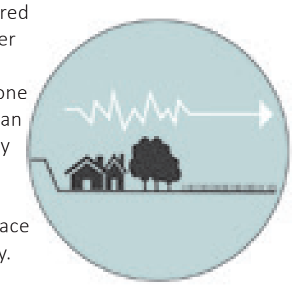
The cultural structured edge is put in a wider context to serve as agricultural bufferzone and foster rural-urban linkages. Accordingly its soil pattern and open land use, it covers place for food forests.

H 4: build buffer



The cultural structured edge is put in a wider context to serve as agricultural bufferzone and foster rural-urban linkages. Accordingly its relative location with the polders context, it covers place for housing/industry.

H 5: buffer transition

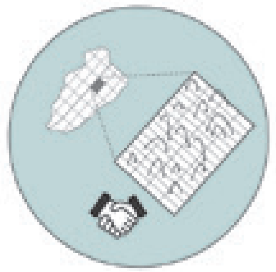


The cultural structures of the polders edge and plane are put in a wider context, and legibility is increased by reinforcing their characteristics: edge- closed plane- open.

H 6: green belt

Green buffers are constructed on the edges of build cores. They cover biodiversity, resilience to urban spread, space for rural-urban linkages, and they reinforce the open characteristic of the polder plane.

H 7: farm module

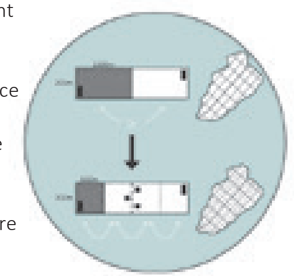


Historically structured polder modules consist out of a farmers cooperation, ensuring interaction between farms. Recycling processes and function support help to generate (shared) income and reinforce resilience.

H 8: module flows

Between the different modules/farmers cooperations, interaction takes place (recycling, function support) to generate (shared) income, reinforce regional autonomy, and ensure resilience.

H 9: new settlers



New farm roads are created parallel to the original farm roads. They divide farm plots into smaller systems and create room for new, rural housing, inviting 'new settlers' to the polder; continuing the polders' tradition.

H 10: soil related food

To create a resilient and diverse food region, the type of agricultural food production is decided accordingly Haarlemmermeer's natural soil pattern, with corresponding needs and qualities.

H 11: bike/walk network

Use regional culture structures- farmroads and ringdike - as recreational biking/ walking network to put this heritage in a wider context, and promote access to the food region.

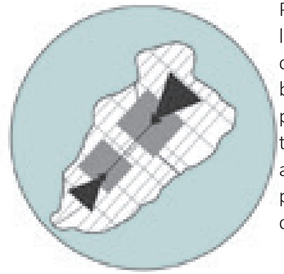
H 12: water network

Use regional culture structures- waterways and ringdike - as recreational water network to put this heritage in a wider context, and promote access to the food region.

H 16: food label

Create a regional food label for the Haarlemmermeer to promote its cultural food heritage, guarantee qualitative food that is produced sustainably, and generate fair income for farmers.

H 17: linear food park



Promote rural-urban linkages by extending cultural farm roads into build cores. Linear food parks can be created to increase food access and to put food production in a wider context.

H 13: Stelling route

Use the supra-regional culture structure - Geniedike (Stelling van Amsterdam)- as recreational network to put this heritage in a wider context, and promote access to different food regions.

H 14: food fort

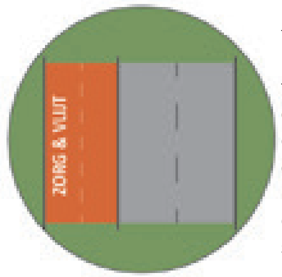
Use supra-regional culture components - fortresses (Stelling van Amsterdam)- to transmit (in)tangible heritage and to connect consumers with their regional food landscape (food access).

H 15: food farm

Use regional culture components- old settler farms - to transmit (in)tangible heritage and to connect consumers with their regional food landscape.

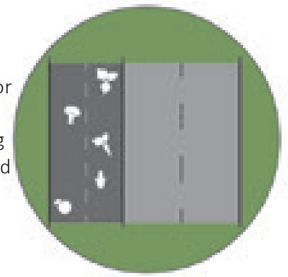
5.4 GUIDELINES FOR SITE COMPONENTS IN THE HAARLEMMERMEER

S 1: old farm route



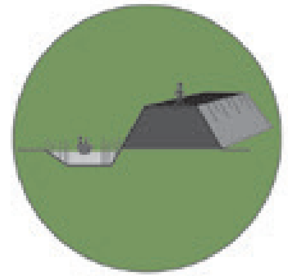
(In)tangible heritage of the polder's settlers is put in its wider context through a food-route for cyclists alongside the old farm roads, inviting consumers into the food landscape. The route is enriched with location specific farm names.

S 2: new settler route



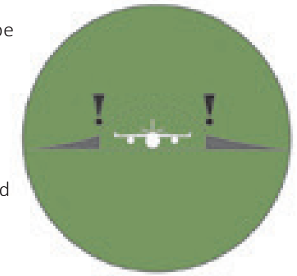
(In)tangible heritage of the polder's settlers is put in its wider context through a food-route for cyclists alongside the new settler roads, inviting consumers into the food landscape. The route is enriched with Haarlemmermeer specific food products.

S 3: Stelling route



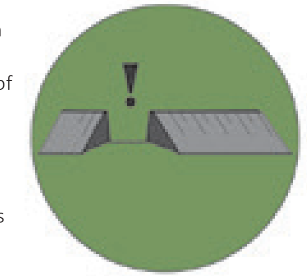
Acces to the (supra) regional food landscape is promoted by using the historically valued Geniedike (Stelling van Amsterdam) as recreational network for cycling, walking and water recreation.

S 4: broken roads



Translate/materialize lost heritage between cultural farm roads and new flight strips of Schiphol by uplifting the broken access points of the roads. Friction between rural-urban linkages is highlighted.

S 5: broken coupures

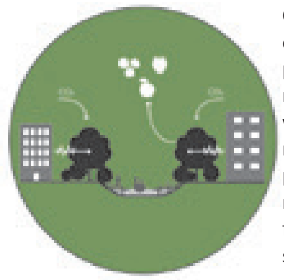


Translate/ materialize lost heritage between the Geniedike and new roads by highlighting broken dike coupures. Friction between old-new landscape is shown.

S 6: new settlers

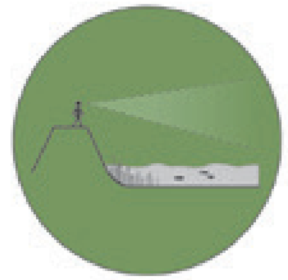
To continue the tradition of settling in the Haarlemmermeer, new settlers from all over the country are invited to settle the new farm roads in the Haarlemmermeer with sustainable housing- and farming systems.

S 7: linear food park



Cultural farm roads are extended by linear food parks in urban cores, to re-connect consumers with the original rural function of the polder. They provide recreation, diversity, food, but also CO_2- and sound buffering.

S 8: wide water view



Visual access to the polders food landscape is perceived from the cultural/natural shaped Ringdike edge. Water buffer zones are perceived with a wide view, referring to the former lake (intangible heritage).

S 9: village view

Visual access to the polders food landscape is perceived from the cultural/natural shaped Ringdike edge. From the dike, a closed view is set to the historical villages. A wide view is created from the village into the polder, highlighting this tangible heritage.

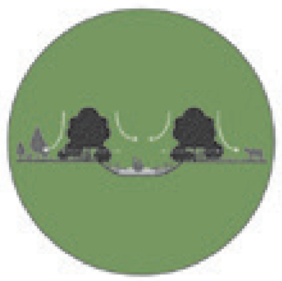
S 10: diverse views

Visual access to the polders food landscape is perceived from the cultural/natural shaped Ringdike edge. Diversity is created through an alternation of open/closed views.

S 11: small edges

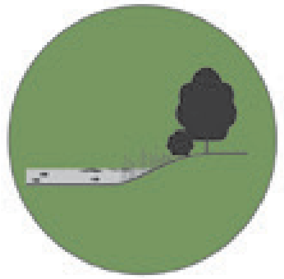
Different edges are created to reinforce the cultural polder structure and promote biodiversity. East-West alongside the farm plots, small ecological shores are created, assisted by low vegetation (houtwal).

S 12: large edges



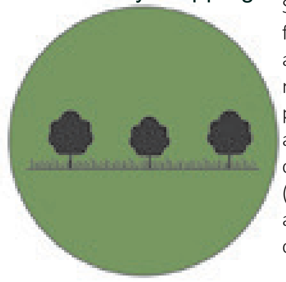
Different edges are created to reinforce the cultural polder structure and promote biodiversity. North-South alongside the farm plots, wide ecological shores are created and low intensity recreation can take place.

S 13: ecological shore



Sustainable farming methods are introduced to regenerate the soil and promote biodiversity: waterways with ecological shores to promote water quality/ quantity and introduce polder fish farming.

S 14: alley cropping

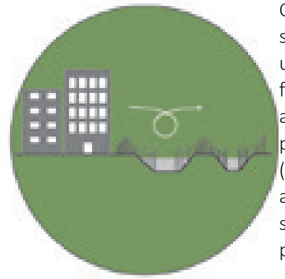


Sustainable farming methods are introduced to regenerate the soil and promote biodiversity: alley cropping with cooperating species; (guilds) perennial trees and (per)annual cash crops in-between.

S 18: flight strip edge

Create resilient (food) systems considering Schiphol: flight strip edges are used for productive crops, adapted to their relative location with the soil, and Schiphols planting requirements.

S 19: helofyte edge



Create resilient (food) systems considering urban cores: helofyte filters are introduced around urban edges to purify the water system (going to polder plane) and buffer urban spread into the polder plane (park recreation).

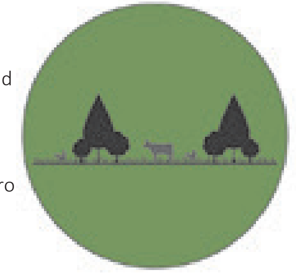
S 23: plot flows

Each farm plot consists of multiple (food) systems to promote interaction and reinforce the use of guilds/function support, natural resource management, biodiversity and recycling processes.

S 15: wind-breaker

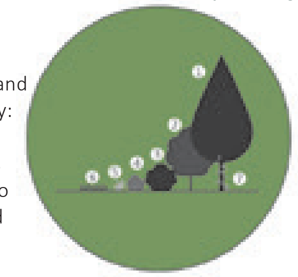
Sustainable farming methods are introduced to regenerate the soil and promote biodiversity: wind-breaker trees on the farm edge to ensure protected micro climates (smell/sound buffer)

S 16: silvopasture



Sustainable farming methods are introduced to regenerate the soil and promote biodiversity: silvopasture with cooperating animals and plants (guilds) to provide diverse food harvest.

S 17: seven-layer edge

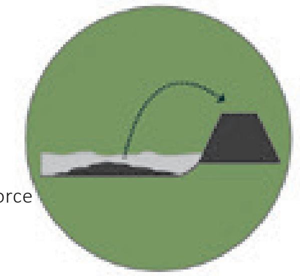


Sustainable farming methods are introduced to regenerate the soil and promote biodiversity: seven-layer plant system with cooperating species to maximize productive space.

S 20: industry edge

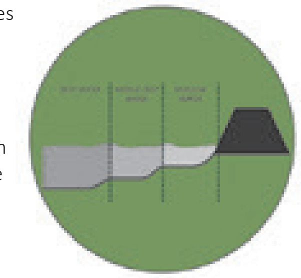
Create resilient (food) systems considering industrial sites: (food) forests are planted along industry edges to buffer its growth, camouflage its appearance and reinforce the open character of the polder plane.

S 21: soil recycling



Use natural resources and relative location advantages for landscape constructions in the polder: dug soil from water buffers can be used to construct adjacent dikes

S 22: water zones



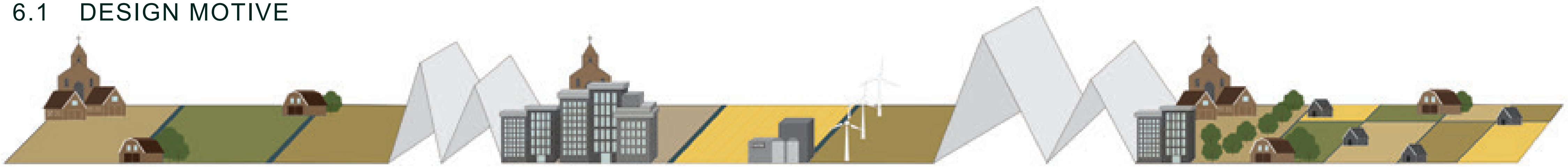
Different zones are constructed in the water buffer to promote eco- and food-system diversity. This multi-functional use helps to increase the water buffers resilience.

DESIGN

"If a space is well designed to function seamlessly for its intended use, it will be used; if it is used, it will be loved; and if it is loved, it will become beautiful"

- Keni Althouse (Althouse, 2016, p.19) -

6.1 DESIGN MOTIVE



Derived from the analysis, the polders' spatial development over time can be summarized. This ensures valuable insights to formulate a new design motive for the creation of a resilient food landscape for the future of the Haarlemmermeer.

HISTORY *1852 - 1960*

As it was not the main purpose to create new land, but rather to safeguard surrounding cities from the 'Waterwolf,' not much attention was given to the spatial organization of the Haarlemmermeer. After the reclamation, settlers from all over the Netherlands suffered a severe struggle for existence. Considering the spatial design of the polder, the natural layer was completely neglected as intensive agriculture methods exhausted the soil. The cultural layer consisted of a strict agricultural grid, designed to serve as leading structure for the development of the polder. The urban network of the Haarlemmermeer is not so much developed yet in this period. Overall, the polder was not recognized as a place with cultural aspirations but rather as a place to speculate in land (Van Paassen, 1955; Steenbergen et al., 2009).

CURRENT *1960 - 2019*

Currently, the focus of the polder is directed by the growth of surrounding cities. Schiphol airport is the biggest spatial influencer as it has expanded to cover almost a quarter of the polders surface. This growth of urban influence decreased agricultural land use and the number of inhabitants working in the agricultural sector (Langeveld et al., 2015). The Haarlemmermeer became a commuting area for the Randstad (Van Paassen, 1955). Current agricultural companies have undergone processes of up-scaling and have further exhausted the soil. With the growth of urban areas and the rise of agricultural monocultures, the cultural layer has become fragmented. The balance between the urban and rural landscape was lost as the Haarlemmermeer developed itself as a proto-urban landscape in the shadow of Amsterdam (Reh et al., 2005).

FUTURE

With my role as agro-architect, I advocate for the creation of a clear spatial organization with focus and recognition for Haarlemmermeer's (undervalued) agricultural aspirations, turning these into **a leading food landscape for the future**. The urban network layer must be guided by, and cooperate with its underlying cultural- and natural layer to create a balanced and sustainable landscape for the future. Within this landscape, there should be place for new settlers, pioneering in a future-proof form of agriculture – continuing in the tradition of the Haarlemmermeer – . An attractive human-scale landscape needs to be designed, in which people can experience and practice the process of food-production.

DESIGN CONCEPT

A re-interpretation of the polder structure is made to guide this aimed-for landscape, and prevent further fragmentation. The original polder-grid is used to divide the polder in different modules; a new polder grammar. With this new polder grammar, the Haarlemmermeer can finally develop a noteworthy culturally valued landscape, and trigger the creation of a sustainable food region. I opted for this grammar strategy since this division helps to make the design more graspable. Also, this typical module-configuration is representative for most polder areas in the Netherlands. Hence, the new polder grammar can be used to create an overarching design-language for the redesign of Dutch reclamation areas into sustainable food polders.

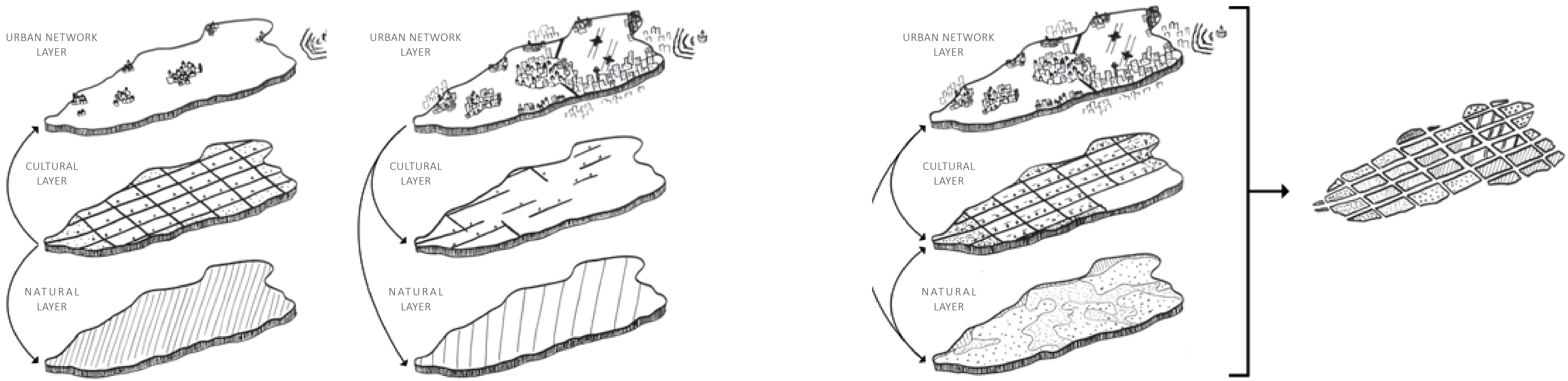


Figure 6.1: development Haarlemmermeer over time

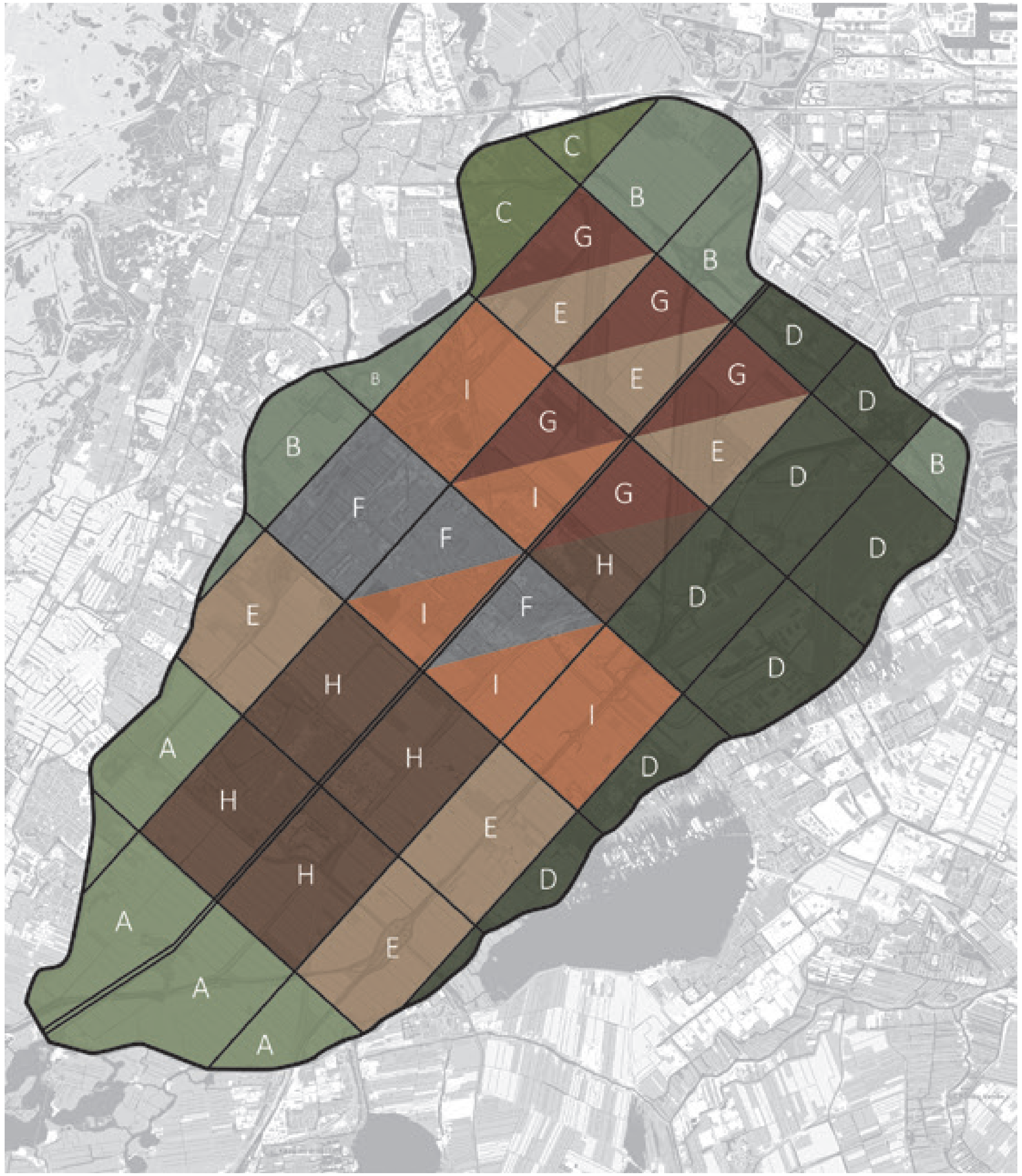


Figure 6.2: polder module layout (including legend on the next page)

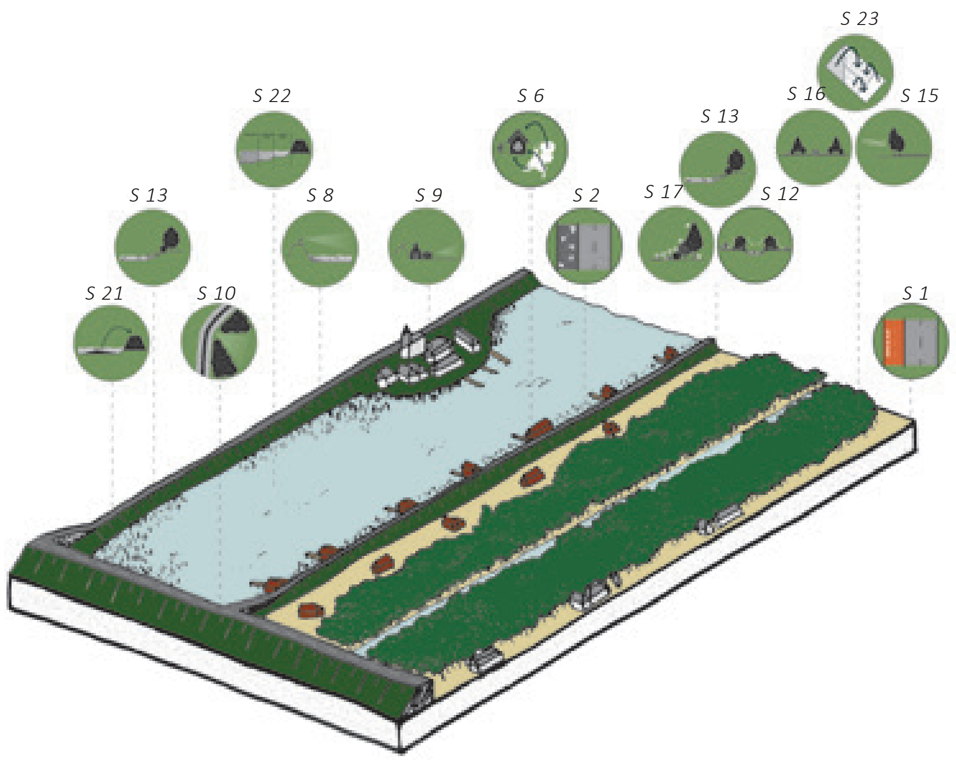
6.2 NEW POLDER GRAMMAR

This chapter covers the implementation of the guidelines developed in the previous chapter. Aforementioned design motive explains the vision of this implementation, and lays the foundation for the various designs; regional design, site design and supra-regional design. Each design consists of a concrete elaboration of the guidelines, supplemented by an in-depth explanation of the various design elements. Additionally, it will be discussed how these designs can be used to guide other regions within the MRA towards similar, sustainable food regions (focussed on the reclamation areas). Thereafter, the spatial configuration of the food systems within these different designs will be discussed, based on the theoretical City Region Food System (CRFS) model. Finally, the design findings and design guidelines are converted and abstracted into a set of general design principles.

Within the current setting of the Haarlemmermeer, different type of landscapes and spatial configurations can be observed, referring to the prescribed site components; polder edge, polder plane, build core and Schiphol. When adding the strict polder grid to this configuration, a subdivision can be made between different modules, resulting in a range of 9 different module completions (figure 6.2). This range includes modules that consist entirely of one site component, but also modules that consist of combinations of these components. In the development of a new polder grammar, this division of modules is set as a base to design upon. The module designs are based on combinations of the developed guidelines for site components in the Haarlemmermeer. Together they shape a schematic interpretation of each polder module.

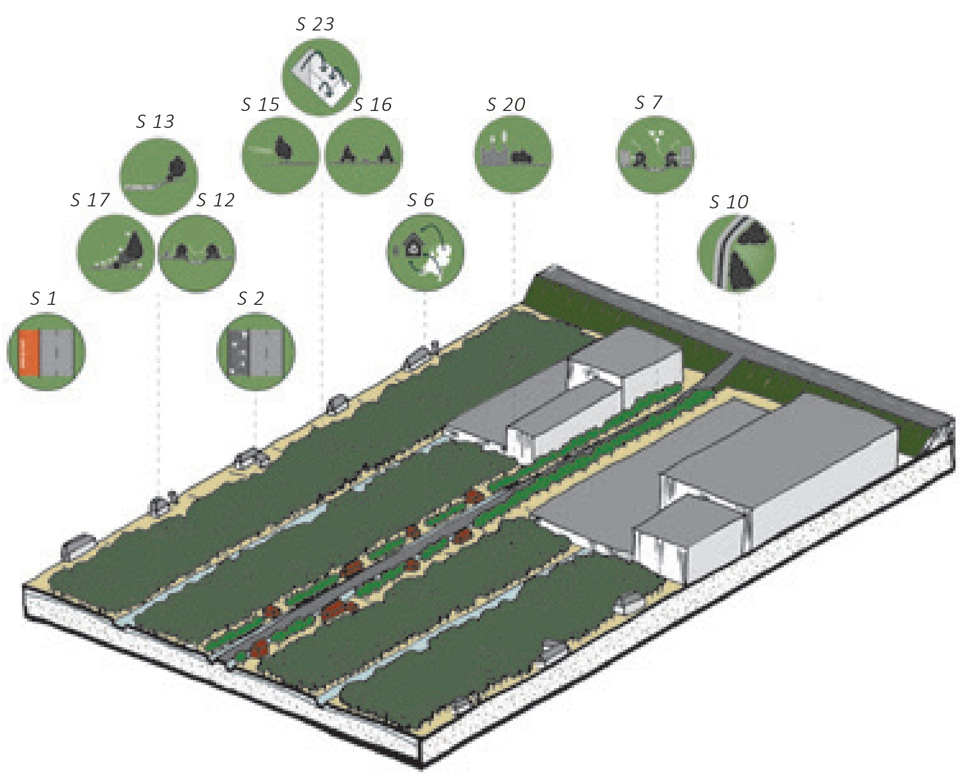
EDGE	A - CLAY EDGE	B - SAND EDGE	C - PEAT EDGE	D - BUILD EDGE
PLANE	E - PLANE			
BUILD	F - BUILD			
SCHIPHOL	G - SCHIPHOL			
COMBINATIONS	H - BUILD + PLANE	I - BUILD (Geniedike) + PLANE		

POLDER MODULES



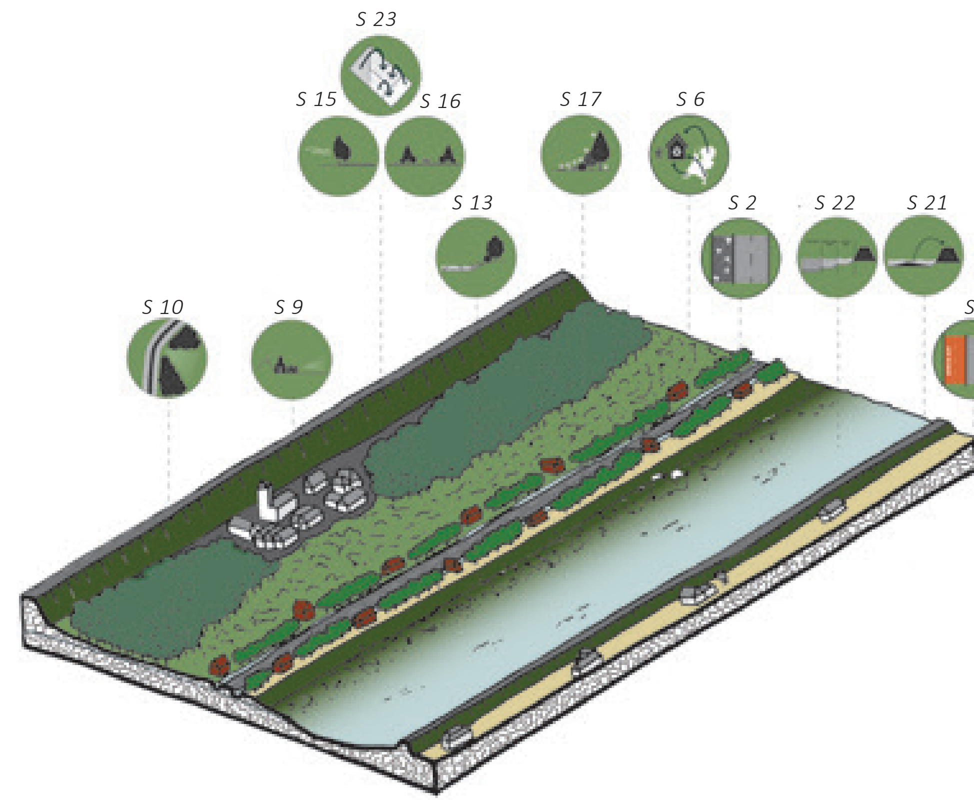
A- CLAY EDGE

This module consists of two main elements: water buffers and food forests. The parts with the strongest soil resistance are used for fresh water storage. Additionally, they can also be used as productive fish farming zones and recreation areas. The remaining parts are planted with productive food forests to reinforce the closed edge character, create ecological buffer zones, and introduce new/ diverse food products.



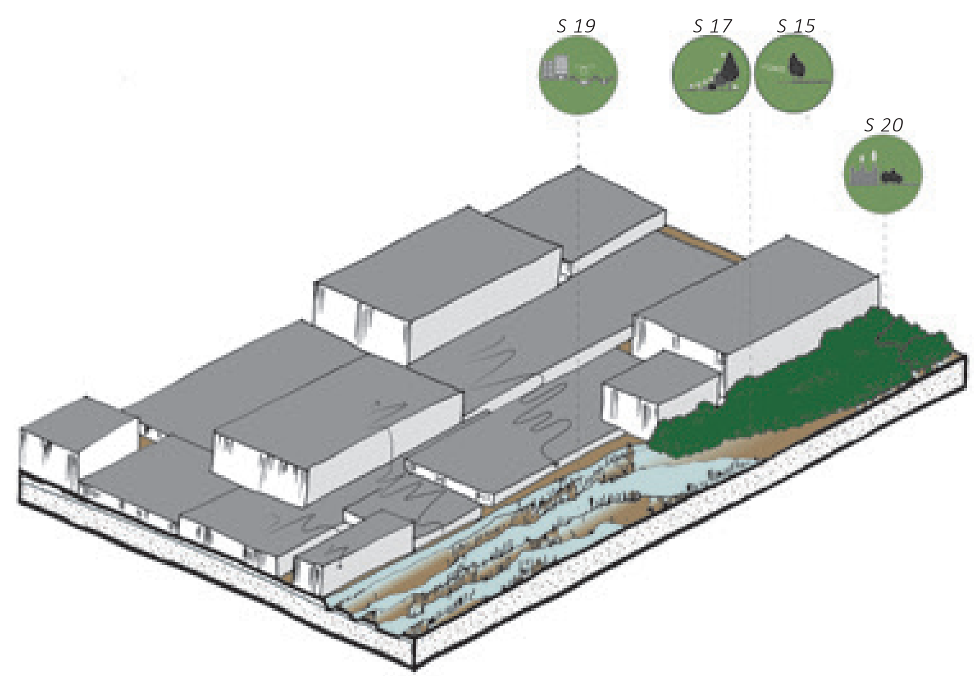
B- SAND EDGE

This module is mainly filled with productive food forest areas. They help to reinforce the closed edge character, create ecological buffer zones and introduce new/ diverse food products. Existing housing areas in these sand edges (mainly in the north of the polder) are surrounded by these forests to create a wooded area with its own edge-characteristics.



C- PEAT EDGE

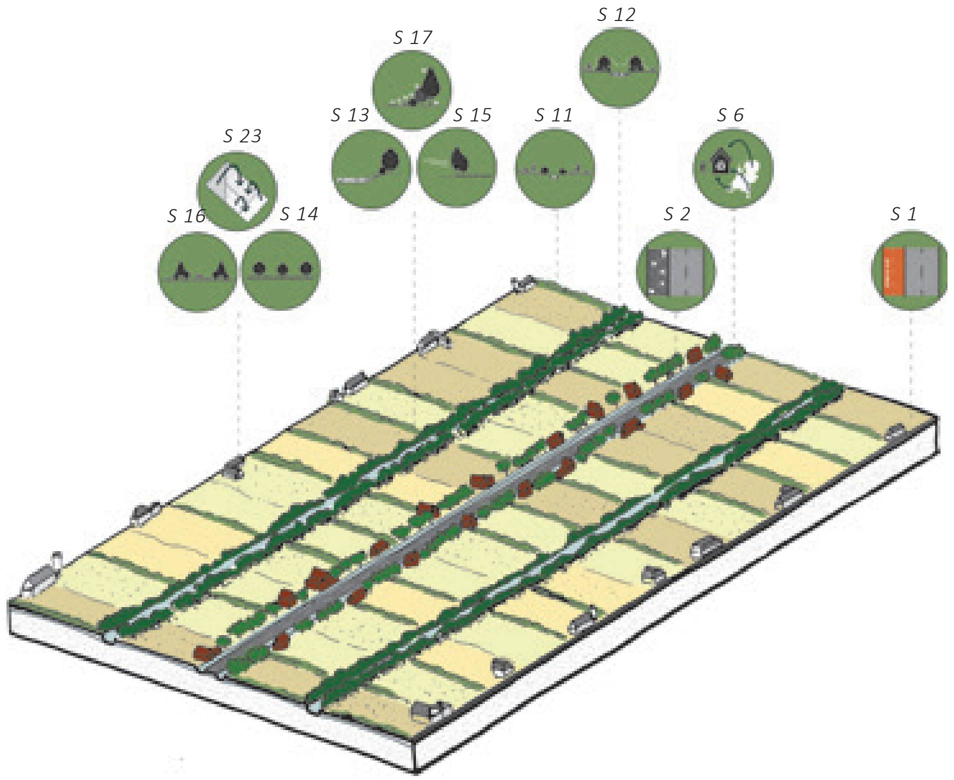
This module consist of a gradual transition from semi-wet areas near the Ringdike, to shallow water areas near the polder plane. This excavation to wet peat fields is needed to inhibit peat oxidation and promote peat growth. Besides, the smooth soil gradient promotes the development of various edges, and it offers possibilities for new/ diverse food products.



D- BUILD EDGE

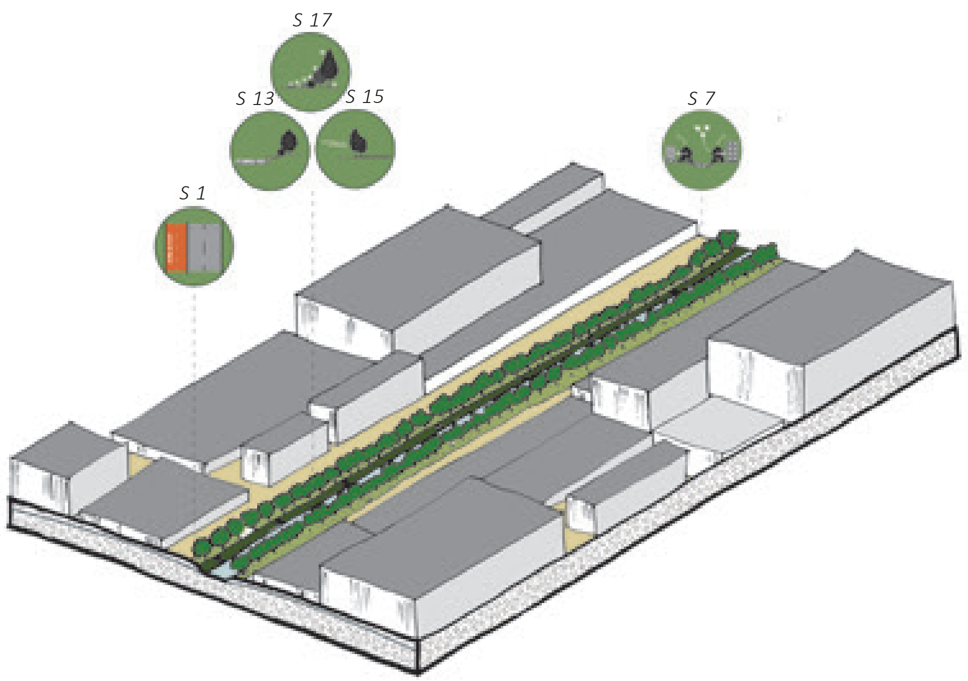
This module mainly consists of build-up areas. When an industrial area borders the polder plane, this will be buffered (both visually and ecologically) by afforestation. Other build-up borders are surrounded by helophyte filters to purify grey water coming from these buildings (potential for agricultural). These practical buffer functions can be combined with recreational purposes.

POLDER MODULES



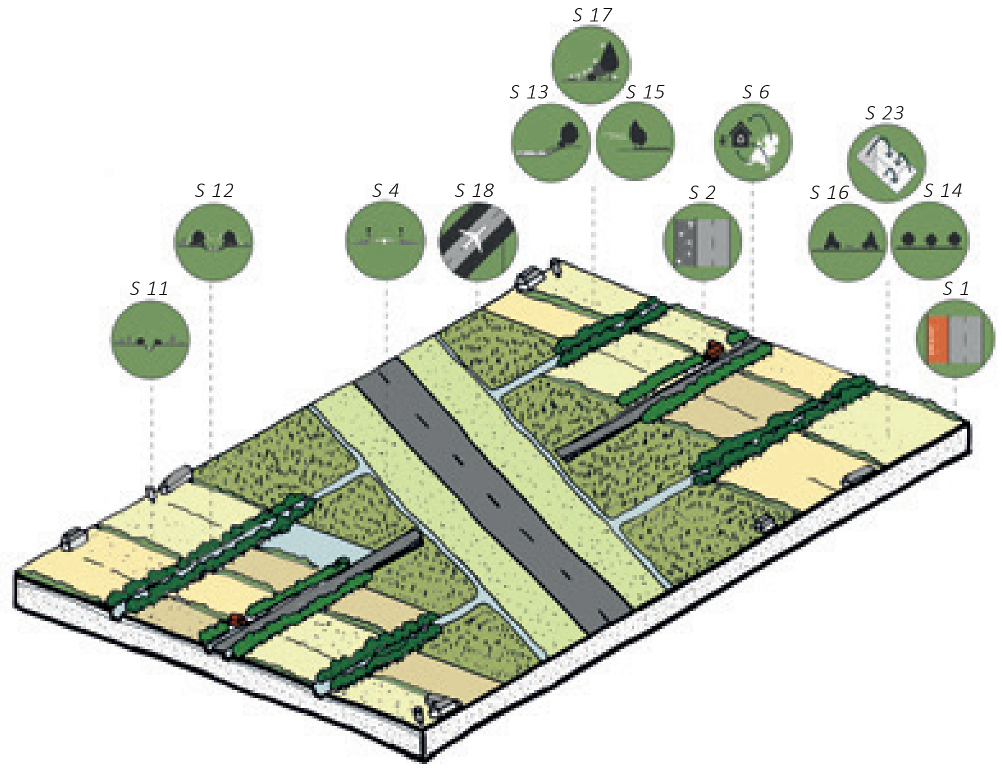
E - PLANE

This module includes the basic agricultural polder plane. Between current plots, a new settler road is created, including new housing possibilities. Subsequently, the original plots are halved by a new, ecological waterway-edge. In the opposite direction, plot boundaries are set with small hedgerow-edges. On the plots, diverse farming methods take place, promoting diversity and perennial systems.



F - BUILD

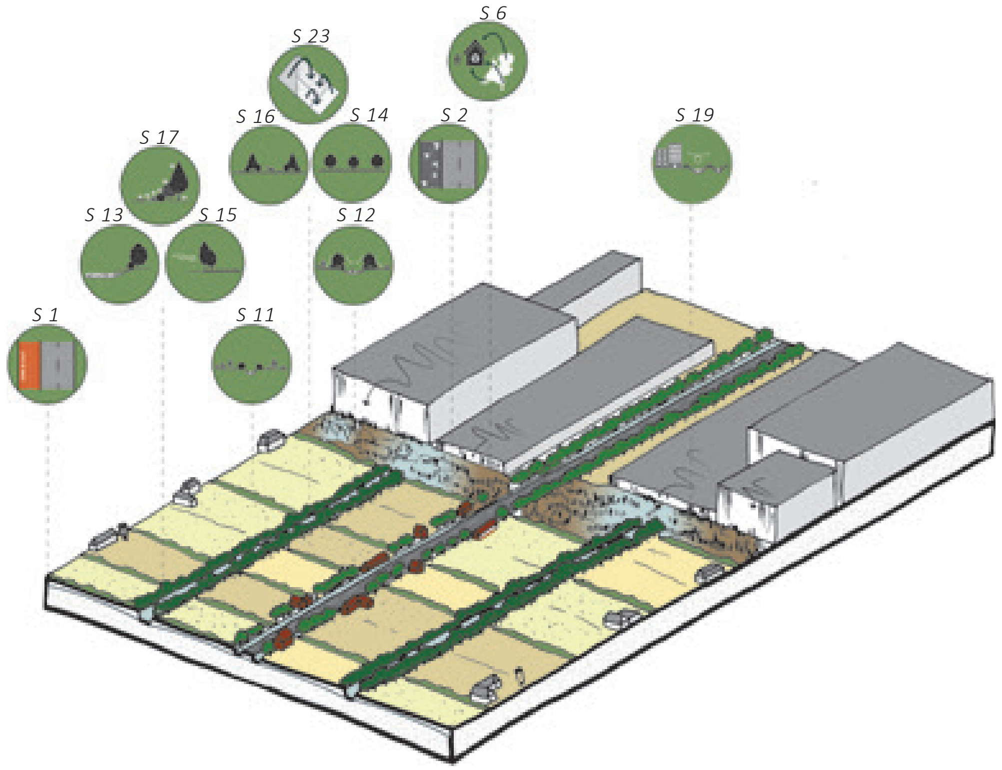
This module mainly consist of build-up areas. To highlight the (lost) cultural polder structures/farm roads, a linear park is constructed in line with this grid. This park is planted with food productive species to highlight the polders original- and main function of food production, and to connect consumers with the origin of their food. The park offers place for recreational functions.



G - SCHIPHOL

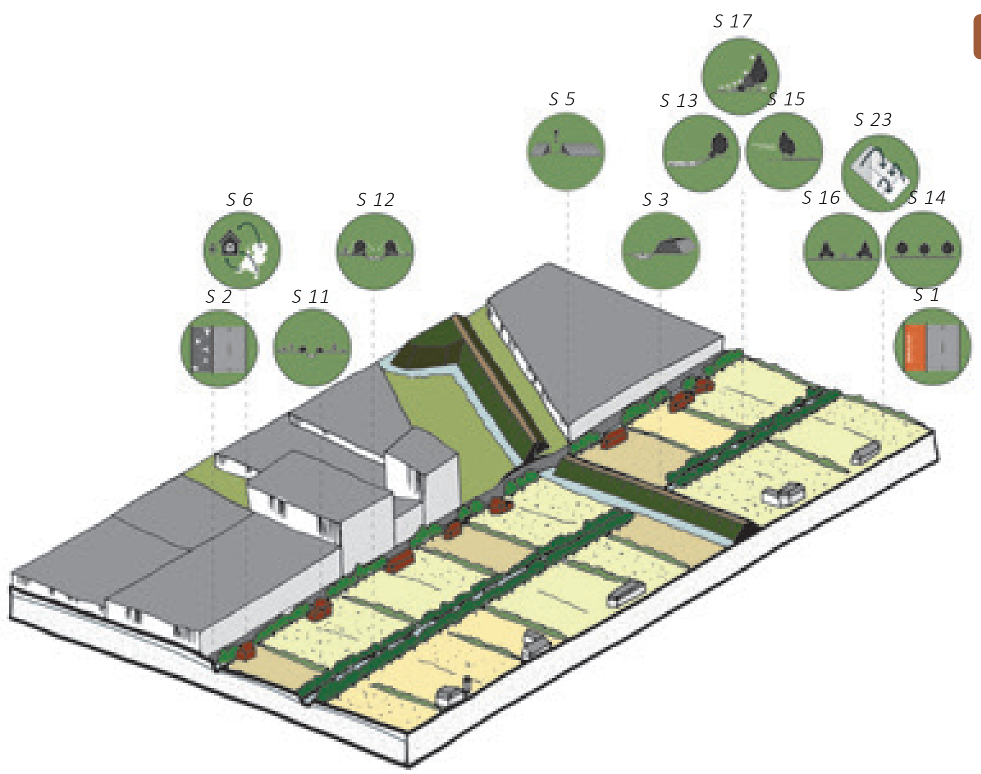
This module consist of a flight strip, surrounded by the basic agricultural polder plane (module E). The zone right next to the flight strip is planted with non-productive short grass. The next zone is planted with (food) productive plants, adapted to specific requirements of the airport (such as bird repellent qualities).

POLDER MODULES



H- BUILD + PLANE

This module consists of a combination between module E and F. It illustrates the edge between a build core and the polder plane. The zone between these two areas is filled with a buffer area, including helphyte filters (purifiying grey water), park areas and forest areas to buffer/ camouflage industrial sites.



I- BUILD (Geniedike) + PLANE

This module consists of a combination between module E and F. It illustrates the position of the Geniedike in relation to these two components. The dike is used for recreational functions such as cycling and walking, but also sailing in the accompanying waterway. At points were the dike is breached by conflicting elements (e.g. a road), a dike coupure is constructed to highlight this important cultural structure.

Figure 6.3: rough implementation of the designed polder modules

MODULE COMPOSITION

When the designed modules are pragmatically implemented in the entire Haarlemmermeer polder, we get an idea of what the regional design might look like (figure 6.3). This way, the modules serve as site component building blocks to compose the regional landscape of the Haarlemmermeer. However, this abstract configuration shows modules that function as solitary elements, based on solitary design guidelines. It is essential to integrate these abstract modules and guidelines with spatial design elements to let them 'land' in the landscape and create a good design. The result of this module integration will be elaborated on in the following paragraph.

Figure 6.4: regional design Haarlemmermeer; including regional guidelines

6.3 REGIONAL DESIGN HAARLEMMERMEER

For the regional design of the Haarlemmermeer, a refinement is made of the rough conjunction of polder modules, shown in figure 6.4. To realize this refinement, emphasis needs to be put on the composition and interpretation of the prescribed site components, represented in the designed polder modules; the polder edge, the polder plane, build cores and Schiphol. As mentioned in the analysis chapter, these components have been developing differently from each other. However, these differences and characteristics have never really been valued nor recognized. With this regional design I aim to activate and reinforce these characteristics. This way, a new polder landscape is designed in which these differences are visible, whilst the unifying factor is guaranteed; the creation of a sustainable food system for the city region landscape.

POLDER EDGE

The current polder edge component is characterized by its 'closed' and diverse character. Continuing in these spatial developments, I aim to reinforce these characteristics by transforming this edge into a diverse buffer zone (H1; figure 6.5). Because of the profitable soil resistance of clay, in the south of the polder, this part of the buffer edge is filled with water areas to save excess water in wet seasons, and provide agriculture with fresh water in times of drought (H2). Although these water buffers will improve the polders' self-sufficiency in terms of water quantity, the polder will still be connected with surrounding water bodies to promote a flexible system, capable of assisting varying water needs. Matching some peat areas outside the polder, the edge still covers some peat soil remnants, although they are currently not used as such. In the designed polder edge, these peat remnants will be transformed into wet peat field areas to preserve and build the peat and to prevent further CO_2 emissions. Shallow water plants can be grown here in an aquaculture environment (e.g. cranberry/willow). Next to (shallow) water zones, the polder edge will be filled with dense food forests (H3) to reinforce the 'closed' character of the polder (H5) and to create a resilient buffer zone that inhibits the growing urban developments from outside the polder, so to guarantee agricultural land use in the polder plane.

POLDER PLANE

The polder plane is characterized by its openness and wide views over the fields. In the design for the Haarlemmermeer, these fields will be transformed into diverse farming systems, producing a large range of different food products, adapted to their specific type of soil (figure 6.6). In general, the openness of the polder plane is preserved. Although some high vegetation edges will be added to the plane to downscale agricultural plots and to promote large varieties in ecological niches. These edges consist of the new ecological waterways in north-south direction, and hedgerows between the plots in east-west direction.

Figure 6.5: thematic map regional design; site component polder edge

BUILD CORES

Whereas the original build cores of the polder were intended to be in close connection with the agricultural polder landscape, they changed into large urban settlements, housing many Randstad commuters without any relationship to the agricultural polder. Besides, build cores play a big role in the fragmentation of the polder grid, creating a labile balance between urban and rural elements (Van Paasen, 1955). To restore this balance and re-value the Haarlemmermeer as an important agricultural landscape, further urban growth is inhibited for the benefit of this rural landscape. New housing should take place within the urban borders, or it should be integrated with the rural landscape, accordingly the new settler roads. Around the urban cores, a green buffer park is created to ensure this rural preservation and to improve the legibility of the difference between rural and urban areas (H6; figure 6.7). These buffer parks create space for local food production to improve consumers food production awareness and to refer to the food-focused nature

Figure 6.6: thematic map regional design; site component polder plane

of the polder. In addition, helophyte filters will be installed at the edge of these buffer parks to purify grey water, deriving from build areas, and possibly supply this to agricultural fields. To reinforce the historical polder grid in the build cores, linear food parks will be created in line with the old farm roads (H17). These linear parks consist of a waterway, accessible for water recreation, and are surrounded by planted lines of food productive species. Again, this will improve consumers food production awareness and it will refer to the food-focused nature of the polder.

SCHIPHOL

Concerning the site component Schiphol, (food) production fields alongside the flight strips will be adapted to the specific requirements of the airport (figure 6.8). The airport itself can be integrated into the polders food landscape by transforming it into a valuable market to sell Haarlemmermeer's food products.

Figure 6.7: thematic map regional design; site component build core

RECREATION NETWORKS

Recreation networks that intersect the polders food landscape are promoted by introducing new cycling/ walking paths alongside the old farm roads and the new settler roads (H9 & H11). Water recreation is introduced through the refined water network in the ecological waterways and water buffer areas (H12). Besides these networks, consumers awareness considering food production is promoted by introducing the possibility to visit some of Haarlemmermeer's farms; food farms (H15). A recreational network, connecting the polder with neighbouring food regions, is envisioned through the Stelling of Amsterdam (H13). In the Haarlemmermeer this takes shape in the Geniedike, covering walking, cycling and sailing routes. These routes will be extended outside the polder through different food regions. The characteristic forts alongside this route can be transformed into food forts, promoting the regional food landscape and informing consumers (H14).

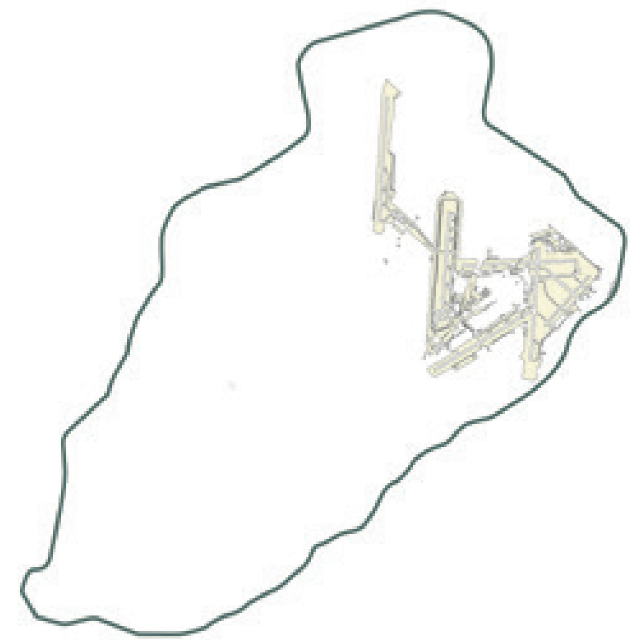


Figure 6.8: thematic map regional design; site component Schiphol

FARM COOPERATIONS

As I discussed in the chapter on permaculture, it would be an interesting contribution to the revenue model of sustainable farming systems to create farm cooperations. As medium-sized permaculture farms tend to have higher production costs, efficiency can be achieved in a joined stage of processing and marketing, practiced by a cooperation. With this shared responsibility comes shared risk, which reinforces the resilience of the system (Shepard, 2013). Considering the regional design of the Haarlemmermeer I propose to introduce such farm cooperations per different polder module. Main collaborations take place within these cooperations, though inter-linkages should also be found between them (H7 & H8). In this way, a resilient regional food system is created and shared risks and profits can be guaranteed.

PLANT MATRIX

As mentioned in previous paragraphs, the new farming systems will be adapted to the specific types of soil in the Haarlemmermeer. This adjustment is needed to shift away from current soil-destructive monocultures, into soil-improving polycultures. This creates a more sustainable regional food landscape that guarantees diverse food products and long term profits for both the farmer and the landscape. To assist Haarlemmermeer's (new) farmers in the realization of these new systems, I created an extensive plant matrix (figure 6.13-6.17, and appendix H). This matrix offers insights in suitable food products to be farmed on the different soil types in the Haarlemmermeer (H10); clay, sand and peat. Per soil typology, plant species of different sizes and habitats are suggested to provide suitable species for both forest-, field- and water agriculture. Also, an animal matrix is created to offer insights in suitable farm animals that can be kept for meat- and/or dairy production (figure 6.18). Each of these proposed plants and animals are supplemented by their belonging features, further explained in an extensive legend (figure 6.9).

FOOD LABEL

When this versatile and comprehensive palette of food products and animals is applied in a sustainable way, a great range of polder products will result from this. These products will be branded with a specific label for the Haarlemmermeer to guarantee its origin and sustainable way of production (H16). Subsequently, these labelled products can be marketed in different ways in the region; at the farm shop (figure 6.11), in local supermarkets, and through a regional delivery service (figure 6.12). This service can provide inhabitants with HLM-labelled food packages, delivered in returnable crates. These crates serve as recurring elements in the regional food chain, to be used by regional inhabitants for grocery shopping and bike transport (figure 6.10). In this way, consumer awareness with regards to food is improved, and the Haarlemmermeer is finally recognized as a valuable food polder.

LEGEND

Figure 6.9: legend for plant matrix Haarlemmermeer

Figure 6.10: HLM-labelled food products in returnable crates

Figure 6.11: HLM-labelled food products in merchandise tote bag →

Figure 6.12: Haarlemmermeers' regional delivery service with HLM-labelled food packages in returnable crates

SANDY SOIL - HEAVY SALINATED

H 10: soil related food

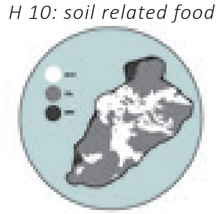


Figure 6.13: plant matrix Haarlemmermeer; sandy soil part I

fold out

SANDY SOIL - HEAVY SALINATED

H 10: soil related food

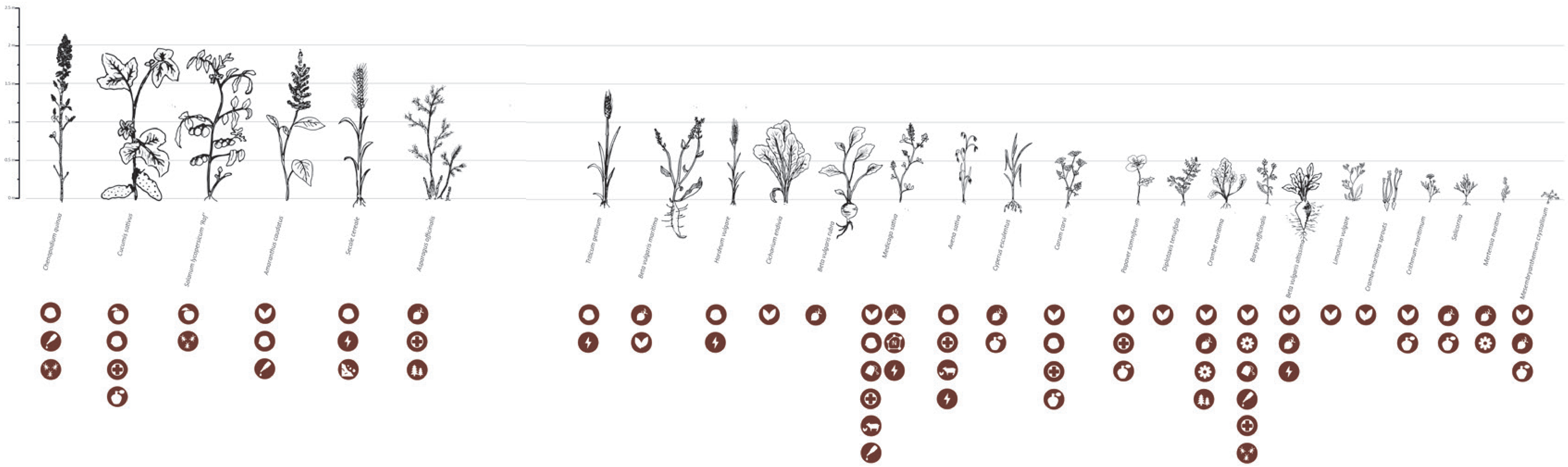


Figure 6.14: plant matrix Haarlemmermeer; sandy soil part II

fold out

PEAT SOIL - LITTLE SALINATED

H 10: soil related food

Figure 6.15: plant matrix Haarlemmermeer; peat soil

fold out

CLAY SOIL - LITTLE SALINATED

H 10: soil related food

Figure 6.16: plant matrix Haarlemmermeer; clay soil part I

CLAY SOIL - LITTLE SALINATED

H 10: soil related food

fold out

Figure 6.17: plant matrix Haarlemmermeer; clay soil part II

fold out

ANIMALS & FUNGI

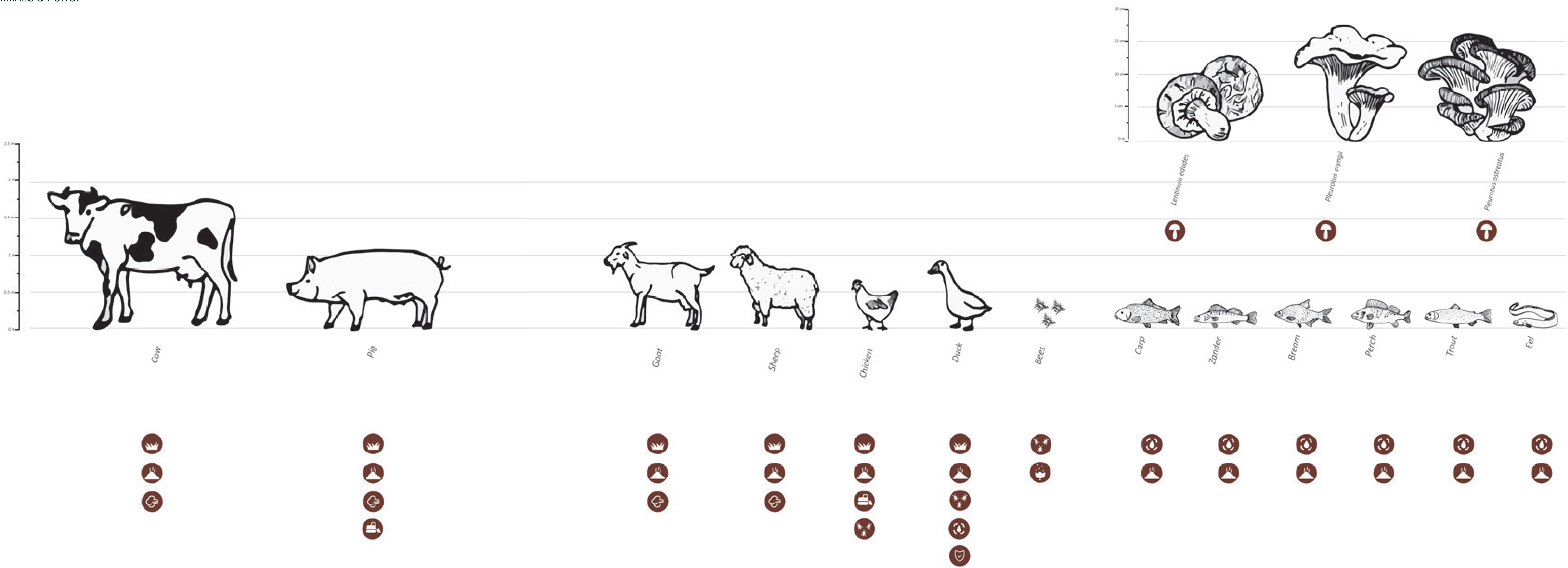
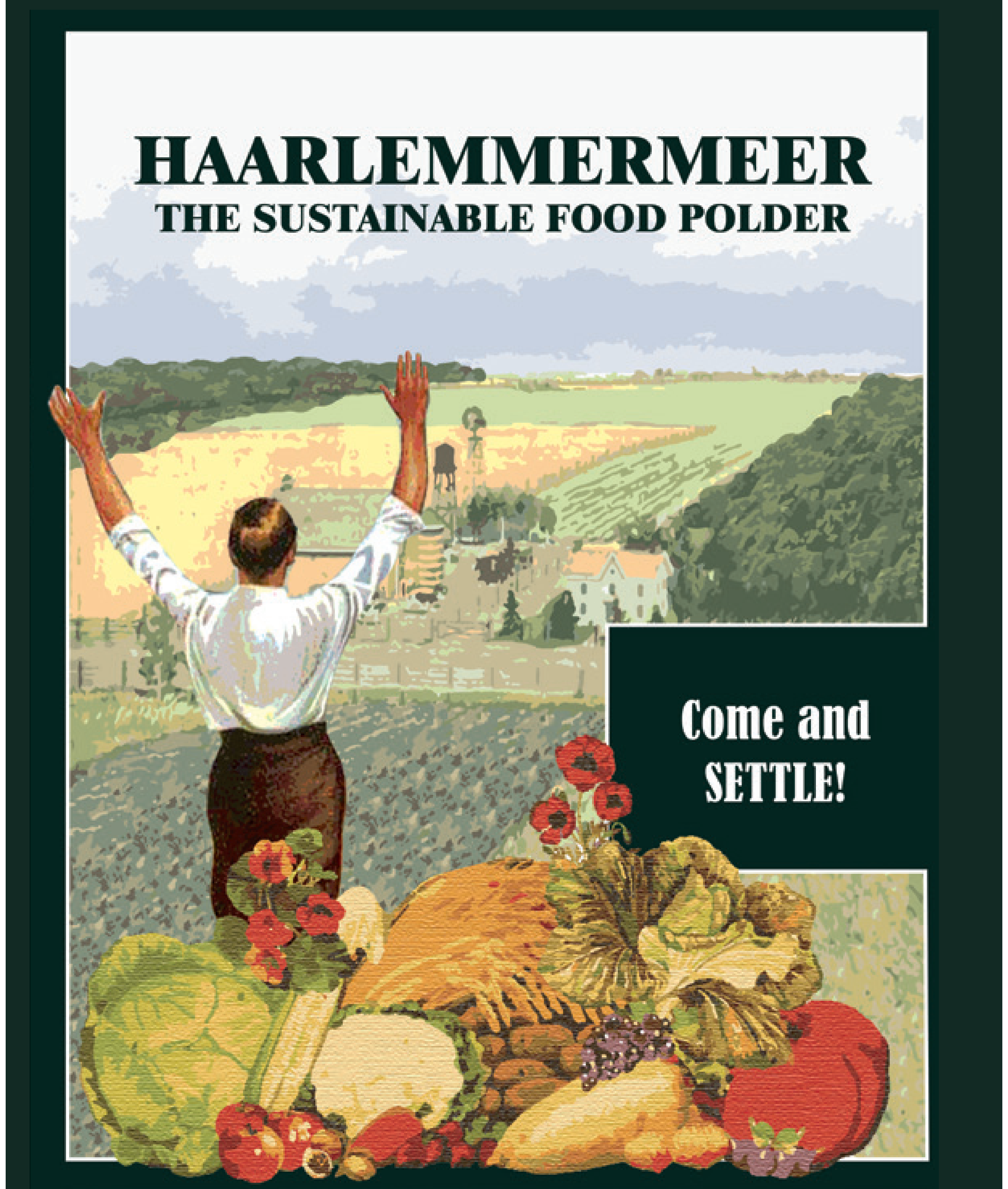


Figure 6.18: animal matrix Haarlemmermeer; animals & fungi

fold out



NEW SETTLERS

After the reclamation of the Haarlemmermeer, domestic settlers from all over the Netherlands were invited to come and settle as farmers in the Haarlemmermeer. As each settler family brought cultures and traditions from their own region, a great variation in building styles and farming methods arose in the Haarlemmermeer. Over the years, this beautiful and historically valuable heritage (both tangible and intangible) was fragmented or lost, together with Haarlemmermeer's clear characteristics as a food production polder. In designing a sustainable food system for the city region landscape of the Haarlemmermeer, it is important to include this valuable form of heritage, together with the aimed for sustainable farming methods. Therefore I think it is time to continue this beautiful settler tradition and revive it by introducing new settler possibilities in the polder. Parallel to the existing old farm roads, a new settler road is constructed, creating place for new polder inhabitants. The main focus is put on inviting farmers from all over the Netherlands, with an ambition to contribute to this sustainable regional food system (figure 6.19). As this form of agriculture is still in its infancy, all forms of knowledge are welcome and new initiatives and experiments will be encouraged and promoted. In addition, settlers may also consist of other target groups such as elderly people that seek rest and a sense of nostalgia. Another possible target group could be refugees that look for the familiar habit to produce food, as might have been their profession or tradition in their home country. Such new settler initiatives have to be directed from top-down, at a regional municipal level. This way, the overarching message and structures remain, while experiments and variations can be made on a small scale in the expression thereof.

DEVELOPMENT IN TIME

In the implementation of the design for the sustainable food polder Haarlemmermeer it is of interest to keep the aspect of time and design phasing in mind. First of all it is important to clarify the difference between design elements/structures, and farmers' implementations. As mentioned in the introduction, I see my role as an agro-architect expressed in the structuring of agricultural food regions, instead of designing the actual farmland. In this way, overall cultural and environmental values are guaranteed whilst farmers can flourish in their domain. This distinction between designed- and farmers elements/structures is visualized in the site impressions (figure 6.37-6.39). The red bars indicate designed elements/structures consisting of: ecological waterways, new settler roads, hedgerows between the plots, tree lanes alongside roads, dikes and water buffer areas. The green bars indicate farmers' implementations of the land. In the design phasing of the Haarlemmermeer it is important to start with the construction of the outlined designed elements/structures to create a clear regional base framework for the farmers to build upon. In the second stage, farmers are invited to start implementing sustainable farming methods. This process is free to interpret by the farmers as long as they relate their production to the soil characteristics and the given component zone (e.g. forest edge, polder plane). As it is known that permaculture-based farming systems acknowledge a production based on long term profit, it takes more time to establish a stable harvest system. Therefore it is important to start planting perennial plants and trees as early as possible. However, to still generate a stable income in the start-up years, it is profitable to use part of the land to farm annual cash crops, such as quinoa (van Bemmel et al., 2017; Boulestreau, 2016). Besides, top-down arrangements need to be made to help sustainable farmers in their start-up phase by setting up the prescribed farmers cooperations, and arrange a protected food label for the Haarlemmermeer. Also, market platforms need to be encouraged in selling these regional food products.

← *Figure 6.19: potential 'propaganda' poster for new settler in the Haarlemmermeer*

6.4 SITE DESIGN NIEUW-VENNEP

To go more into depth about the polder module conjunction and show how these different modules work together, a site design is made. To create a representative example for the rest of the polder, it is important that the site design location consists of a gathering of significant module elements within the polder. The chosen location is set in the southeast edge of Nieuw-Vennep (figure 6.20). This location includes interpretations of module A, E and F (H); the water/forest edge buffer, the polder plane and the build core.

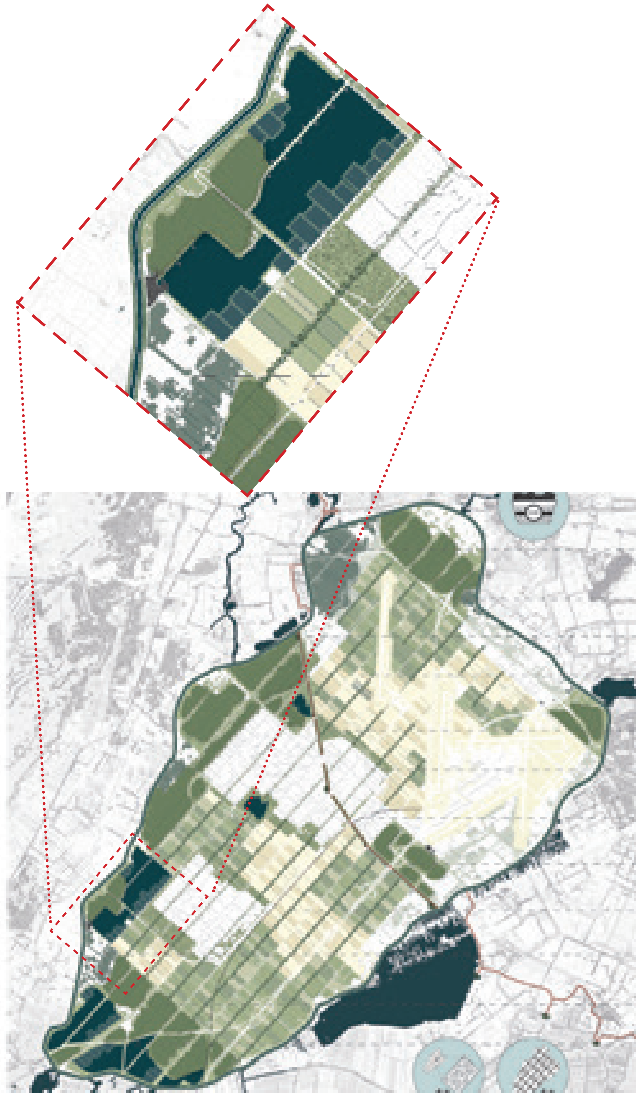


Figure 6.20: site location within the regional design

SITE ANALYSIS NIEUW-VENNEP

The chosen site location in the southeast corner of Nieuw-Vennep consist of the three main soil typologies of the polder; sand, clay and peat (figure 4.15). The clay grounds in this area cover the highest soil resistance of the Haarlemmermeer, making them extremely suitable for controlled water storage (figure 4.11). Furthermore, this area offers a representative reflection of the agricultural fields in the polder: large monocultures with little crop diversity; grain, beets, potatoes, maize and grass for livestock (figure 4.5).

The location consist of two polder edge villages: Beinsdorp and Lisserbroek, and one polder core village: Nieuw-Vennep. The most notable feature of these villages is their position towards the agricultural polder fields, namely with their 'backs' to it. There is no visible connection between this rural-urban interface in the form of recreational networks or landscape structures. The park 'Venneperhout' could play a unifying role to improve this interface, but instead it stands on its own and creates a green barrier towards the agricultural hinterland. Regarding infrastructure, the area is accessed in an East-West direction via a four-lane regional road (N207), and in a South-North direction through a two-lane regional road (N205). The latter is also called the 'three lake road' (Drie Merenweg), referring to the polder's former interpretation.

Furthermore, the location includes few of the polders' first settlers farms. These farms can be deployed as tangible food-heritage remnants to experience the characteristic food landscape of the Haarlemmermeer. Other interesting starting points to help shape the sustainable food system for the future are the cold storage 'Frigo' (suitable for cooling regionally produced food), the 'Veldzicht' living- and day centre (as an educational / voluntary labour force for agricultural land), and the 'Jeugdland' playground (to bring children into contact with regional food production in an educational manner).

Figure 6.21: site analysis map Nieuw-Vennep, aerial view derived from: (Google, 2019)

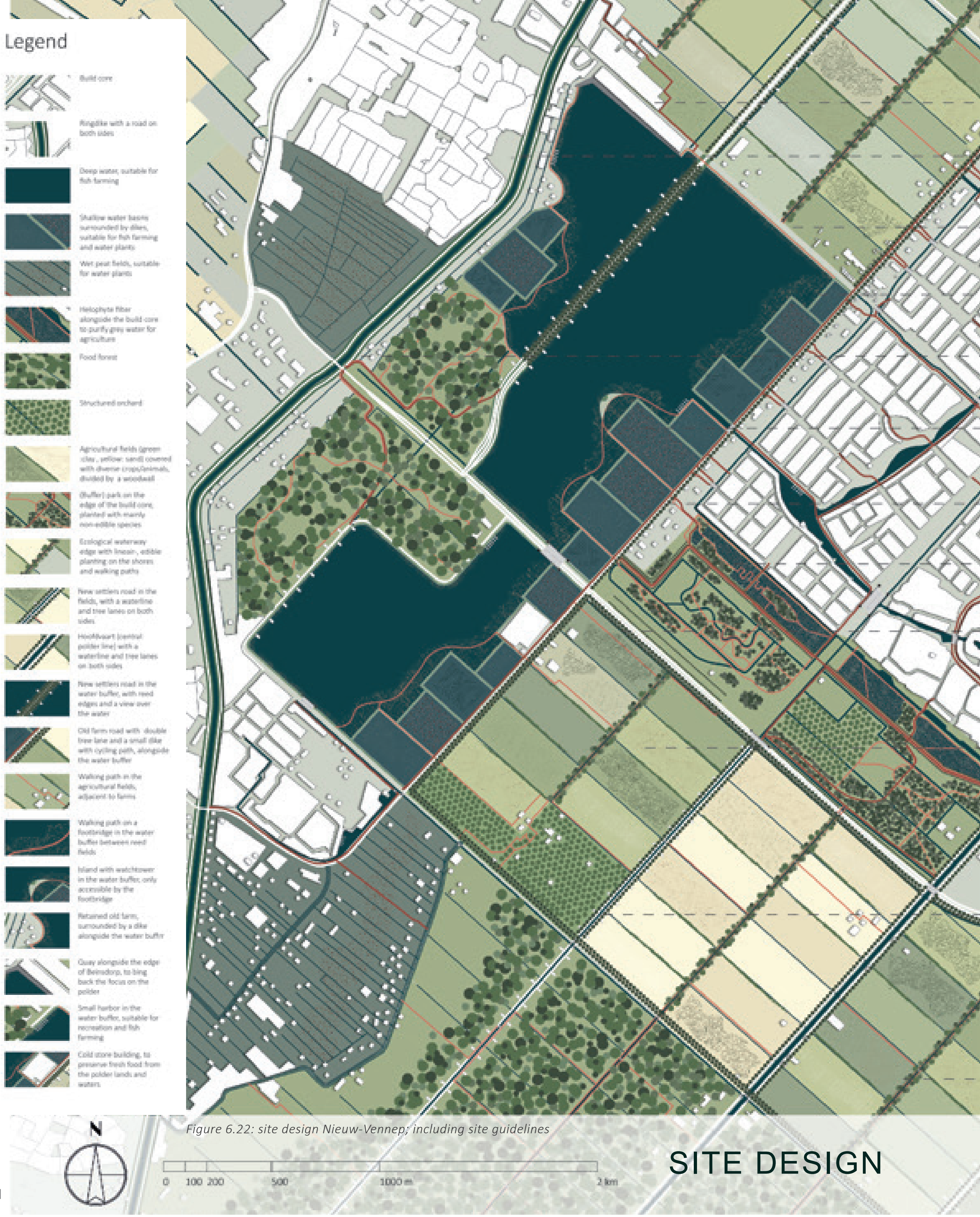
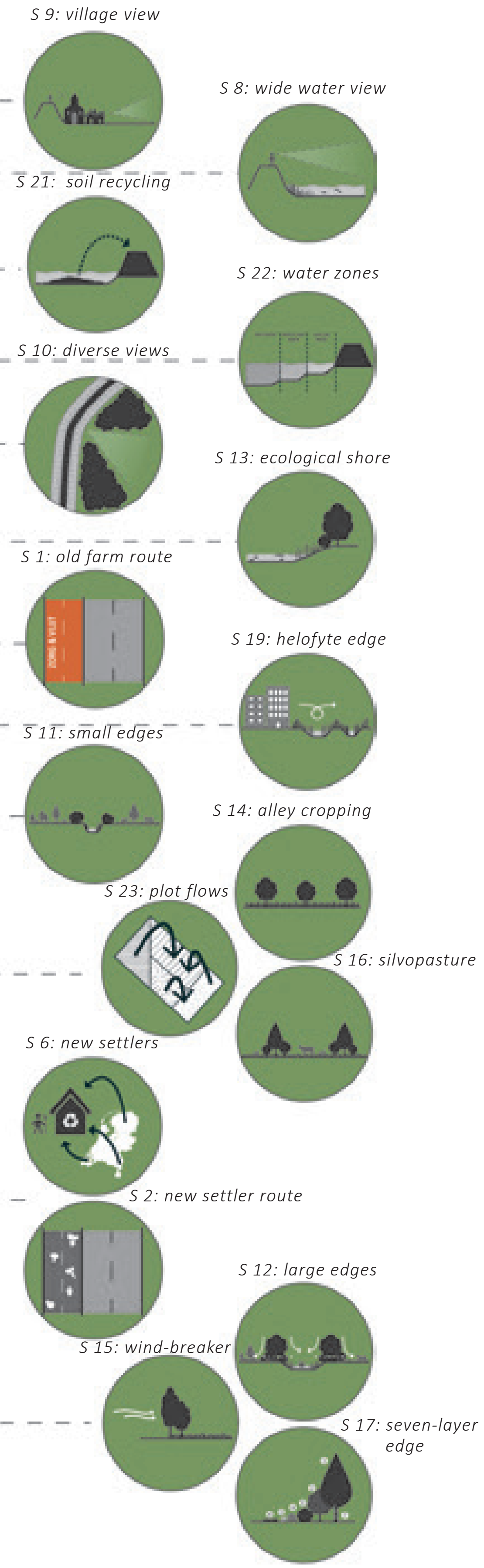


Figure 6.22: site design Nieuw-Vennep; including site guidelines

SITE DESIGN



SITE DESIGN NIEUW-VENNEP

The site design of Nieuw-Vennep presented two main challenges. First of all I had to look for ways to shape the meeting point between different modules (A, E and F) so they would merge properly while the differences remain clearly visible. The second challenge was to include aesthetic values to the design so that the straightforward design guidelines would adjust and blend with the landscape, to create an exciting landscape experience. These challenges are carried out by means of alternation between closed and open structures between different polder components (S10). Closed structures are created through dense planting compositions (S 11, 12, 13, 15, 17), and dike-bodies between the water buffer and the polder plane (S21). These closed elements alternate with open structures and wide views over the polder plane (S9) and the water area (S8), creating a diverse and interesting landscape. The new settler roads form a common thread through this diverse and rich polder landscape of the Haarlemmermeer because they cross all these different landscapes. In addition to experiencing the polder by living in it (S6), the design offers diverse recreational structures to enhance walking, cycling and sailing networks that invite people (possible consumers) into the polders food landscape. The area between urban and rural landscape is filled with a buffer park that creates space for grey water purification (helophyte filter, S19), and small scale food production to create consumer food-awareness. Because of these multiple different edges/buffers, and the recognition of different soil typologies, the polders food landscape is shaped by a great variety of farming systems and produced food products (S14, 16, 23). Besides agriculture on land, new possibilities are created for food production on the water. Zones with varying water depths have been designed in the water buffer area to create space for various habitats and forms of aquaculture (S22). The diked water basins are suitable for shallow water plant production (e.g. cranberry) whilst the deeper water areas can be used for fish farming.

Figure 6.23: thematic ecology map site design

Figure 6.24: thematic water map site design

ECOLOGICAL STRUCTURES

In the current configuration of the polder, nature and agriculture are seen as two separate functions. This causes a decrease in ecological quality and a lack in qualitative ecological connections (Provincie Noord-Holland, 2014; Van Pridon x De Groot landschapsarchitecten et al., 2012). With the design for Nieuw-Vennep, I aim to integrate these two functions. As agricultural land use and its associated plant species are adapted to specific soil qualities and salinization processes, a multitude of different niches is created. These niches are mainly used to create a diverse production landscape, but this development will also go hand in hand with the promotion of wildlife habitat. In fact, when both functions are managed effectively, fruitful collaborations can arise. The different niches consist of dense food forests, park vegetation, wet peat fields, deep- and shallow water bodies and open polder fields. These different niches are interconnected through linear tree/hedge structures to create a well-accessible ecology network (figure 6.23).

WATER STRUCTURES

As the current water structure of the Haarlemmermeer barely meets the draining needs of the polder, and water safety and -quality is endangered (Van Pridon x De Groot landschapsarchitecten et al., 2012), there is a great need for a more resilient and self-sufficient water system. To achieve this, a new, more refined water structure is added in the polder so that faster water supply and discharge can take place. Also, water buffers are introduced in polder areas with a high soil resistance (clay soil) and in the wet peat fields. Through these buffer areas, excess water can be collected in the wet winter season, whilst this buffered fresh water can be pumped to agricultural fields in the dry summer season. This way, the polder is less dependent on water bodies from outside the polder, and less water is wasted on the diluting processes of salinized seepage water. In addition to this enlargement of water quantity, water quality will be improved by creating ecological shores (S13), introducing water purifying plant species (e.g. azolla), and installing helophyte filters (figure 6.24).

Figure 6.25: thematic recreation map site design

Figure 6.26: section locations site design

RECREATION STRUCTURES

Haarlemmermeer's current recreation networks are mainly located around the polder or merely used as intermediate to get from one place to another. With the site design for Nieuw-Vennep I aim to illustrate how new/additional recreation networks can be introduced in the polder to make it possible for people (possible consumers) to experience Haarlemmermeer's food landscape characteristics and qualities in different ways. These recreation structures are focused on walking, cycling and sailing. Cycling structures are mainly located alongside the strict polder grid; the old farm roads and the new settler roads. These roads are enriched by pavement structures, referring to the old farm names, and to the polders food products (S1 & S2). Walking structures take place between the strict polder grid to promote encountering different landscapes at relatively short distances. Sailing routes and accompanying harbours are introduced in several waterways between the farm plots and on the water buffer area (figure 6.25).

SECTIONS

Technical sections are made for six locations in the site design (figure 6.26). These sections show both the current and the future (designed) situation of that specific place. The chosen locations cover the most representative places within the design. Section A and B envision the characteristics of the new settler road in both the 'open' polder plane (A), and the 'closed' forest edge (B). Between the new settler houses, a wide waterway is created with ecological shores and a tree lane with accompanying country roads on both sides. Section C and D envision the characteristics of the new ecological waterway, subdividing the original plots into half. Section C takes place in the polder plane and section D in the forest edge. Both sections are characterized by a wide waterway with slight slopes to promote ecological diversity. On the shores, a seven-layered edge is created with food productive species (S 17), accompanied by a small footpath. The waterway is suitable for water recreation and small scale fish farming.

Section A - A' & Section B - B'

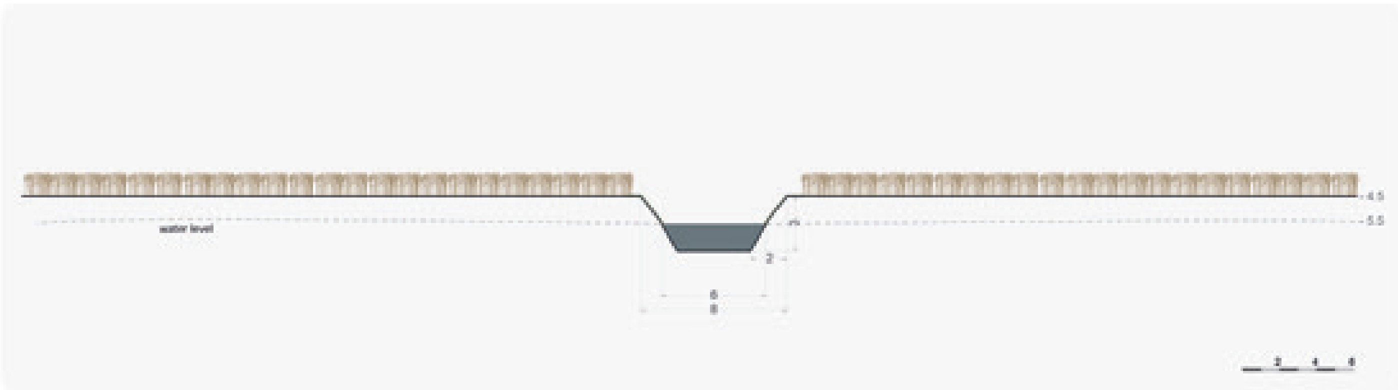


Figure 6.27: current location section A-A' and B-B'

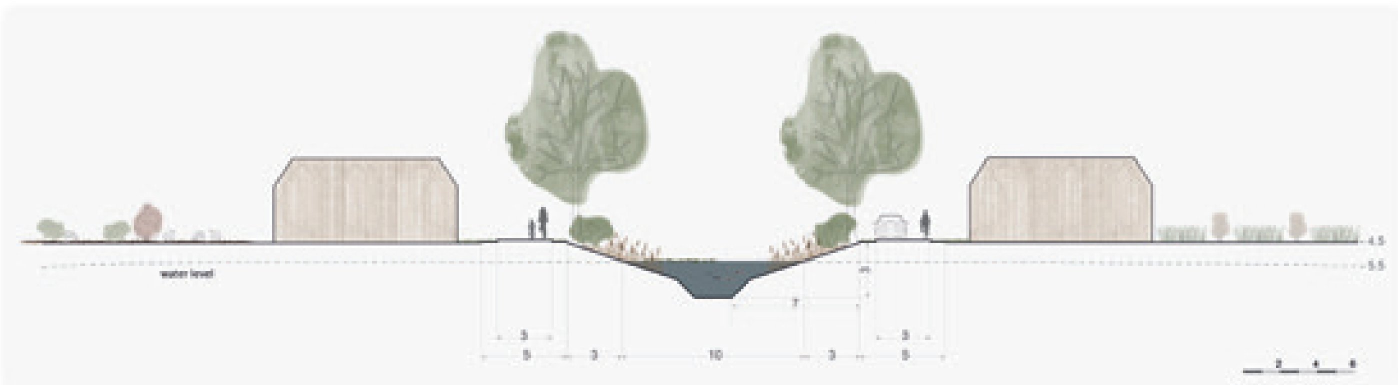


Figure 6.28: future location section A-A'

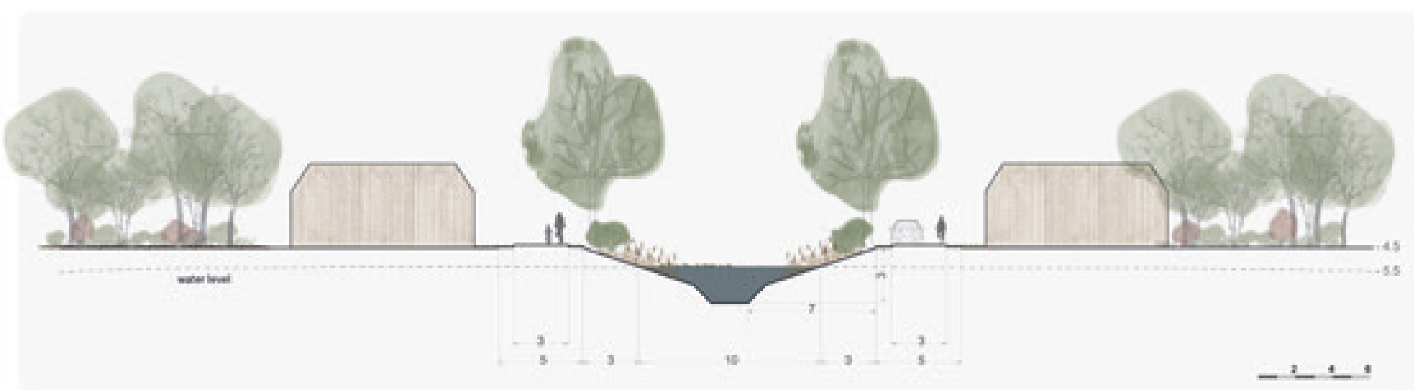


Figure 6.29: future location section B-B'

Section C - C' & Section D - D'

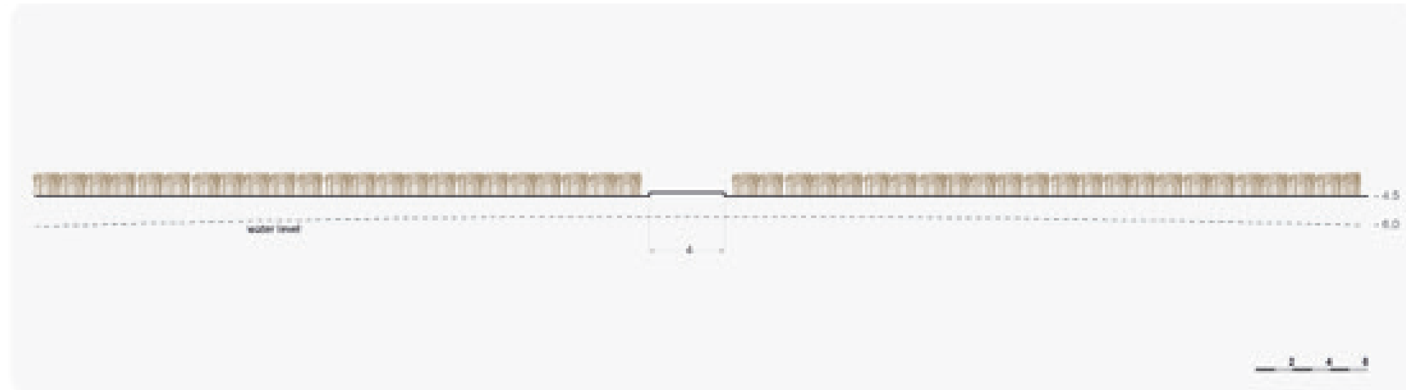


Figure 6.30: current location section C-C' and D-D'

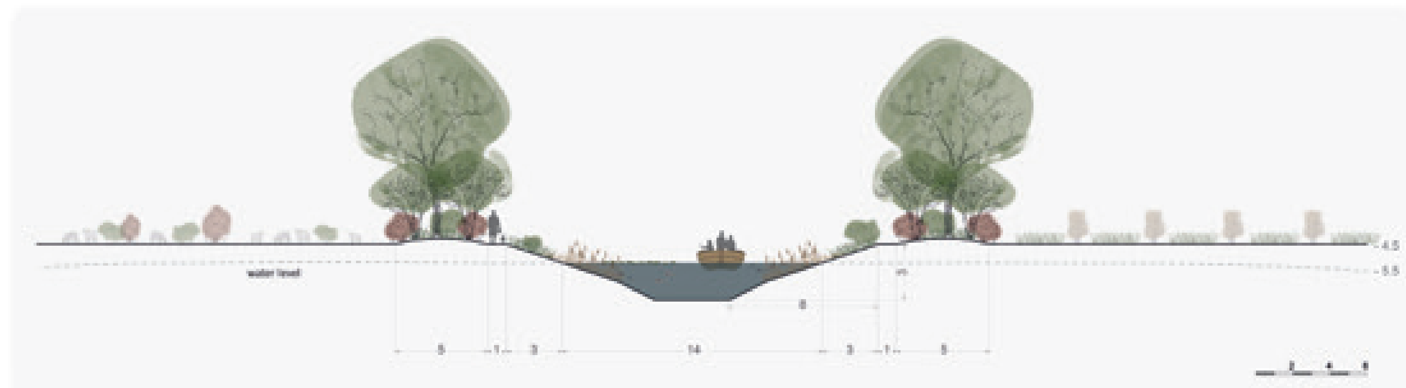


Figure 6.31: future location section C-C'

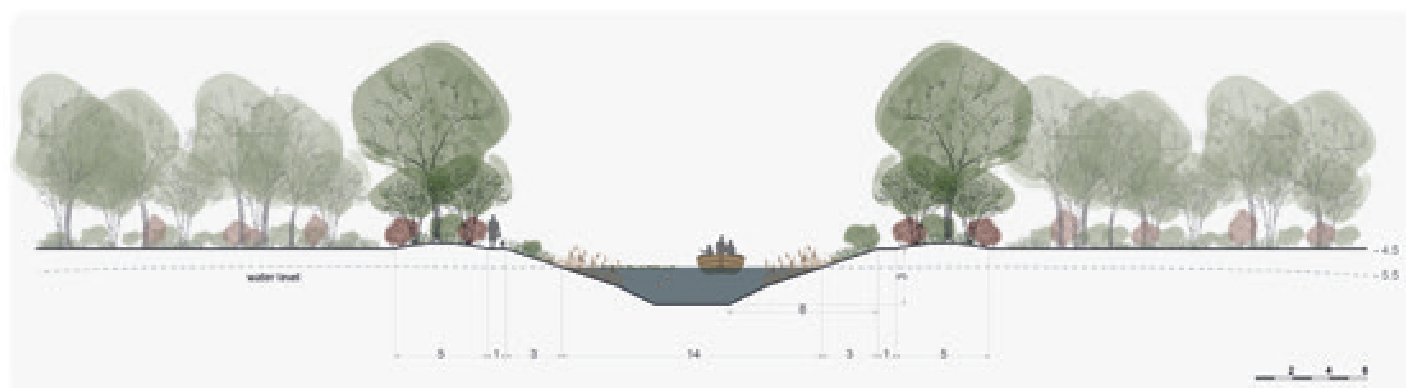


Figure 6.32: future location section D-D'

Section E - E'

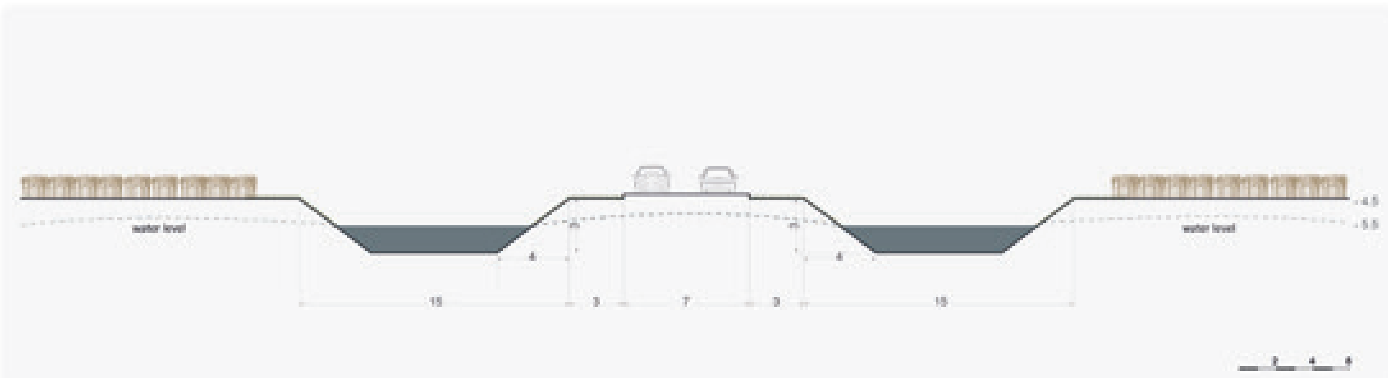


Figure 6.33: current location section E-E'

Figure 6.34: future location section E-E'

Section E visualizes the characteristics of the new settler road in the water buffer area. The new settler roads are added to the existing regional road N205. Between these roads, a double-lined tree avenue, including small hedgerows, is created. This intermediate planting ensures that the settler houses experience minimal disruption from the busy regional road. The orientation of these settler houses is directed towards the wide water buffer lake.

Section F - F'

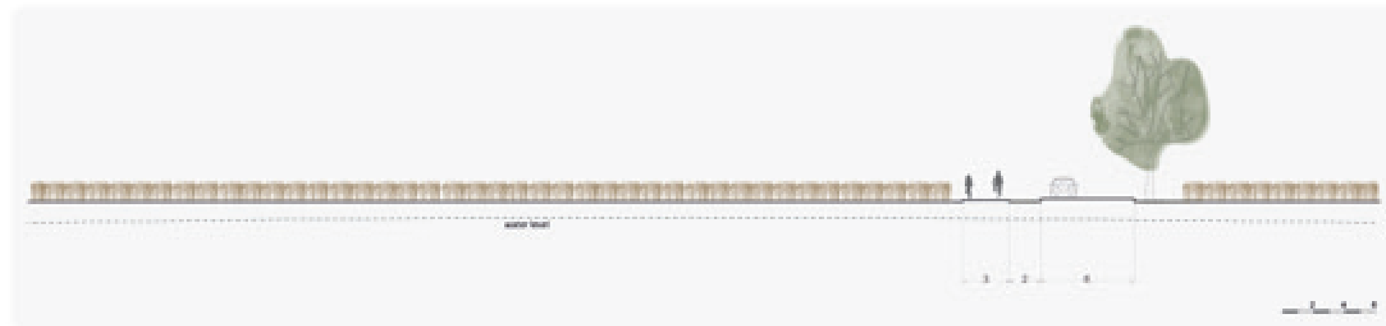


Figure 6.35: current location section F-F'

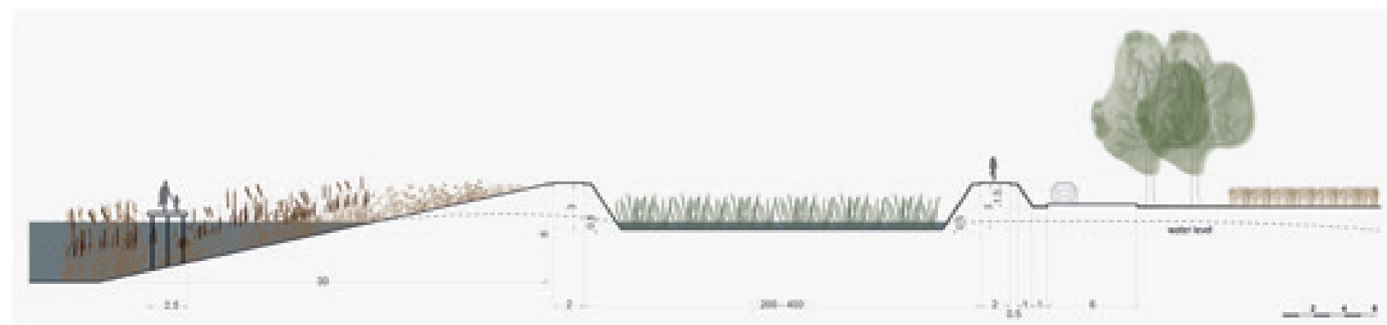


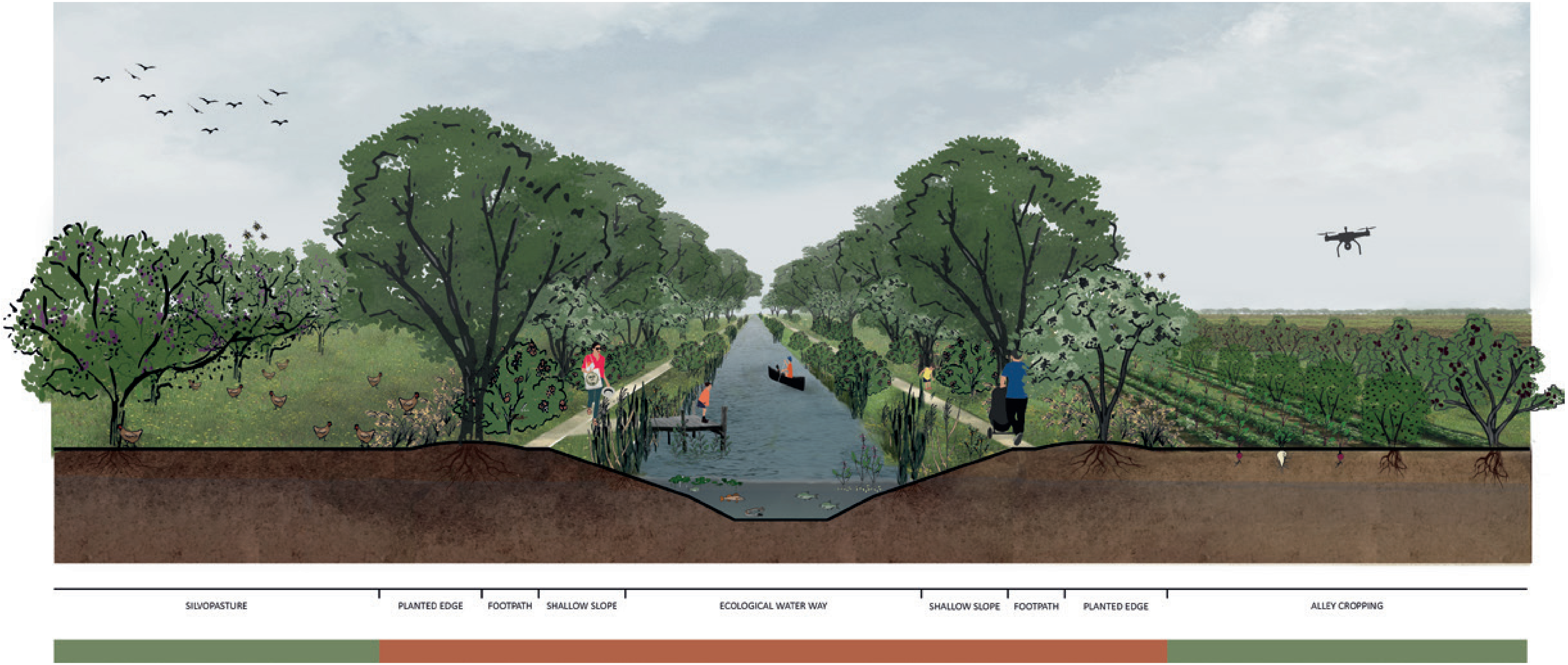
Figure 6.36: future location section F-F'

Section F visualizes the characteristics of the intersection between the water buffer area with the polder plane. The old farm road is accompanied by a double-lined tree avenue on the polder plane side, and a small dike with cycling lane on the water buffer side. The zone next to this is completely enclosed by dikes to create a manageable water basin. In this basin, shallow water crops can be farmed such as cranberries or willows. Next to this zone, a slight slope is constructed to create optimal conditions for the growth of reed and cattail. In this reed-zone, a wooden footpath is implemented. Next to this zone, a deep water buffer area is constructed, suitable for fresh water storage, water recreation and fish farming.

IMPRESSIONS

To illustrate the atmosphere of some representative places within the design, three visualisations are made (6.37-6.39). The first one gives an impression of the ecological waterway in the open polder plane, the second one visualizes the atmosphere of the new settler road in the food forest edge, and the last one shows an impression of the water buffer area next to the open polder plane. Within these impressions, a difference is made between designed elements/structures (red bar) and non-designed farmers' implementations (green bar). In the impressions, possible representations are made for these non-designed farmers' implementations.

IMPRESSION - ECOLOGICAL WATERWAY IN THE POLDER PLANE Figure 6.37



designed structure/element   farmers' implementation

IMPRESSION - NEW SETTLER ROAD IN THE FOOD FOREST EDGE *Figure 6.38*

FOOD FOREST FARMING | NEW SETTLERS HOUSING | NEW SETTLERS ROAD | SHALLOW SLOPE | ECOLOGICAL WATER WAY | SHALLOW SLOPE | NEW SETTLERS ROAD | NEW SETTLERS HOUSING | FOOD FOREST FARMING

designed structure/element

farmers' implementation

IMPRESSION - WATER BUFFER vs. POLDER PLANE *Figure 6.39*

designed structure/element

farmers' implementation

POLDER SIMILARITIES

The two main landscape types present in the metropolitan region of Amsterdam are reclaimed polder lands and peat areas. For the peat areas in the Haarlemmermeer, general suggestions are made, namely transforming them into wet peat field areas. This intervention of inundating peat areas is necessary to prevent further CO_2 emissions and soil subsidence (appendix B). Considering the peat areas in the MRA, I think similar interventions should take place. This means that these peat areas should change their mono-functional grassland use towards aquaculture-based farming systems. Moreover, this transformation to wet peat fields offers possibilities for fresh water storage (e.g. for the purpose of water supply to agricultural areas in reclaimed polders).

Considering the second main landscape type present in the MRA - the reclaimed polder lands – many of the regional design interventions for the Haarlemmermeer can be implemented in similar ways. In a study on Dutch reclamation areas, comparisons have been made between these different polders, showing recurring structures such as strict and linear polder planes and modules, and deviating edge structures (figure 6.41-6.43). In addition, all these polders have been confronted with urban growth over time. This means that all these reclamation lands share the same main site components with the Haarlemmermeer, namely: polder plane, polder edge and build core(s). Only the site component of Schiphol is very specific for the Haarlemmermeer and cannot be found as a standard component in the other polders. Though some of its sustainable design interventions can be used for Lelystad Airport, situated in the reclaimed land of Flevoland. Besides similarity in the three main site components, these reclamation lands share the same kind of agricultural problems, such as soil salination (figure 6.40) and pressure on agricultural lands through urbanization. Both type of similarities make these polders extremely suitable for the adaptation of similar design interventions, used in the regional design for the Haarlemmermeer. In this way, all food producing polder landscapes can be transformed into sustainable food regions. Some examples of similar design interventions are the implementation of green/blue buffer zones in the polder edges, the use of salt-tolerant crops, but also the halving of plots to accentuate the cultural polder grid, create smaller farming systems and to invite new settlers to the polder. The proposed polder grammar and assisting site- and regional guidelines can be adapted as useful tools in this design process of transforming the polders into sustainable food regions.

An elaboration of these similar design interventions for the peat- and polder areas in the Metropolitan region of Amsterdam, have been further elaborated through the supra-regional design in the following section.

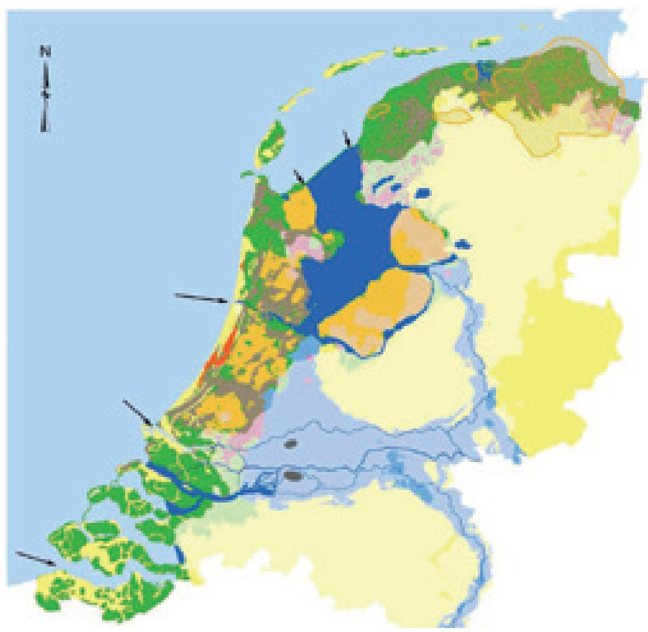


Figure 6.40: salinated soils in the Netherlands; light yellow is not salinated (De Ingenieur, 2018)

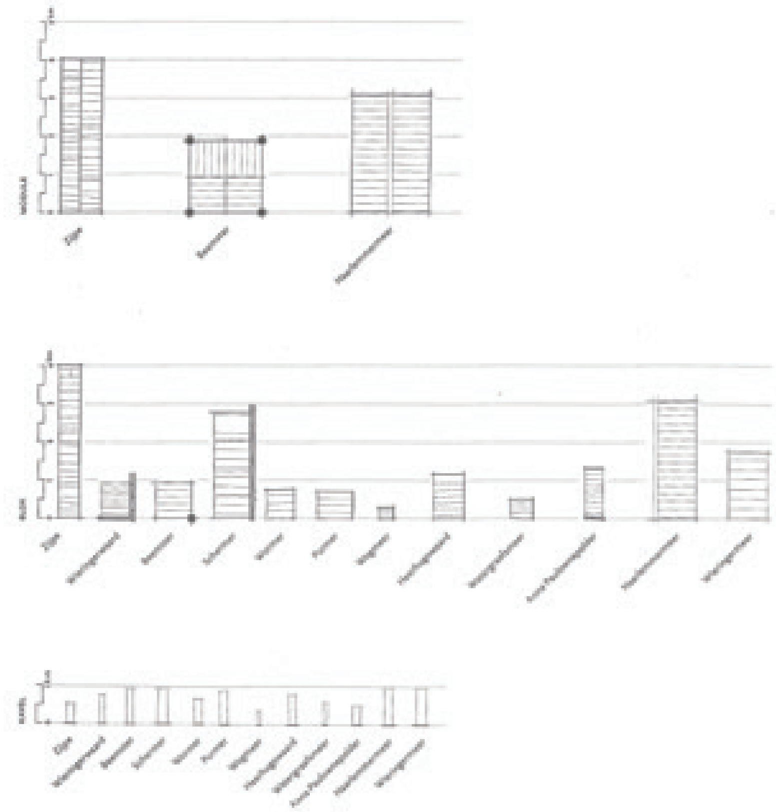


Figure 6.41: plot/field comparisons within Dutch reclamation areas (Reh et al., 2005)

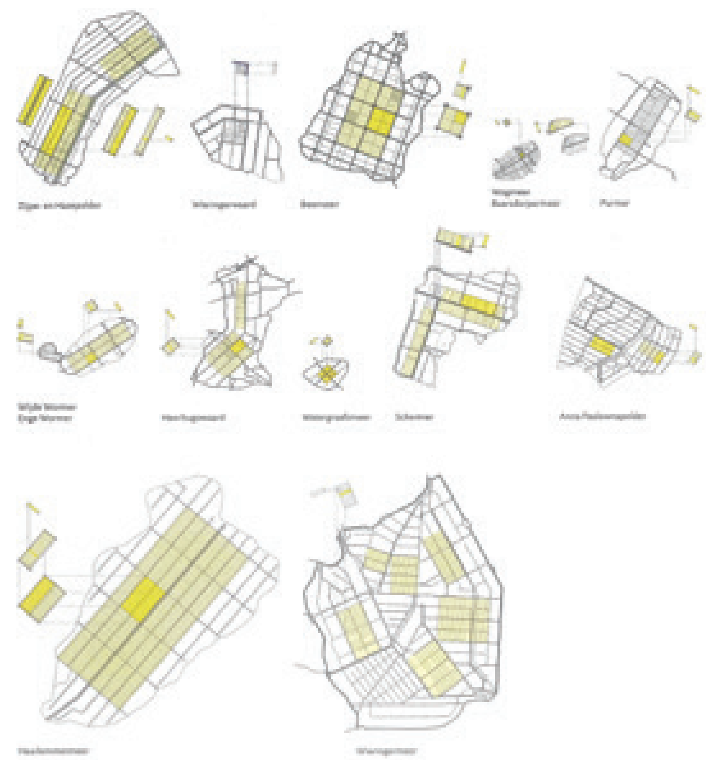


Figure 6.42: plane comparison within Dutch reclamation areas (Reh et al., 2005)

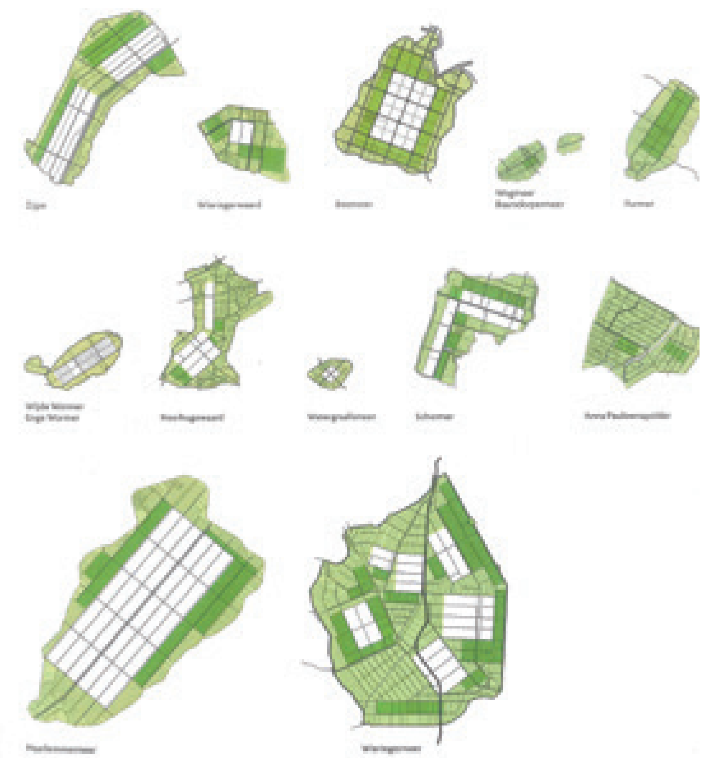


Figure 6.43: edge comparison within Dutch reclamation areas (Reh et al., 2005)

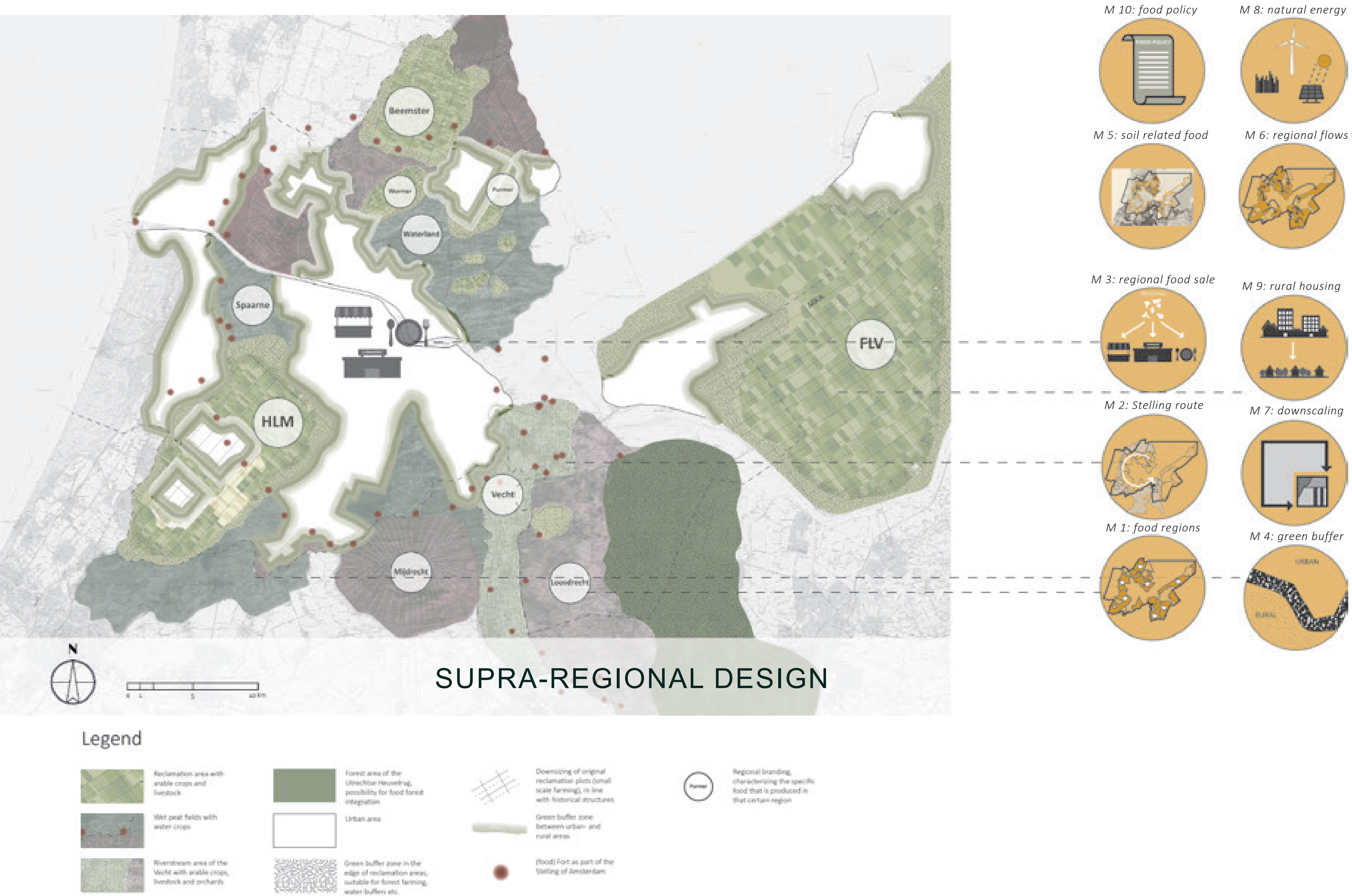


Figure 6.44: supra-regional design Metropolitan Region of Amsterdam; including supra-regional guidelines

6.5 SUPRA-REGIONAL DESIGN METROPOLITAN REGION OF AMSTERDAM

The design for the metropolitan region of Amsterdam includes a schematic representation of large urban cores surrounded by food producing regions. Differences in landscape qualities and soil compositions within these regions are reflected in the types of food production (M5) and recognized through established food labels (M1), guaranteeing the sustainable nature of production. These food products are sold in adjacent urban cores (M3) to ensure a market for farmers and to promote consumers awareness considering the origin and quality of their food. The interface between urban and rural areas is transformed into a resilient green buffer zone (M4). This zone inhibits further urban growth at the expense of agricultural lands. The completion of these zones is not fixed, instead it can consist of multiple different elements such as edge forests, water buffer areas and waste disposal terrains. New housing should take place within the urban borders, or it should be integrated in the rural landscape (M9). Furthermore, farming systems in the food regions will be transformed into sustainable and diverse farming systems, downscaling destructive monocultures (M7). Between these food regions, large scale interactions can take place such as water buffering or-release (M6). Also natural resource management will take place on this scale as new ways of energy production are implemented, for example in the shape of windmill- or solar parks (M8). Considering recreation, the existing network of the Stelling of Amsterdam will be used to connect the different food regions by means of cycling and walking paths, but also by transforming the old forts into food forts, providing multiple functions related to the nearest food region (M2). Overall, these new implementations, considering the creation of a sustainable food landscape, are established into food policy (M10). This policy is pursued from top-down in order to guarantee the specific landscape values and to create possibilities for related financing.

6.6 THE FOOD SYSTEM: COMPONENTS & FLOWS

To explain the specific food components and flows of my proposed site-, regional-, and supra-regional design, I refer to the spatial configuration of the sustainable city region food system proposed by Kasper et al. (figure 6.45). I will explain the designed food system accordingly the five spatial elements of production, processing, distribution, consumption/market and waste disposal. Furthermore, I will illustrate the flows of goods, people and actions between these components. All together this provides a complete picture of how the region will function as a sustainable food system.

SITE DESIGN NIEUW-VENNEP

Seen from the smallest designed scale level, the site consists of four main types of food production areas: arable crops & livestock on the open fields, three harvest and forest animals in the forest edges, water crops in the wet peat fields and shallow water areas, and fish from the water buffer area. These food products will partly be processed and distributed in existing cold store before they are transported to the consumer, and partly be directly sold at the farm or in local shops. The consumer/market consist of three main cores with food selling points: Nieuw-Vennep, Lisse, and Hillegom. Waste products are recycled as much as possible, for example urban GFT-waste that is transformed into green compost for agriculture. Other important flows are the storage and delivery of fresh water by water buffer areas and the recreational possibilities that production lands offer to consumers (figure 6.46).

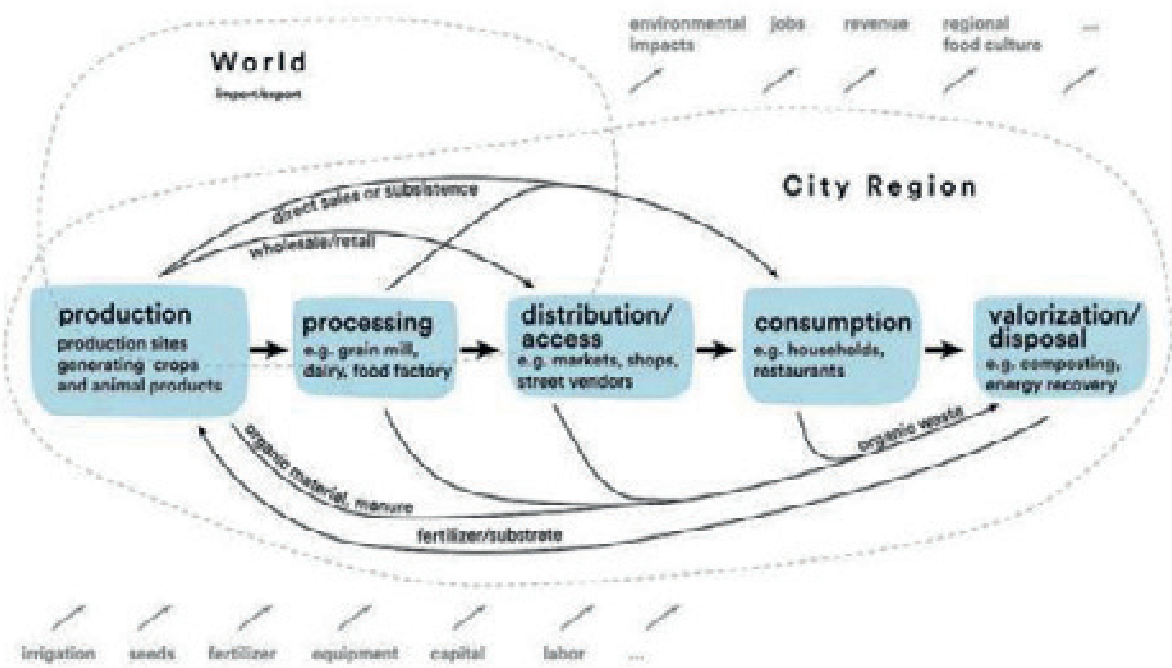


Figure 6.45: spatial configuration of the City Region Food System (Kasper et al., 2017)

Figure 6.46: site design Nieuw-Vennep; food system components and flows

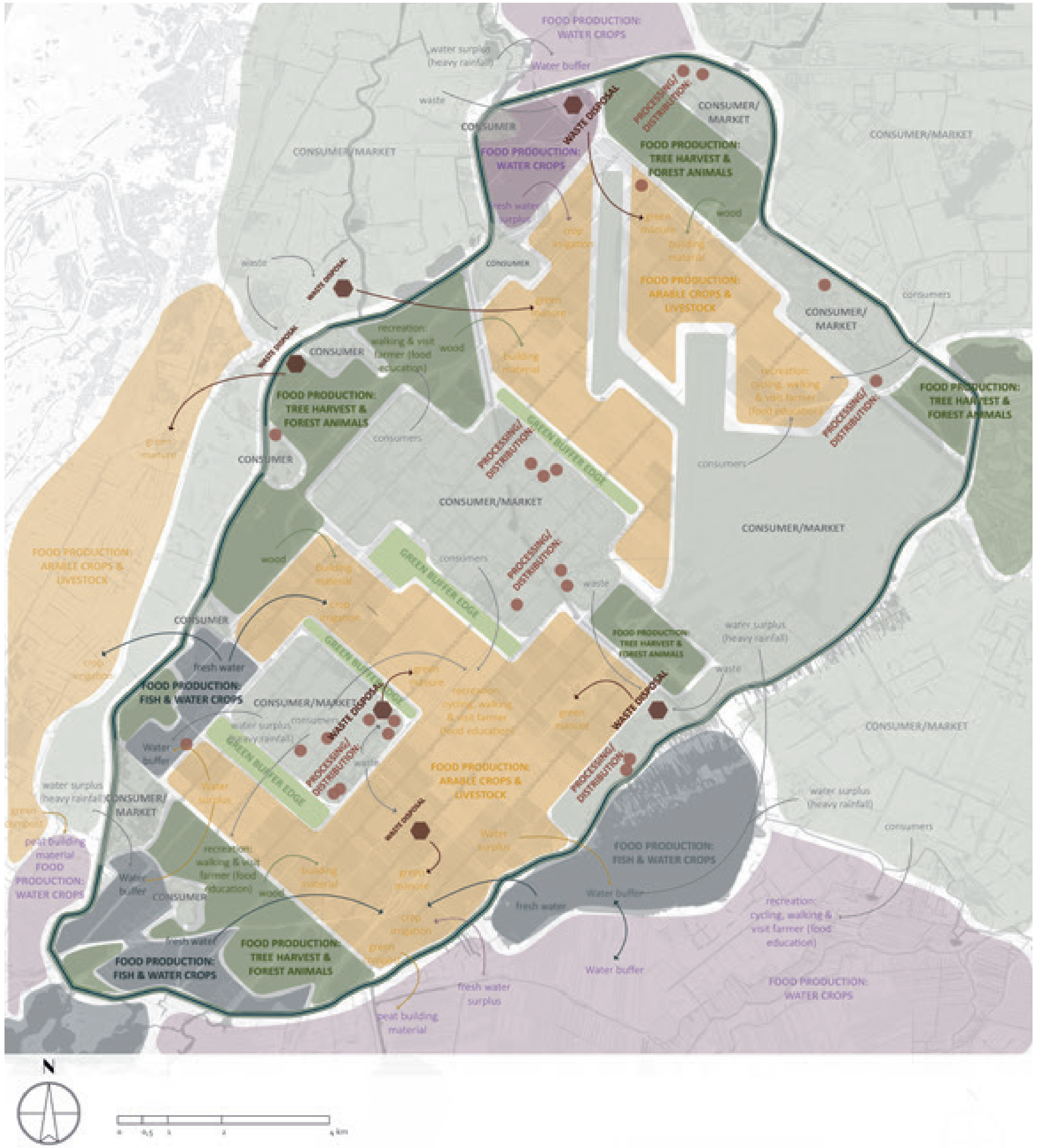


Figure 6.47: regional design Haarlemmermeer; food system components and flows

REGIONAL DESIGN HAARLEMMERMEER

Within the regional scale, the four aforementioned food producing zones gain more area, but they retain their function. Existing distribution/processing companies (Van Bossum, 2018) are used to process and save this regional food, after which it is transported to nearby markets. These markets consist of urban areas that are both located in the polder and adjacent to the polder. Subsequently, both consumer- and agricultural waste is processed and recycled in regional waste disposal companies. This component map also shows how food flows can go beyond their own city region as they assist one another. Neighbouring peat fields can for example be used as fresh water storage for agricultural lands, whereas these agricultural lands can provide the peat fields with soil building material such as organic 'waste' from the lands (figure 6.47).

METROPOLITAN REGION OF AMSTERDAM

Food flows and components within this supra-regional scale are visualized in a very abstract manner. A great variation of food products is produced in the different landscape regions within the metropolitan region of Amsterdam. These products are processed and distributed in the urban cores from which they will subsequently be transported to consumers/market in that same urban core. Waste products are connected and recycled in green buffer zones around the urban cores (figure 6.48).

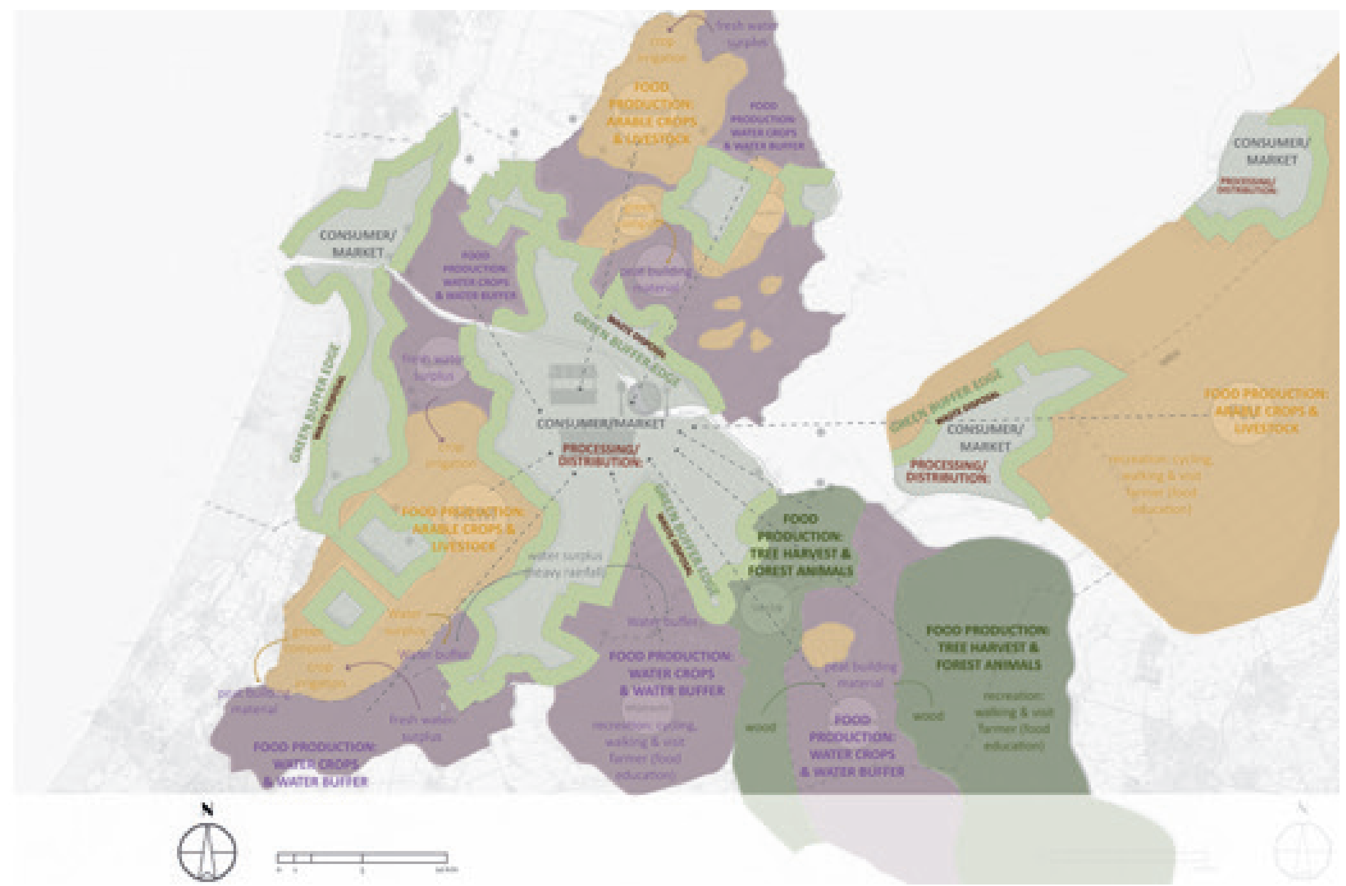


Figure 6.48: supra-regional design Metropolitan Region of Amsterdam; food system components and flows8

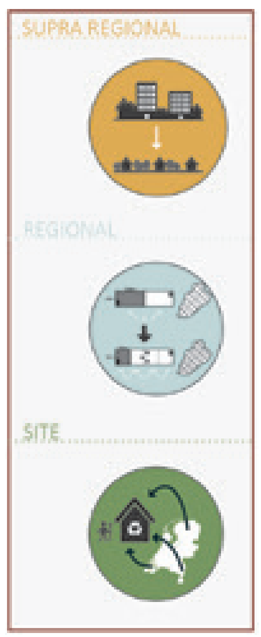
6.7 GENERALIZING GUIDELINES INTO PRINCIPLES

Throughout the design process, the developed guidelines for each of the three scale levels were leading. Together with my influence and aesthetic considerations as a designer, these guidelines were joined and integrated into the specific landscape of the Haarlemmermeer. As described in the introduction, the case study location is meant to explore possibilities in achieving the general research objective: *'design principles which can be used to create a new, sustainable food system for the city region landscape'*. So far, gained research knowledge is transformed into guidelines for the case study location of the Haarlemmermeer (chapter 5). Subsequently, these guidelines were implemented and refined through the case study design, described in the preceding paragraphs. The last step that needs to be executed is to generalize these refined guidelines into general design principles that can be used in the creation of sustainable food system landscapes for city regions worldwide. In this last step, design results, with matching guidelines, have been analysed through the different levels of scale. Thereafter, interconnections were made to summarize the main guideline topics. Finally, these interconnections were abstracted into eleven general design principles.

P1: GUARANTEE SOIL QUALITY THROUGH ADAPTIVE SOIL USE

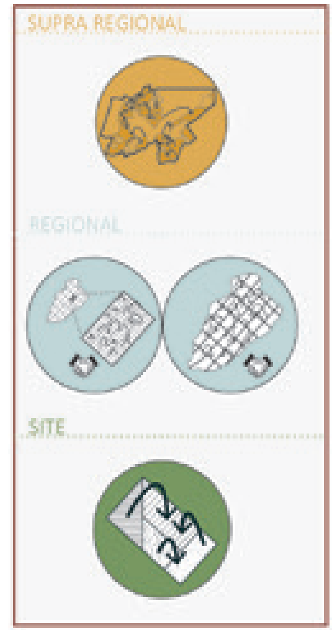
Agricultural land use should be adapted to underlying soil structures to guarantee soil quality over time. This results in a broad palette of food products. To assist farmers in this process, soil-specific plant matrices can be made. In case of site deviant structures/regulations, an appropriate form of agriculture, with matching species, should be sought

P2: IMPROVE THE CONSUMER-PRODUCER RELATION AND CONTROL URBAN GROWTH THROUGH AGRICULTURAL HOUSING



To improve the consumer-producer relation and to prevent uncontrolled urban growth, housing should be integrated into the rural landscape. A responsible way to do this is to build on, and strengthen existing cultural structures. These new housing structures can be used to invite certain target groups (e.g. sustainable farmers) to the countryside.

P3: MINIMIZE WASTE AND PROMOTE EFFICIENCY THROUGH INTERACTIVE CYCLES

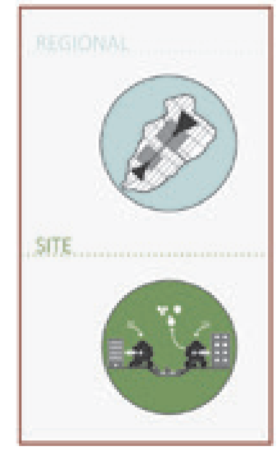


Waste should be minimized and efficiency should be promoted by the introduction of interactive cycles on all scale levels; within the farm plot, between plots and between regions. To structure these interactions and to create a safe environment for sustainable agriculture developments, farmers cooperations can be established.

P4: CONNECT DIFFERENT FOOD REGIONS THROUGH OVERARCHING (SPATIAL) STRUCTURES

In connecting different food regions, there should be searched for an overall/connecting structure (e.g. historical defence line). This structure helps to visualize food characteristics of different regions. Alongside this structure, recreational routes and food-information points can be created.

P5: INTEGRATE THE RURAL LANDSCAPE IN THE CITY THROUGH URBAN FOOD PARKS

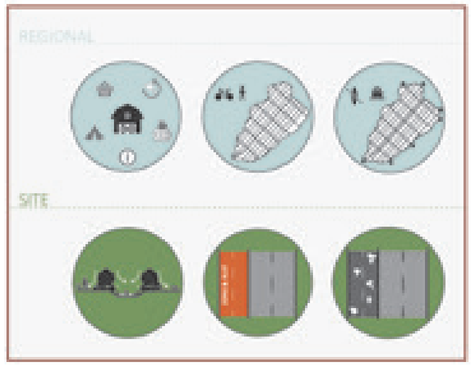


To interweave the rural landscape in the city, agricultural structures (such as farm roads) must be continued in the urban landscape by means of (linear) food parks. These parks are planted with food productive species to promote consumers food-awareness, and to refer to the agricultural hinterland.

P6: REDUCE ENVIRONMENTAL POLLUTION THROUGH THE INTRODUCTION OF SUSTAINABLE RESOURCE MANAGEMENT

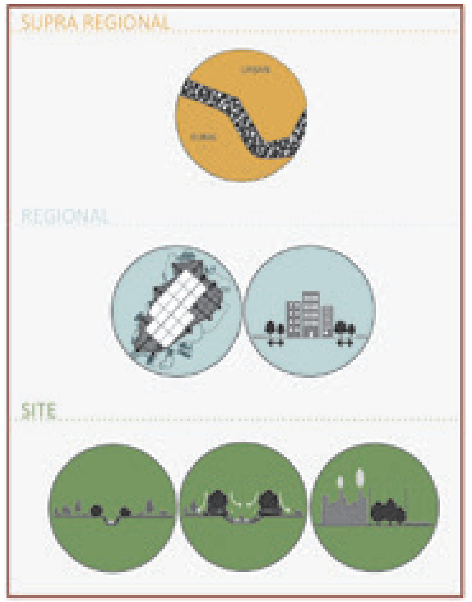
To reduce environmental pollution from farming systems, sustainable and local energy input must be found (e.g. windparks). Elements must be linked so that one's output is the other one's input. In this way, input is supplied from within the system as much as possible.

P7: MAKE THE AGRICULTURAL LANDSCAPE ACCESSIBLE THROUGH THE INTRODUCTION OF RECREATIONAL FOOD NETWORKS



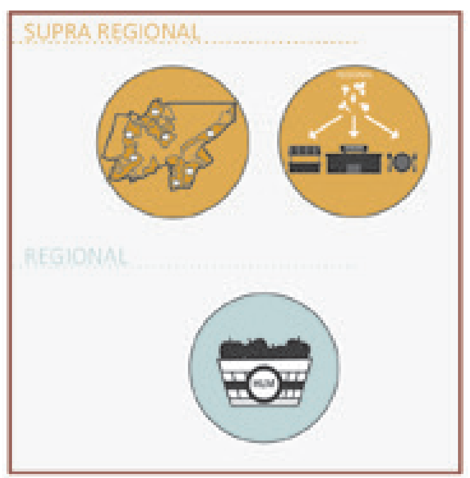
To make it possible to experience the characteristics of the agricultural landscape and to promote the consumer-producer relation, different recreational structures must be created. Existing structures (e.g. farm roads) can be transformed and new (matching) structures can be added. These routes can be enriched with artistic food related elements (pavement). Farms alongside these routes could widen their profession with food related activities (e.g. shop/camping).

P8: SAFEGUARD AGRICULTURAL LAND THROUGH GREEN BUFFER ZONES



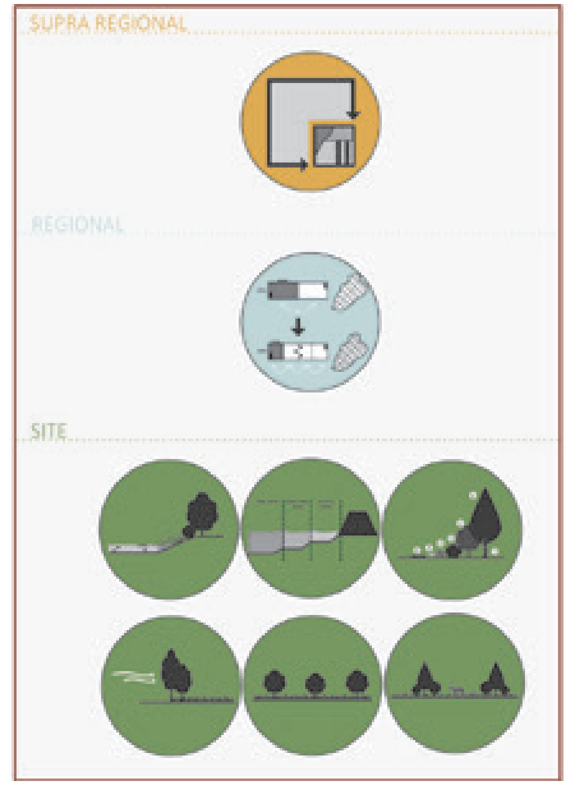
To safeguard agricultural land from urban expansion, green buffer zones are applied between urban and rural areas. The interpretation of these zones is flexible (e.g. fresh water storage, waste disposal etc.). While these buffer zones prevent urban growth, they also create valuable networks for ecological development and the creation of different niches. These buffer zones can take place on all different scale levels.

P9: PROMOTE CONSUMER-FOOD AWARENESS THROUGH REGIONAL FOOD BRANDING



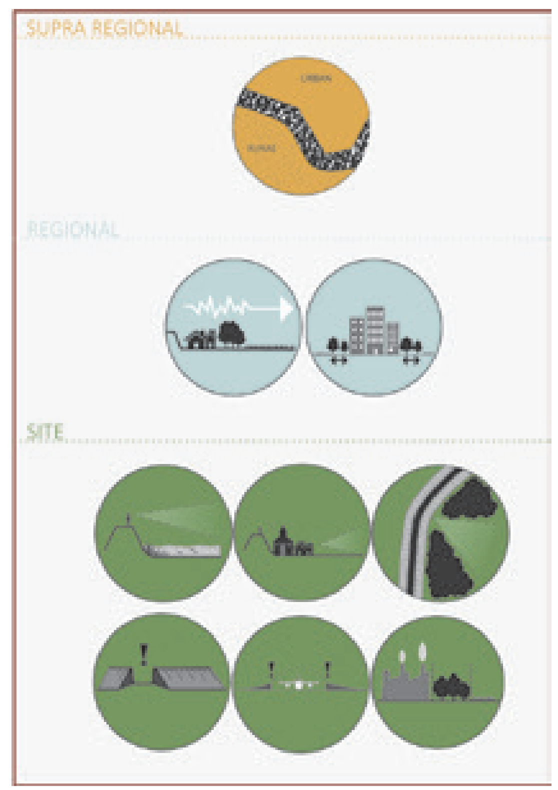
To promote consumers' awareness on the origin and quality of their food, and to ensure farmers markets (regional autonomy), regional food labels are introduced. These labels ensure the regional origin and sustainable production of a certain product. This food-labelling helps to promote certain characteristics within a food region.

P10: GUARANTEE RESILIENT AGRICULTURE THROUGH THE PROMOTION OF SUSTAINABLE FARMING SYSTEMS



To ensure a sustainable regional food system, large scale monocultures must be downscaled into diverse polycultures. This diversity of crops produces a wide variety of food products. It also enriches the soil and ensures a profitable food system on the long-term. Systems to ensure sustainable farming are for example: forest farming, ecological shores, seven-layered planting system, wind protection trees, alley cropping and meadow farming.

P11: REINFORCE SCENIC FOOD REGION VALUES BY PROMOTING LEGIBLE LANDSCAPE STRUCTURES



To create visual clarity and legibility in the new food landscape, it is important to reinforce food-related spatial elements and camouflage deviant structures. Some examples of how this can be done are to create planted buffer zones to separate different landscape types, plant dense forests to camouflage industrial sites, or highlight fragmented structures. Besides clarity, it is of great value for the landscape experience to create exciting alternations between open and closed structures/elements.

CONCLUSION & DISCUSSION

" Deze tijd is de tijd dat het besef terugkomt dat de bodem het begin is van alle leven. Dat gebruik maken van de natuurlijke processen in de bodem en van de zon, de basis is voor een volhoudbare land- en tuinbouw. Onze voorouders wisten dat, wij voegen die kennis samen met de moderne technologie. Vooruit naar vroeger!"

- Hans Huijbers (de Voor, 2019, p. 43) -

7.1 CONCLUSION

The aim of this thesis was to expand knowledge on the design for more sustainable food systems, based on a new strategy that combines three different fields of knowledge; city region food systems, cultural food heritage and permaculture theory. As these theories include the qualities of sustainability: economic, cultural/social and environmental (Hansmann et al., 2012), new possibilities were explored to create a holistic and sustainable food landscape, capable of outcompeting the current economies of scale, whilst improving its cultural- and environmental qualities. In this process, knowledge had to be gained on these three theories, and steps had to be taken to convert this knowledge into applicable design principles. The case study location of the Dutch Haarlemmermeer polder was used to explore and design possible steps to solve this knowledge gap. Through this research and design process, the main research question could be answered: *'What design principles are needed for creating a sustainable food system for the city region landscape, using permaculture theory, in combination with site specific cultural food heritage values?'* In this chapter, the results of this research will be summarized by answering the sub-research questions and the sub-design question. Subsequently, these outcomes will be reflected upon through a critical discussion, followed by ensuing recommendations and reflection.

HOW SUSTAINABLE IS THE CURRENT FOOD SYSTEM IN THE CITY REGION OF THE HAARLEMMERMEER? (SRQ 1)

In answering this question, knowledge had to be gained on both the general meaning of city region food systems as in depth knowledge on the food system of the Haarlemmermeer. Respectively, this knowledge was derived from literature studies and site analyses.

The city region food system can be defined as: *"the complex network of actors, processes and relationships involved in food production, processing, marketing and consumption, and related waste, in a given geographical region. A flow of people, goods and ecosystem services exists across this regional landscape"* (FAO, 2016, p.2). The theory is based on the pillars of sustainability (economic-, social- and environmental improvement) and fosters interdependence of rural and urban economies. To develop a sustainable city region food system, six design ingredients are stated (Baraggia, 2016; Bohn & Viljoen, 2010; Dubbeling et al., 2017; FAO, 2016; Kasper et al, 2017):

- Increase food access
- Generate decent jobs and income
- Increase resilience
- Foster rural-urban linkages
- Promote ecosystems and natural resource management
- Support participatory and inclusive governance

As the qualities of the land define the perimeters of a food region, it is important to use flexible and diverse approaches per different city region (Dubbeling et al., 2017). The main aim of this approach is to foster regional interdependence, whilst side functions can still cooperate with global systems in a complementary and sustainable way (Speksnijder, 2018).

In analysing the current food system of the Haarlemmermeer, it can be stated that this landscape is deteriorating in both quantitative- and qualitative aspects. Urban spread reduced the original agricultural land surface to 51% of the total polder grounds (Gemeente Haarlemmermeer et al., 2011; WEnR, 2018). Due to globalization processes, farmers developed large scale monocultures, producing five main food products for consumers all over the world (grain, potatoes, beets, maize, and grass for livestock), leaving no connection between regional producers and consumers. Besides this consumers' detachment from regional food, this type of food production has resulted in a degradation of soil-, water- and ecological qualities over time (Van Pridon x De Groot landschapsarchitecten et al., 2012; Van Paasen, 1955; Ter Veen, 1925; Boekel, 1872). In comparison with the described analytical model of the CRFS, it can be stated that the Haarlemmermeer encompasses all five components of a regional food system (Van Bossum, 2018). However, these components are not interconnected, which currently stands in the way of a potential sustainable food system.

Based on this research and analysis, I conclude that the current food system in the city region of the Haarlemmermeer does not meet the sustainability requirements set by the ethics of permaculture and pillars of sustainability; care for earth / environmental, care for people / social and fair share / economic (Hansmann et al., 2012; .Mollison, 1990b). Environmental sustainability is not reached as large scale monocultures cause soil-, water- and ecological deterioration. Consumers' - and farmers' detachment from food creates vulnerability in the social aspect of sustainability, and globalized food processes cause a lack in regional autonomy and resilience, endangering the economic dimension of sustainability. As prescribed developments lead to deterioration of several key aspects of Haarlemmermeer's food system, it would be beneficial to initiate a process that connects the separate food system components, and uses the proposed design ingredients to achieve a sustainable food system instead.

WHAT HAARLEMMERMEER SPECIFIC CULTURAL FOOD HERITAGE VALUES ARE SUITABLE TO STRENGTHEN A SUSTAINABLE FOOD SYSTEM FOR THE CITY REGION LANDSCAPE? (SRQ 2)

To find out Haarlemmermeer's most important cultural values and use them to strengthen a sustainable regional food system, I first had to define '*cultural food heritage*'. Secondly, knowledge had to be gained on ways to maintain and develop cultural food heritage, and on how to use it to promote sustainability. This was achieved through a literature study of general knowledge and strategies on cultural food heritage. To research Haarlemmermeer's valuable food heritage, a cultural site analysis was executed, including map/document analysis, field visits, a visit to Haarlemmermeer's historical archive and an interview with an expert on cultural food heritage in the Haarlemmermeer.

Cultural food heritage can be described as: *"the set of material (tangible) and immaterial (intangible) gastronomic elements linked to production, the agricultural sector and a collective regional heritage"* (Bessière, 2013, p.279). Three design ingredients are proposed to enable these tangible and intangible values to be preserved and developed (Bouchenaki, 2003):

- Put tangible heritage in its wider context
- Translate intangible heritage into materiality
- Support practitioners and the transmission of skills and knowledge

These ingredients convey the belief that heritage is in constant change, evolving with time. An equilibrium between conservation and endless adaptation is aimed for, also called: *heritagisation*. This strategy helps to preserve cultural food heritage values in a certain region and connect producer and consumer in the same physical space (Bessière, 2013). Agro-tourism can strengthen the promotion of a certain region and reinforce landscape characteristics and legibility. This strategy should be interpreted in changing spatial contexts to give it the space to evolve in time (Antrop, 2005).

The Haarlemmermeer is a polder developed around food production. Settlers from all over the country were invited to come and farm in this 'promised' land. This resulted in a strict grid of tangible heritage: farm roads accompanied by farms with different names and architectonic appearance due to varying settler origins. Although this design seemed progressive, clear governance and a qualitative spatial design were not forthcoming. Combined with the lack of a shared past, settlers were joined by a common endeavour to focus on the future in a rather practical and individualistic manner. This intangible attitude resulted in a very high and progressive standard of agriculture which is typical for the Haarlemmermeer (Van Paasen, 1955; Ter Veen, 1925; Boekel, 1872). With the growth of urban areas and the rise of agricultural monocultures, tangible food heritage became fragmented and intangible food heritage and characteristics were lost.

These two main aspects of Haarlemmermeer's cultural food heritage are inextricably linked to the original food productive function of the polder. When preserving and developing these forms of cultural food heritage into a form of agro-tourism, using the prescribed design ingredients, they appear suitable for strengthening a sustainable food system for the city region landscape of the Haarlemmermeer.

HOW COULD PERMACULTURE THEORY BE SCALED UP INTO IMPLEMENTATIONS FOR THE CITY REGION LANDSCAPE OF THE HAARLEMMERMEER? (SRQ 3)

In answering this question, literature studies and expert consultations were used to gain knowledge on the meaning of permaculture theory, its design ingredients, and ways to upscale these ingredients in a city region landscape. Subsequently, the geographical food landscape of the Haarlemmermeer was analysed with map/document analysis and field visits to research its possibilities in implementing these upscaled permaculture design ingredients.

Permaculture theory can be described as: *"a system of assembling conceptual, material, and strategic components in a pattern which functions to benefit life in all its forms. It seeks to provide a sustainable and secure place for living things on this earth"* (Mollison, 1988, p. ix). Underlying ethics of this definition match the pillars of sustainability as they encompass a holistic approach that ensures: care for the earth, care for people and fair share (Hansmann et al., 2012; Mollison, 1990b). To implement these ethics, ten design ingredients were defined:

- Relative location
- Each element performs many functions
- Each important function is supported by many elements
- Efficient energy planning
- Use of biological resources
- Energy recycling on the site
- Small-scale intensive systems
- Using and accelerating natural plant succession
- Polycultures and diversity of beneficial species
- Use of edge and natural patterns

From a comparison with industrial agriculture, it can be concluded that the economic feasibility of a permaculture system is high as it provides food for more than double the number of people compared to industrial agriculture. Also a more diverse and calorie-rich diet is provided, and the farmers' incomes are higher. An important notion to keep in mind when comparing these two systems is the difference in time vision, as industrial agriculture is based on short-term profit, whilst permaculture systems rely on long-term profit. The potential of upscaling permaculture is supported by the idea that development and the application of knowledge knows no limits in quantity (Mollison & slay, 1988). Therefore, prescribed design ingredients can be implemented on every scale level. Furthermore, the introduction of farm cooperations, new niche-equipment and flexible market platforms help to create a shared responsibility/risk and reinforce the resilience of an upscaled permaculture system (Shepard, 2013).

The Haarlemmermeer stands to gain significantly from a shift from industrial agriculture to a permaculture system because it could feed more than twice the number of people. In this development, permaculture theory and its design ingredients can be upscaled by implementing larger structures, for example edges, energy/recycling streams and biological resources. Sustainable farming systems with diverse polycultures should be adapted to the rich soil pattern of the polder. Also, farm cooperations and flexible market platforms can be established to reinforce the system's resilience in the city region landscape of the Haarlemmermeer.

HOW TO DESIGN GUIDELINES FOR THE REDESIGN OF THE CITY REGION HAARLEMMERMEER INTO A SUSTAINABLE FOOD SYSTEM LANDSCAPE? (SDQ)

Results from the sub-research questions were used as input source to develop design guidelines for the redesign of the city region Haarlemmermeer into a sustainable food system landscape. These results consist of two elements: theoretical design ingredients, and Haarlemmermeer specific analysis knowledge. Through the use of a realistic case with realistic analysed problems, the theoretical design ingredients are transformed from abstract ingredients to practical guidelines. This is done through a process of iterative designing (design guideline generator; figure 5.1). For each of the different ingredients, case specific solutions are created to subsequently join them into a list of design interventions for the different scale levels of the Haarlemmermeer; guidelines. This guideline creation, through the use of '*research through designing*,' is an essential part of the research as new knowledge is generated.

Since these guidelines are focused on the safeguarding and development of a sustainable food system, they provide the basic ingredient for a redesign of the city region Haarlemmermeer into a sustainable food system. Aesthetic design values were included in the design process to blend and adjust the straightforward design guidelines with the landscape. The redesign is executed on the same scale levels as the provided guidelines: supra-regional, regional and site. To generate a clear design structure and to do justice to the various landscape components within the Haarlemmermeer, the site design is composed out of multiple polder modules. These modules are shaped by the developed site guidelines, and create a new polder grammar for the site design of Nieuw-Vennep. The regional design for the Haarlemmermeer includes both the site guidelines from the polder modules, and the regional guidelines. Subsequently, this regional design for the Haarlemmermeer, together with the supra-regional guidelines, was used to give a general idea of how the sustainable, supra-regional food landscape of the metropolitan region of Amsterdam could look like.

With the guideline generator, an answer was given to part of the sub-design question: *how to design guidelines (...)*? The guideline-based designs then provide an overview of the implementation of these guidelines, answering the second part of the sub-research question: (...) *for the redesign of the city region Haarlemmermeer into a sustainable food system landscape?*

WHAT DESIGN PRINCIPLES ARE NEEDED FOR CREATING A SUSTAINABLE FOOD SYSTEM FOR THE CITY REGION LANDSCAPE, USING PERMACULTURE THEORY, IN COMBINATION WITH SITE SPECIFIC CULTURAL FOOD HERITAGE VALUES? (MRQ)

The results from the sub-research questions and the sub-design question inform the answer to this main research question. Abstract design ingredients from the three theories; city region food system, cultural food heritage and permaculture, provide the research with a sound basis for the design of a sustainable food system. With the analytical input of a case study in the Haarlemmermeer, followed by the guideline generator, these abstract ingredients were converted into practical guidelines. To test and refine the guidelines applicability, they were implemented in the design for three different scale levels; metropolitan region of Amsterdam (supra-regional), Haarlemmermeer (regional) and Nieuw-Vennep (site). From these designs, a number of recurring patterns and matching guidelines were observed on multiple scale levels. Guideline interconnections were made to subsequently generalize them into eleven design principles:

PRINCIPLE 1: Guarantee soil quality through adaptive soil use

PRINCIPLE 2: Improve the consumer-producer relation and control urban growth through agricultural housing

PRINCIPLE 3: Minimize waste and promote efficiency through interactive cycles

PRINCIPLE 4: Connect different food regions through overarching (spatial) structures

PRINCIPLE 5: Integrate the rural landscape in the city through urban food parks

PRINCIPLE6: Reduce environmental pollution through the introduction of sustainable resource management

PRINCIPLE 7: Make the agricultural landscape accessible through the introduction of recreational food networks

PRINCIPLE 8: Safeguard agricultural land through green buffer zones

PRINCIPLE 9: Promote consumer-food awareness through regional food branding

PRINCIPLE 10: Guarantee resilient agriculture through the promotion of sustainable farming systems

PRINCIPLE 11: Reinforce scenic food region values by promoting legible landscape structures

These general design principles are suitable for implementation in different food regions worldwide. However, implementing them does not automatically guarantee a good design, as skilled landscape architects are needed to apply them in correct ways (Prominski, 2017). Also, there is no strict order for the application of the principles. In fact, they could be applied separately. Nevertheless, the intent of the principles is made so that together, they ensure the best result, and general aim of this thesis: a sustainable food system for the city region landscape.

7.2 DISCUSSION

In the discussion I will reflect critically on the prescribed results and limitations of this thesis. The research approach and design will be reflected upon separately. Also, the significance of this thesis will be discussed for both the general problem statement, as for the field of landscape architecture.

RESEARCH APPROACH

The research approach is based on three main theories: city region food system, cultural food heritage and permaculture. With this combination, I tried to create an approach as holistic as possible considering the pillars of sustainability (Hansmann et al., 2012), because I think we need to act beyond separate disciplines and approach issues as a whole; supported by ecological literacy (Orr, 1992). However, it is debatable whether this is the most suitable combination to achieve this, as I figured out that there is a great range of different strategies to achieve sustainability. Most of these strategies imply change, although concrete design ingredients are often not included. In selecting appropriate theories for this research, I focused on strategies that included specific ingredients to inform a possible design as concrete as possible. Although the design ingredients of the three used theories offer concreteness, they were often still fairly broad to interpret. Take for example the design ingredient *'increase food access*.' This can be interpreted in multiple ways. Also, there were very few examples of realistic implementations of these design ingredients because they are relatively new (*city region food system*), not so much viewed from the perspective of food (*cultural heritage*), or not used to large scale implementations (*permaculture*). Because of this, I regularly had to use my interpretations as a designer to define the theoretical design ingredients as specifically as possible. Though the resulting ingredients are provided with interpretations, they provide a useful overview for each of the three theories.

Regarding the case study, the chosen location was guided by a collaboration with the Evidence based Food System Design-project, operating in the metropolitan region of Amsterdam. Within this area I looked for a region that best suited my study scope; (potential) agricultural lands and proximity to a city. Within the MRA, this limited the choice to reclamation grounds or peat areas. Although peat areas are certainly interesting and representative areas for both the MRA and the Netherlands, I opted for a polder. This choice was determined by greater possibilities considering the production of different food crops. In addition, the various soil types within the polder offer more possibilities for future representation to other food regions worldwide. Nevertheless, design results for this case must be verified in other cases to improve its validity and reliability.

An important player in the area of the case study is Schiphol. Because this airport and its configuration can be the topic for a thesis on itself, and because it did not fit within the stated study scope, I decided not to focus on it. Though, I think it is important to keep it in my mind and take a 'position' on this matter. I expect that the designed food focus for the future of the Haarlemmermeer will conflict with the interests of Schiphol since it limits the airport in terms of area expansion and regional influence. However, I think that Schiphol can still play a valuable role in the near future, since it can act as a major customer of the food produced in the Haarlemmermeer. This allows the airport to act as an important influencer, promoting sustainable food production, and creating a stable market for farmers; strengthening regional autonomy. In addition, I believe that Schiphol's interests should be placed in a time perspective that is consistent with the proposed sustainable solutions. These solutions use an exponential growth system (figure 3.8), which consists of long growth periods; 50 years and beyond. If the development of Schiphol is also placed within this time frame, the question is whether the airport will still exist at this location by that time. The growing protest against noise disturbance, and the limited opportunities for growth, have increasingly fuelled the discussion about an alternative airport location in the North Sea (de Volkskrant, 2019). In addition, with the current discussion on flight-miles and the growing public support towards more sustainable ways of travelling, the question is whether the airport will still be such a major player in 50 years. Such speculation places Schiphol's short-term interests in perspective, thereby showing that they do not outweigh the long-term benefits of a sustainable and resilient food system. Furthermore, when it comes down to it, we can live without flying but not without food.

For the generation of case specific knowledge, I executed an elaborate analysis, covering geographical-, historical-, cultural-, spatial-, and food system related data, mainly consisting of documents and maps. This analysis offers valuable information for the landscape of the Haarlemmermeer. I would have liked to supplement this analysis through an extensive conduction of expert-interviews, however this process was limited within the time constraints of this research. Also, I experienced how limited (or lacking) the supply was regarding food system- and regional permaculture experts (in the Haarlemmermeer, but also in general), which made this input even more limited. What was most disappointing was the limited availability of data about the food system of the Haarlemmermeer and about permaculture production numbers. When techniques considering this data are further developed in the future, it will be of great value to give this type of thesis research effective decisiveness. Together with more elaborated expert-knowledge, additional insights and design inspiration could have been generated considering the site. Additionally, it might have been interesting to supplement this knowledge with participation input from case study inhabitants (e.g. to better characterize Haarlemmermeer's identity and sharpen its needs).

DESIGN

Referring to the design process model of van Etteger (figure 2.3), it can be said that design is integrated through all parts of the research, covering the leading structure throughout this thesis. Research directed design, but also the other way around, as design sometimes directed and even inspired further research.

In the process of guideline development, a high level of designers influence is adapted to transform abstract theoretical ingredients and analytical outcomes into practical guideline solutions. These interpretations are biased as they include intuition and personal design preferences. Certain designers influences are insurmountable when creating new guidelines, however, it would be valuable to propose different designers with the same theoretical and analytical outcomes to test if similar guidelines would be the result. In addition to this suggestion, it would be interesting to test and refine the guidelines with interdisciplinary teams of ecologists, economist, farmers, hydrologists etc. Similar improvement processes also apply to the generalized design principles, as repeated applications by different experts are needed to further develop them into a set of solid design tools. In this way, design principles can fulfil the function of *enzymes*, accelerating and catalysing processes (Prominski, 2017). In this case they can accelerate the process of turning our current food systems into sustainable ones.

As the designed guidelines already covered site specific case study information, it was a small step towards the creation of the different designs. Again, these designs include determining aspects from me as a designer. The designs were created to give clarity on how the guidelines could be implemented in the actual landscape. During the design process it became increasingly clear how this accumulation of guidelines was not only useful for the design of a sustainable food-system, but also for the deployment of other functions such as housing, ecological networks and new recreational structures and experiences.
A questionable element from my design could be why I did not draft more extreme design solutions, such as the demolition of built-up areas in favour of agricultural land, or a transition to full perennial vegetation through a gigantic food forest. Such extremes could have been the result since the retention of non-food functions did not fit the purpose of this thesis. However, within the vision of sustainability, and especially permaculture, it is stated that design is: *"a system of assembling conceptual, material, and strategic components in a pattern which functions to* ***benefit life in all its forms****"* (Mollison, 1988, p. ix). This means that in addition to the development of a sustainable food system, I also looked at sustainable uses of existing functions. I found out how both functions can complement one other, e.g.: housing provides consumers, needed for the marketing of food, and attractive food landscapes provide a qualitative housing environment. Hereby, the design is realistic in nature and shows how food functions can be combined with existing non-food functions.

As is clearly visible in the impressions (figure 6.37-6.39), the design is divided in two different types of executions: the designed framework and the farmers implementation. The designed framework is used to give guidance and clarity to the agricultural landscape, whilst offering flexibility to farmers' implementations, as they encompass the main land use function. Within these lands, space must be created for new farming systems, combining ancient permaculture-methods with new technology. At the Maaskant Dialoog (2018), Louise Fresco spoke about this combination of old and new technologies: *"the landscape is not becoming more technological, but the means are. When using this in correct/sustainable ways, we can create a landscape that becomes more diverse and human-friendly"* (Fresco, 2018). I think we should aim for this diverse landscape with technological means. However, it does not necessarily need to be executed everywhere. With this development, characteristic food landscapes do not get stuck in one safeguarded time frame, instead, a future proof food heritage landscape can be created; in constant change and evolving with time (Bessière, 2013). Examples of such future-proof farming systems are pixel farming (Pixelfarming, 2019), mixed cultivation with farm robots (De Boo et al., 2017), but also initiatives such as the Herenboeren (Van Dinther, 2019), and community-supported agriculture (CSA's).
The proposed design framework and new farmers implementations require patience because sustainable farming systems are based on long-term profit. Both for farmers, as well as for administrative bodies, this will be a challenge as they often operate in shorter periods of time. Additional research is needed to investigate how such systems are feasible for both parties.

Another challenge is the 'messy' appearance, that is often part of diverse, sustainable farm landscapes. As landscape architect Joan Iverson Nassauer describes: *"designers need to start translating ecological patterns into cultural language that people will recognize as maintained, well cared for, and attractive"* (Althouse, 2016, p. 23). With the creation of a design framework, I tried to ensure this maintained and attractive appearance. This is also something that the farmers could use help with, considering their plot implementations. However, I also think a change in mindset is needed considering this aversion towards messiness, as it is part of the solution towards a more sustainable food landscape. To promote this change in mindset, appealing impressions/visualisations can be used to show people the beauty and richness of this messiness. I tried to initiate this with the impressions in this thesis, but much is still to be gained here. Another method to promote this change in mindset and create support for the development of sustainable food system designs can be found in the field of *eco-revelatory design,* as this encompasses the believe that: *"revealing ecological process in the built environment will allow human users of that environment to connect with, appreciate, and ultimately value the processes more than they otherwise would"* (Eisenstein, 2005, p.2). Interesting research in this field is being carried out in the master thesis of Merel Gerritsen (to be published).

SIGNIFICANCE

With agriculture as one of the largest land uses on Earth (Ritchie & Roser, 2014), and its associated negative globalization effects, there is a great need for sustainable alternatives to preserve our planet in a sustainable manner, on the long term. Landscape architects can play an essential role in leading this development. Hence, I think it is our duty to 'defend' the landscape and stand up as agro-architects, engaging in the discussion of new, sustainable food landscapes. Therewith, this thesis offers both significance for a worldwide problem, as for the development of food-related design within the profession of landscape architecture.

As this food-related design is still quite unexplored in the domain of landscape architecture, this thesis design is of great value since it provides examples and concrete design tools. As such tools are still in their infancy, they need further development and refinement. As similar kind of design experiments are emerging, they can serve as valuable additions to complement one another; e.g. Brood & Spelen (Brood en Spelen, n.d.) and the project Regio van de Toekomst (Berkers, 2019). As it became clear that food-related design interventions can promote other spatial functions, these principles should be seen as a valuable design tools. They should be integrated way more often in future designs for both rural and urban areas. Another valuable point of significance is the food system-focused, landscape analysis approach. This method offers interesting insights on the origins of the landscape but also on the spatial configuration of the landscape through existing food components and flows. This analysis perspective builds upon existing analysis methods and helps broaden the landscape view and its functional understanding.

Scientifically speaking, this new knowledge within landscape architecture can help to bring different disciplines of science closer together, with food as the unifying element. Collaborations can arise with for example ecologists, water experts, estate agents, soil experts, cultural historians and farmers' organizations. This way, issues are approached as a whole, thus resulting in more effective- and sustainable solutions.
Altogether, I think this thesis offers clarifying insights with regards to the demand for more agro-ecological food systems. As globalization has negative effects on food regions worldwide, this design can be seen as a source of inspiration to counteract such developments and trigger the development of attractive and functional food landscapes, with recognition for specific regional characteristics. These spatial changes should however go hand in hand with a change in mindset, covering the believe that we cannot be supplied with a year-round, constant availability of low priced, diverse food products (Wiskerke, 2015). Instead, farmers should look for a wide range of production possibilities in their own region, and consumers need to acknowledge what their specific region has to offer per different season.

"Koopt in het buitenland niet wat eigen land u biedt" (Westerman, 2008, p. 211-212).

This does not mean that everything needs to come from the surrounding region, as this is not always sustainable (Speksnijder, 2018). We must strive for an appropriate, profitable, diverse and sustainable solution per different food region. These movements are needed to outcompete destructive global food-systems and initiate sustainable ones instead.

7.3 RECOMMENDATIONS & REFLECTION

To encourage and initiate further research based on the research and design of this thesis, several recommendations are proposed.

The research approach that is used in this thesis is just one example of an exploration considering more sustainable food systems. Therefore it would be valuable to research other approaches to this topic; e.g. combining different theories, using a different case study or work on a different scale level.

Due to a lack of time and a different research focus, the two potential study scopes of financial- and political feasibility were not included in this thesis. However, since it deals with the real employability of the design, it could be input for an interesting follow-up study. As the current minister of agriculture, nature and food quality, Carola Schouten, promotes the development of alternative food systems and circular agriculture, favourable opportunities are created to investigate the political feasibility of this thesis (de Voor, 2019). Besides, it could be interesting additional research to discuss and improve the designs through participation- and/or expert meetings with different stakeholders. Such initiatives can increase the integration of the design and promote public support. To research the true feasibility of the designs, such investigations and additional expert-elaborations need to be executed. Moreover, assumptions about the robustness and quality of this design are uncertain until the design is actually implemented and tracked over a longer period of time.

Other interesting follow-up studies could deal with a further exploration of the spatial configuration of food components and flows. As this data was not well developed and accessible during my research process, future developments might provide new opportunities.

Another interesting follow-up study could include the research and design for the city-countryside interface. In this thesis they are covered under the concept of buffer zones/edges. However, they lack concrete design elements and functions. As this area covers the meeting point between consumers and producers, this is a relevant zone for further research on how these two components can be better connected and integrated.

To conclude, I hope that this thesis will contribute to a growing awareness on the increasing need for new, sustainable food systems. In addition, I hope that the threshold towards concrete solutions has been reduced by offering attractive and sound designs, based on practically applicable design principles.

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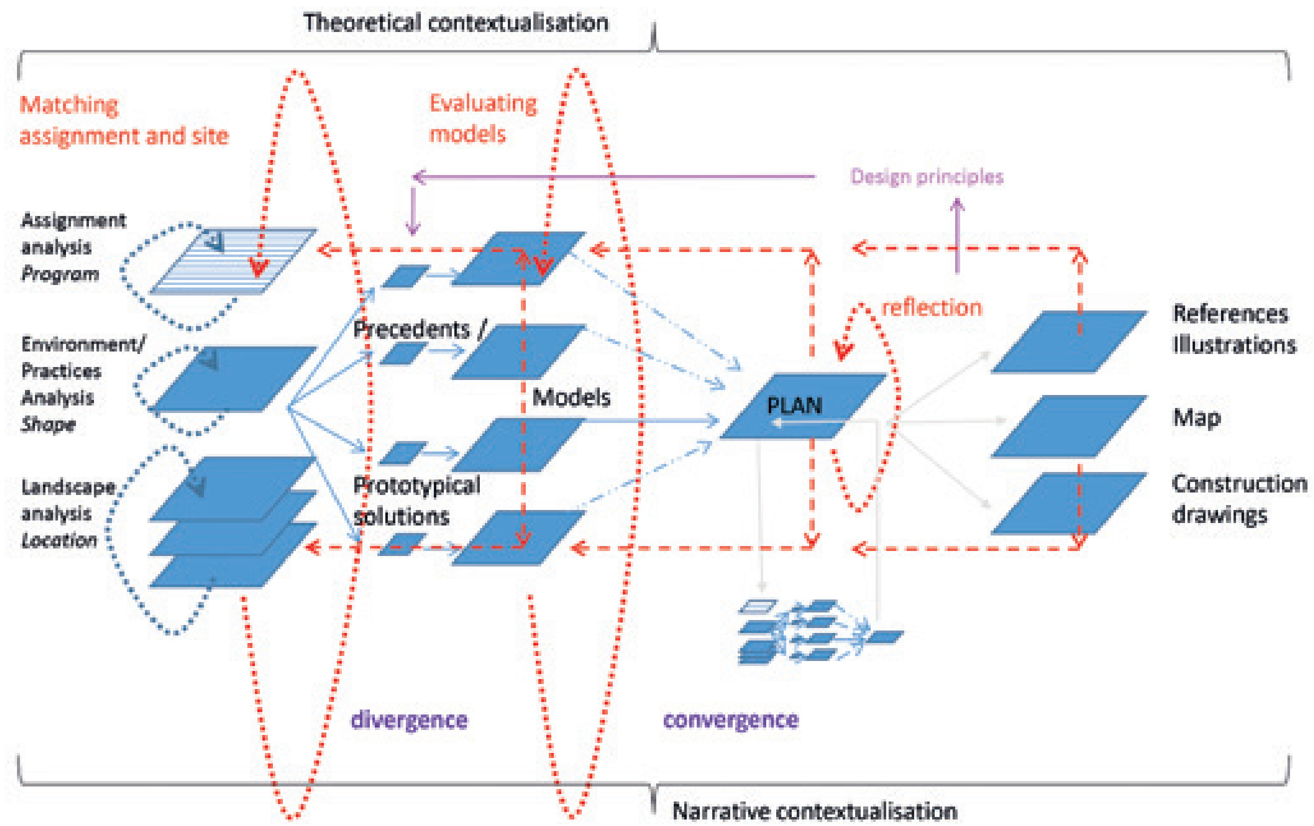
APPENDICES

APPENDIX A: design process model by Rudi van Etteger (van Etteger, 2017)



APPENDIX B: landscape unities table of the Metropolitan region of Amsterdam

Coastal Dunes *(Jongmans et al., 2013)*	The coastal dune area can be divided in three sub-units, The Noordzee coast, New dune landscape and the landscape of sand barriers and plains. The coastal dune area serves as a water extraction area. Fresh and salt ground water meet in the coastal dune areas. Fresh water remains on top of salt water due to the difference in density/concentration. The fresh water lens which developed in the dune area is being used for water extraction.	**Noordzee coast** **New dunes** The New dunes are characterised by irregular relief and semi-natural vegetation. The new dune areas are part of the Dutch nature network and most parts are protected. The New dunes are often divided in three drifting areas. The first phase started in the 9th /10th century. The second phase started from 1500 and the third phase started in the second half of the 18th century. The dunes have always been used by people and this usage influenced the drifting process. There are, besides biking and hiking paths, almost no roads in the New Dune landscape. **The landscape of sand barriers and plains** The landscape of sand barriers and plains is situated more inland compared to the new dunes landscape. Some sand barriers are excavated for Bulb-cultivation. The unexcavated sand barrier landscape are characterized by significant relief. The sand barriers were used for settlement and the landscape is still characterized by 17th century estates with gardens and water features, villages and cities. The older roads in the area are condensed and have a sout-north orientation. The unbuilt areas are mainly covered with (deciduous)forest. The excavated sand barriers (Zanderijgronden) are mostly in use for Bulb-cultivation. The plots are square-shaped and separated by ditches with infiltration water. The plain areas are, compared to the sand barriers, situated on a lower topographical and hydrological level. The lower plains are situated in the east, the higher plains in the west. Ditches with a high water level are characteristic for the plain landscape and the main land use is grassland. Relief, trees and shrubs are almost absent and few roads ensure the connection between the plains and the sand barriers.
Reclaimations *(Jongmans et al., 2013)* *(Berendse, 2011)*	The reclaimed lands of the MRA all used to be water. Some in the shape of former seas and some used to be inner lakes. The basic soil material consists of sand and heavy clay, with some local peat sites. After reclaiming these former seas/lakes, the hydrological situation got regulated by man, causing artificial water level differences, and height levels varying from 2-7 metres below sea level. Because of the fertile sea clay grounds, these new polders were ideal for agricultural land use. In the last century though, more land is used for industrial and residential areas, covering the people overflow from the Randstad (Amsterdam, Rotterdam, Den Haag, Utrecht).	**Reclaimed land from the 17th-18th century** This type of polder consists of the Beemster, Purmer and Wormer. These polders find their origin in small peat-river streams. Though under influence of the wind and sea, these stream became bigger and transformed into fierce lakes. These lakes were connected to the Zuiderzee and threatened to become a huge inner sea. To prevent this from happening, man decided to reclaim these lakes. Dams disconnected them from the sea, and mills were used to pump the water out. The new lands were divided into rectangular plot patterns, accompanied by region-typical farms: stolpboerderij. **Reclaimed land from the 19th century** The Haarlemmermeer used to be a huge inner lake, threatening its surrounding cities with fierce storms. The lake was reclaimed in 1852 by the use of 3 steam engines, named after the polders engineers: Leeghwater, Lijnden and Cruquius. In comparison with older polder reclamations, the plot sizes were much larger: from 4 ha in the old polders to 20 ha in the Haarlemmermeer. These lands were providing a landscape for large agricultural production. The Haarlemmermeer was designed with two big urban cores: Hoofddorp and Nieuw Vennep. **Reclaimed land from the 20th century** Flevoland was the last polder to be reclaimed, finished in 1968. Again we see an increase in plot size compared to the Haarlemmermeer, and a main focus on agricultural land use. Since this polder is still quite new, it is expected to encounter some soil subsidence in the coming years (30-150 cm). Flevoland covers two urban cores: Lelystad and Almere.
Peat areas *(Jongmans et al., 2013)* *(Berendse, 2011)*	The peat areas in the Netherlands can roughly be divided into: - High-peat, situated on sandy soils above sea level, mainly nourished on rainfall. - Low-peat, situated on soils below sea level, nourished by both rainfall and ground water. The latter applies to the MRA. Peat consists of accumulated dead organic material, that is maintained by a stable moisture condition, and starts to decompose when it is exposed to oxygen. Around the 10th century, the Dutch peat landscapes were being reclaimed by its inhabitants. The peat was used as fuel and the lands provided space for agriculture. With this system, oxidation processes were reinforced and peat started to cling. In time, the lands became too wet for agriculture and further drainage would even accelerate the process of cling. Nowadays, these peat areas have little value for agricultural production, and instead, they are covered with grassland for livestock farming.	**River conducted peat (Rivierbegeleidend veen)** This type of landscape can found alongside small peat-river streams, mostly situated below the Noordzeekanaal. The small riverbanks alongside these streams were ideal for settlement, from which one could start the peat reclamation. Over the years, a ribbon of settlement developed alongside these peat-river streams (lintbebouwing), the so called cope-reclamation landscape was created. **Coastal conducted peat (Kustvlakteveen)** These areas used to be former shallow lakes, under influence of the sea. When this marine influence disappeared, landfall arose and peat moss started to grow. A landscape of raised peat domes (hoogveenkoepels) was developed. Around these domes one could find small peat streams, that were used as settlement- and reclamation base. From this edge, parcels were created towards the middle, and highest point of the dome, creating star-shaped allotment patterns. **Wild peat lakes (Petgatenlandschap)** These areas can be found around the Loosdrechtse Plassen on the west side of the Heuvelrug and in Waterland on the North of Amsterdam. They are characterized by their unstructured plot patterns, often under (former) influence of the sea. Part of the plots are still covered with peat and part is dredged. Parts of these wild peat lakes are now in function of nature development, such as the Loosdrechtse Plassen near the Heuvelrug.
The Vecht region *(Venster op de Vecht, n.d.)*		**The Vecht and its levees** The Vecht meanders in curves from south (Utrecht) to north (Muiden) though wet peat areas. The landscape on the river banks is diverse. Country houses, forest areas, farms, orchards and estates and castells are situated on the levees: the natural dikes along the river (The Vecht is a former branch of the Rhine and the levees are the result of the sedimentation process). If you follow the Vecht from South to North you can experience the difference between the 'Heren- en BoerenVecht'. The higher levees offered a solid foundation for buildings in comparison to the wet peat areas around the Vecht. The levees in the south are wider compared to the levees in the northern part of the Vechtregion (due to the sedimentation process). The southern levees were thereby more attractive for settlement compared to the smaller northern levees. **Vechtweide / Former Flood baisins** A bit further from the Vecht, the landscape transforms from levee into 'Vechtweide', the former flood basins. The Vechtweide is an open landscape that consists of fertile meadows characterised by deep, narrow ditches and rows of willow trees. The fertile clay meadows are used for agriculture purposes, mainly livestock farming. The areas with the deepest ditches are also used to grow corn and grains and there are also a few large orchards in the Vechtweide. There are almost no farms in the Vechtweide, those are located on the higher levees.
The Heuvelrug *(Jongmans et al., 2013)* *(OKRA Landschapsarchitecten B.V., 2010)*	The Heuvelrug is a push moraines landscape that developed during the penultimate glacial period, almost 150.000 year ago. Enormous glaciers moved from Scandinavië towards the Netherlands and pushed sand and gravel soils departed by rivers forwards. The glaciers disappeared but the stowed material, mixed with boulders and firestones from Scandinavië remained. The Heuvelrug is an outstanding landscape unit due to the relief and the contrast between the relief and the lower, open, flat landscapes in the surrounding. The Heuvelrug is mainly covered by forest, mixed with heathland, marshes and drift sand areas. The area is an important part of the Dutch nature network. The Heuvelrug is mainly situated in the Province of Utrecht, only a small part belongs to the Province of Noord-Holland. The Heuvelrug is of great importance for the Province of Noord-Holland as it ensures 1/3e of the Amsterdam drinking water stock (extracted in Bethunepolder). Ground- and excess water flow through the sandy soils towards the Vechtvallei and feeds the peat areas and lakes in the eastern part of the MRA.	**'t Gooi** 'T Gooi is the most northern part of the Heuvelrug. This area is essentially a small, flattened sand ridge, covered with closed forest areas, wide open heathlands and extended build areas. The transitions between build areas and forest areas are fluent. Roads are spread out over the area in radial shapes starting in the build areas. **de 'Laagten' (The lower parts)** 'De Laagten' is essentially a forest area with three hills surrounded by lower areas. Build areas are situates on the slope of the hills. The lower parts consists of wide, open grasslands with an elongated shape. The 'Laagten' is also known as an area with estates and manor houses with canals and water features. The estates and manor houses are located at the borders of the lower parts.
Urban area	Within the urban areas we find mainly residential functions. Around this, mainly situated alongside the Noordzeekanaal and highway constructions, we find (harbor)industry. Also, within the MRA some big urban recreational sites can be found, such as: Amsterdamse Bos, Westeinderplassen, Sloterplas and the Brettenzone.	
Water defence lines *(Provincie Noord-Holland & Liniebreed ondernemen, 2018)* *(Provincie Utrecht et al., n.d.)*	In the area surrounding Amsterdam we find the "Stelling van Amsterdam," a Dutch water defence line of 135 km, build within 1880 and 1914. Everywhere alongside the defence line, water locks, canals, dikes and military fortresses can be found. In times of military threat, these constructions were used to flood the surrounding polders to about 40 cm knee-height and change the lands into a swamp. In 1996 the stelling was placed on the UNESCO list of world heritage. Because of the former defence purpose, it was not allowed to build around the fortresses and dikes. Therefore a beautiful open landscape arose alongside the defence line. Nowadays, the 'stelling van Amsterdam' forms a popular recreation route with attractive landscapes and multiple activities. In the east side of the MRA, alongside the Utrechtse Heuvelrug, one can also find parts of the old (1672) and new (1815) Dutch water line (oude- en nieuwe Hollandse waterlinie). Same as the "Stelling van Amsterdam," this defence line is accompanied by multiple fortresses and inundation lands, this time surrounded by the "Vecht". Also some castles and characteristic fortified towns can be found.	**Stelling van Amsterdam** **New Dutch Waterline**

APPENDIX C: Field notes excursion Haarlemmermeer 04-04-2018

Excursie Haarlemmermeer 4 april 2018

Deelnemers:
Yvonne Lub - PVA
Barbara Luns - PVA
Kathrin Hannen – erfgoed Haarlemmermeer k.hannen@umail.leidenuniv.nl
Vrijwilliger - NMCX
Dirk Wascher – WUR employee
Merel Gerritsen – WUR student
Isabella Hol – WUR student

Route

Park 2020 – cradle to cradle businesspark – Schiphol area development

Erfgoed boerderijen; diversiteit aan boerderij-typologieën
http://www.park21.info/sites/default/files/pictures/1225-p21_beeldkwaliteit_polder_19-03-2015_ebook.pdf

In Haarlemmermeer komen veel verschillende boerderijtypen voor. De pioniers die zich hier na de drooglegging uit alle delen van Nederland vestigden, bouwden hun boerderij vaak in de traditionele stijl van de streek waaruit zij afkomstig waren. Deze typen waren overigens niet altijd het meest geschikt voor de bedrijfsvoering zoals die in de polder nodig was. Naast de originele types komen dan ook aangepaste boerderijtypen en mengvormen voor.
Structuurvisie Haarlemmermeer 2030 - H1 Kenschets Haarlemmermeer; uitgangspositie 2012
https://hoofddorp-centraal.nl/participatie/wp-content/uploads/2014/11/Structuurvisie-Haarlemmermeer.pdf

Tussenstop Hoeve de Vogel
circulaire expo – Guide Braam https://haarlemmermeergemeente.nl/file/3089/download
Food Union – Pepijn Rijks
https://crowdaboutnow.nl/campagnes/foodunion?crowdfundmarkt=0818E3D0-6488-43BC-B9CD-A2FFE1483323
Oesterzwammen – Marleen Sijpestijn https://www.linkedin.com/in/marleen-sijpestijn-9a206645/

Tussenstop Landgoed de Olmenhorst
https://www.olmenhorst.nl/het-landgoed/welkom.html

De bezoekers van dit landgoed komen vanuit de grote steden (Rotterdam, Amsterdam Den Haag) om hier te recreëren, veel bezoekers hebben een eigen fruitboom geadopteerd.

Park 21
Kleine delen nu gerealiseerd maar de deelnemers verwachten dat de plannen gaan veranderen wanneer de ontwikkeling dit jaar niet verder gaat.

Hoofddorp
Binnen in deze Vinex wijken heeft iedere straat en/of blok zijn eigen identiteit, buiten de bebouwde gebieden is de samenhang tussen de verschillende identiteiten klein en vormt het een verwarrend geheel.

Stelling van Amsterdam – Fort Aalsmeer
Genie dijk
Dijk nog niet optimaal benut.

Rijsenhout
Geen groei meer mogelijk door restricties Schiphol
Nieuwe kassencomplexen en leegstaande kassencomplexen (Frames en puin)
Gemiste kansen aansluiting Westeinderplassen

Schiphol Rijk
Industrie dorp door geluidsrestricties Schiphol geen woningbouw

Sugar factory, station Halfweg http://www.sugarcityevents.com/nl/

Fruittuinen van West http://fruittuinvanwest.nl/

Wat roept de Haarlemmermeer bij ons op?

Chaos – Infrastructuur – Vliegtuigen – Schiphol – Geluid – Zicht – Vliegtuigen – Decibel zones _ Spookstad Schiphol Rijk – Bedrijven en ondernemerschap – Diversiteit – Landbouw – Uien – Aardappelen – Oesterzwammen – Olifantsgras – Biologisch vs High Tech teelt – Experimenteel – Verstopt erfgoed – Stelling van Amsterdam – Boerderij typologieën – Vinex – Ringvaart – Inpoldering – Restruimte – Vergeten Rijsenhout

APPENDIX D: Field notes excursion Haarlemmermeer 01-05-2018

Excursie Haarlemmermeer 1 mei 2018

Deelnemers:
Pieter Boone – WUR employee
Merel Gerritsen – WUR student
Isabella Hol – WUR student

Algemene opmerkingen/constateringen

- Kassen zijn tegenwoordig dicht voor lichtvervuiling (Pieter)
- Modellen schetsen en strategie kiezen (Pieter)
    - Haarlemmermeer grote schaal (park21 formaten)
    - Schiphol
    - Randkernen
    - Kleine initiatieven kunnen uitgroeien
- De mix van verschillende vormen van voedsel productie distributie etc. naast elkaar zetten en deze mix gebruiken voor de visie. Waar kijk je naar om deze mix te verdelen? Is dat bijvoorbeeld de grondprijs? (Pieter)
- De schaal waarop je nadenkt is niet perse de schaal waarop je gaat ontwerpen, die vrijheid moet je nemen. (Pieter)
- Wat wil ik laten zien. De diversiteit van voedsel en voedsellandschappen binnen de Haarlemmermeer is interessant. (Merel)
- Wat Florian nodig heeft is een teelt kalender om het hele jaar mensen te trekken (Pieter)
- Dancing with the antropy (Adriaan Geuze en Matthew Skjonsberg)
  "Finding inspiration and drive in the chaos and fragmentation of today's world, Adriaan Geuze and Matthew Skjonsberg of West 8 have developed an approach that they refer to as 'radical contextualism'. This requires not only a respect for reality and existing conditions, but also an openness to multiple layers of meaning and a wide variety of inputs, whether historic, cultural, anecdotal or even random. Giving themselves over to evolutionary entropy, they work with ingenuity with whatever they encounter."

- Merel mailt Petra Kort van de gemeente en bureau Loos van Vliet
- Isabella mailt podium voor architectuur, Kathrinn en stuurt een herinnering naar Dirk en zijn collega's

Gesprek met Florian de Clerck van landgoed de Olmenhorst

- Veel boeren in de kern van de Haarlemmermeer willen steeds groter en groter maar daarin gelooft Florian al heel lang niet meer. Aan de mogelijke groei zit een einde en dat betekend voor veel boeren ook het einde. Aan de rand van de Haarlemmermeer zitten veel specialisten die voortbouwen op kwaliteit en identiteit.
- Ze zijn 25 jaar geleden begonnen met het zelfpluk concept.
- De randkernen in de Haarlemmermeer voelen zich vergeten. De opbouw van de Haarlemmermeer verklaard dit gedeeltelijk. De randkernen waren oorspronkelijk veel gericht op alles wat buiten de Haarlemmermeer gebeurde en daardoor ook wellicht een beetje vergeten. Dit 'vergeten worden' voedt het 'kalimero effect'.
- De Haarlemmermeer heeft twee kernen. Hoofddorp hoorde in de eerste plannen bij Noord-Holland en Nieuw Vennep hoorde bij Zuid-Holland. Al snel kwamen de plannen makers er achter dat het zo niet ging werken en werd de Haarlemmermeer één geheel.
- De diversiteit en variatie binnen de Haarlemmermeer maakt deel uit van de identiteit. Florian zit dit als een kans, je kan van elkaar leren en elkaar aanvullen. Het wordt soms echter ook als probleem gezien omdat het conflicten en onenigheden zou opleveren, men zou niet met elkaar kunnen praten door de verschillen.
- Turfspoorweg is één van de twee niet rechte wegen in de Haarlemmermeer. Deze twee wegen horen bij het oude land.
- Florian heeft, toen de markt niet goed functioneerde, besloten om een directe band met de consument aan te gaan. Zo ontstond het zelfpluk concept. Zelf ziet hij het adoptieboom concept als de baby van de Olmenhorst. 7% van de bomen wordt niet (op tijd) geplukt. Hij denkt dat hij ook nog wel een versie begint voor mensen die niet zelf in staat zijn om te komen plukken maar wel een boom willen adopteren, hier is hij tot nu toe nog niet aan toe gekomen.
- Het gaat Florian niet alleen om het plukken. Hij probeert zijn gasten vaker per jaar te trekken zodat zij de cycli van een fruitboom meekrijgen. Hij heeft de ambitie om zijn gasten mee te nemen in het groei en bloei proces en hoopt dat zij hiervan leren. Florian vind het erg dat jongeren niet meer weten waar een appel vandaan komt, dit maakt volgens hem niet vanzelfsprekend deel uit van hun leefomgeving.
- Florian speelt met zijn landgoed slim in op de markt, wanneer hij een kans ziet dan speelt hij daarop in en wanneer iets niet loopt dan past hij het aan. Zo is nu ook de winkel kleiner geworden en het café groter. Florian ziet zijn landgoed als bedrijf met vijf takken : Biologische fruit productie, detailhandel (winkel, bedrijven), groothandel/retail (Olmenhorst sap in supermarkten), Horeca en evenementen.
- De ligging, precies tussen Amsterdam en Den-Haag, is een cadeautje.
- Binnenkort wordt de appelparade georganiseerd.
- Het 'Olmenhorst gevoel' : Koesteren wat goed is van het verleden en van de natuur.
- Zonder Bottom-up steun krijg je niets voor elkaar.
- De trend van het verbonden zijn met voedsel gaat door en daardoor neemt de potentie toe voor nieuwe vergelijkbare initiatieven.
- Florian is van plan om de vroegere gronden, die ooit deel uitmaakten van de Olmenhorst, weer te kopen.
- In de toekomst kan de Olmenhorst gezien worden als parel in geprojecteerde ecologische-zone of wellicht als veredeld stadspark. Dit maakt Florian niet uit zolang hij maar ruimte houdt om door te ontwikkelen en het karakter er niet door verloren gaat. Er is in de Haarlemmermeer al veel verprutst en Florian wil er voor zorgen dat de volgende generatie niet over zijn schouder terugkijkt en denkt.. waar is het mis gegaan met de Olmenhorst..
- Grondprijs plan (300 euro voor een vierkante meter bij Rijsenhout, 9 euro voor een vierkante meter bij de Olmenhorst).
- Florian heeft goed contact met de eigenaar van de Fruittuinen van West en met de eigenaar van de Arendshoeve die dichtbij Rijsenhout ligt. Deze initiatieven kunnen goed naast elkaar bestaan, de markt vraagt er naar en de initiatieven vertonen overeenkomsten maar zijn toch ook heel verschillend.
- Klanten komen uit heel Nederland. Een vrouw komt uit Breda omdat ze de Olmenhorst ziet als een dagje uit, er is meer te doen dan alleen fruit plukken. Mensen uit Culemborg doen elkaar een boom cadeau.
- Laat je niet verleiden tot een te grote schaal. Het is realistischer om kleiner te beginnen.
- We mogen Florian mailen als we verder nog vragen hebben . florian@olmenhorst.nl

APPENDIX E: farm list Haarlemmermeer (van Diemen & Floris, 1987; Google, 2019)

Street	Nr.	Farm name	Type of farm
Kromme Spieringtocht/weg	74	Maria's hoeve	
	171	De Eersteling	
	208	Jacobshoeve	Zeeuwse veeboerderij
	253	Abramina's hoeve	
	298	Vlijt en Zegen	
	357	De Pol	
	* 402	De Dageraad	
Spieringweg	* 536	Schapenburg	
	762	Hoeve Outeren-Heerd	
	801	Curquiushoeve	
	880	Vrede-best	
IJweg	175	Ruimzicht	Zuid-Hollands
	264	Lammertsland	
	373	Voorzorg	Stolpboerderij
	486	Margarethahoeve	
	513	D'Yserinckhoeve	
	686	Hoeve klein Wiltenburg	
	716	Hoeve Wietesteyn	
	760	Mariahoeve	Stolpboerderij
	821	Beers hoeve	Stolpboerderij
	* 921	Commandeurshoeve	Zuid-Hollands met koetshuisje
	943	Meerzorg	
	951	Mendelhoeve	
	1013	Louisa hoeve	Haarlemmermeers type Gronings type schuur
	* 1071	Stad Zaandam	
	* 1092	Onze lust	
	1124	Bornholm	Rentenierswoning, verwijst naar eiland in Denemarken
	1255	Hoop op zegen - Kerstboomboerderij	
	1284	Elisabeth's hoeve	
	1316	Arie Cornelis hoeve	
	1364	De Knap	Stolpboerderij
	1391	Allegonda's-hoeve	
	1455	Luctor et Emergo	
	1517	Acht is meer dan duizend	Friese stolpboerderij
	1716	Klein America	
		Zelden rust	Noord-Hollandse stolpboerderij
		Hoeve Eben Haëzer	
Hoofdvaart/weg	18	Land en Veelust	
	69	Nooit gedacht	
	95	Hoeve Weilust	Noord-Hollandse stolpboerdeij
	151	Nieuwerkerk	
	152	Hazerswoude	
	204	Dorp Zwaag	Stolpboerderij
	205	De Meijerij	
	* 322	Boomkamp	
	440	Peking	Zuid Hollands
	470	Adolfs hoeve	
	481	Harstee	Herenboerderij
	493	Cornelia's hoeve	
	516	Volharding	

	523	Genoegen baart rust	Noord-Hollandse stolpboerderij
	* 743	De witte hoeve	Kop-rompboerderij
	817	Zorg en Vlijt	
	* 836	Henderikskamp	Zuid-Hollands
	* 878	Den burgh	
	983	T Klaverblad	stolpboerderij
	1040	Hoop op zegen	Noord hollandse stolpboerderij
	1041	Kleine Vennep	Kop rompboerderij
	1061	Marianne Hoeve	
	1236	Hoeve Livorno	
	* 1327	Margaretha's hoeve	Noord-Hollandse stolp met rietendak
	1428	De Brecht	
	* 1666	Vondels landleeuw	Limburgs model (met één kant open)
	* 1695	De Meerhof	
	* 1741	Andreashoeve	Zuid-Hollands langhuis met een zomerhuisje
	1797	Kaagermeer	Zuid-Hollands met een fraai overstek en zomerhuisje
	1810	Beets grote plas	Legmeer type met kelder en opkamer
Kagertocht/kaagweg	153	Antjes Hoeve	Stolpboerderij
Sloterweg (Rijnlanderweg)	* 347	Badhoevedorp	
	751	Voortwaarts	Stolpboerderij
	795	Hoeve s'Hertogenbosch	
	878	Den Burgh	
	916	De Vogel	
	1144	Gras-Wijk	
	1185	Weltevreden	
	1261	De Postiljon	
	1274	Sloterhof	Model dat voorkomt in de weidegebieden langs de lek en de maas
	1321	Canton	
	1430	Graanlust	
	1474	Adrianushoeve	
	1489	Rientjeshoeve	Zuid-Hollands
	1547	Adriana hoeve	
	1663	Hoop vlijt de landman	
Slotertocht (Rijkstocht)			
Aalsmeerderweg	577	Arnoldushoeve	
	617	Bouw-lust	
	640	De Rijsenhof	
	655	Jacobahoeve	Zuid-Hollands model oud-hollandse dakpannen en geglazuurde tuile du nord dakpannen
	755	Anna's hoeve	
	779	Maria hoeve	
	883	Hoop doet den landman leven	
	903	Neltsehoeve	
	933	Teding's Hoeve	Brabantse boerderij
Vijfhuizerdijk	73	Veelust	
	137	Antonia Maria's hoeve	
	761	Aurora	

Kruisvaart/weg		Mentzhoeve	Limburgse boerderij (gebouwen rond binnenplaats)
Bennebroekertocht/weg	98	Beleid met Vlijt	Zuid-Hollands
	165	Overleg alles	Noord-Hollands/Zuid-Hollands
	521	Hillegonds hoeve	Zuid-Hollands
Vennepertocht/weg	65	De Ruigenhoek	
	150	Bouw en weilust	
	261	Modjo Rawah	
Molenweg	109	De Nachtegaal	Gebroken kap
Lissertocht/weg	* 485	Boerderij Olmenhorst	
Lisserdijk	121	Roosenhoff	
Grote Poellaan	23	In goede aarde/boerderij rijsenhout	
Hillegommerdijk	260	Mary-land	
	154	Canada hoeve	
Kaagweg	107	Mariënhoeve	
	117	Ariaantjeshoeve	
	135	Kaagse koe	
Turfspoor	196	Hoogendorps Grondwet	
Weteringweg	35	De Herfst	Zuid-Hollands
	57	De Zomer	Zuid-Hollands
	113	De lente	Zuid-Hollands
Huigsloterdijk(ringvaart)	328	De Korenbloem	
Middelweg		Nelia's hoeve	
Cruquiusdijk	* 54	Cruquiushoeve	
Marktplein	* 31	Marktzicht	
Julianalaan	* 46	Voormalige landbouwschool	

* Municipality monument

Semi-structured interview with storyteller Anne van Delft August 2018

Anne van Delft is a Dutch professional storyteller. She tells stories, teaches in this work field, directs story tell theatre and organizes workshops on storytelling. In honor of the Ringbiënnale (a frequent festival in the Haarlemmermeer) on the 17th and 18th of September 2016, Anne van Delft was invited to guide a workshop 'de aardappeleters' based on food stories from Haarlemmermeer's inhabitants.

The workshop was announced as follows:
"In Haarlemmermeer kom je veel verhalen over voedsel tegen die er allemaal tegelijk en vlak bij elkaar zijn. Met wie zitten we aan tafel? Wat eten we? Waar komt ons eten vandaan? Voor welk eten zorgen we in Haarlemmermeer? Hoe doen we dat met arm en rijk? Een streekproduct is niet alleen een lekker kaasje in een leuke verpakking. Het is het resultaat van samenwerking in je omgeving, tussen boeren, burgers, bedrijven, natuur en landschap. Elke gespreksronde heft andere vertellers, maar steeds is er die typische Haarlemmermeer-combinatie van de kleine en de grote schaal" (van Delft, 2016).

In August 2018 I organized a phone call with Anne van Delft to ask her more about this workshop, the stories she collected, the most striking outcomes, the atmosphere she experienced and about her vision on food in the Haarlemmermeer. Since this phone call can be defined as a semi-structured way of interviewing, it does include a strict interview-protocol nor recordings. After this interview, Anne send me some of the stories from the workshop, adding to her answers and enriching it with lively quotes (van Delft, 2016; van Delft, 2018).

In the first part of the interview I asked Anne about more general matters considering the food landscape in the Haarlemmermeer:

- *With the knowledge you gained from the 'aardappeleters' workshop, what image did you get from the role of food in the Haarlemmermeer?*
- *Did you notice differences between the polders core and its edges?*

Anne speaks about three different, consecutive scale levels within the polder
- The original scale of the Haarlemmermeer with its edges and core. In this scale we find the original purpose of the polder: to produce food. This happened on the farms, often owned by rich men (herenboer), employing servants from villages on the polder's edge. Due to the great variation in farmers origins from all over the Netherlands, the Haarlemmermeer reflects the country in the different farm typologies. Though the farmers were not the only ones producing food, as most of the polders inhabitants owned a (small) vegetable garden. In this way most of Haarlemmermeer's inhabitants had a close connection with the food they would consume; an *agricultural awareness.*
- The scale of the Haarlemmermeer, in relation with its surrounding cities, and structures such as the Geniedijk, part of the 'stelling van Amsterdam.'
- The scale of the big supermarkets such as Albert Heijn. Certain companies provide good acces to food from all over the world, though often neglecting the food that is produced just around the corner.

Due to these changes in scale, the landscape got fragmented and suffers from a lack of legibility.

- *In what way were Haarlemmermeer's original farmers related to food? Were they aware of the types of food that were produced in their surroundings?*

Back in history, the farmers of the Haarlemmermeer had a much bigger agricultural awareness (agrarisch bewustzijn). In the centre of the polder, people often owned their own farm, including a small vegetable garden for the household. In the edges of the polder, much of the agricultural workers lived. These houses were often also accompanied by small vegetable gardens to provide these families with fresh food. Cycles of food production and harvest were more visible due to the season-employees.

A story of the workshop 'aardappeleters': Marianne den Breejen van Duren
This woman tells about the big vegetable garden alongside their house in Lynden around 1949. As a kid she used to help her father with this garden, by sowing and by processing the fresh fruit and vegetables (blanching, canning and freezing).

"Ik heb later moeten leren om een hobby te kiezen. Wij hadden nooit hobby's, er was werk te doen. Wat is spannend aan een tuin? Het groeien!" (den Breejen van Duren, 2016)

Elly Bruijnestein & Kiki Blom
These woman remember food in the Haarlemmermeer as a very valuable contribution to the survival of their families during world war II. As Elly's dad smuggled grain from Haarlemmermeer to their home in Amsterdam. *"Omdat vader in Haarlemmermeer graan was gaan halen, kwamen wij de oorlog door"* (Bruijnestein, 2016). And Kiki's mom took her to the Haarlemmermeer to ask for food at the fence of the farmer: *"Ik herinner me dat ik in de wandelwagen met mijn moeder de Haarlemmermeer in ging. Er stond een rij mensen voor het hek van de boer"* (Blom, 2016).

- *How is this relationship consumer-producer in current times?*

Currently people are way more individualistic and there is less connection with the food production origin of the polder as most food that is consumed comes from large scale supermarkets.

A story of the workshop 'aardappeleters': farmer Martin van der Peet
The milk that is produced on the farm of farmer Martin is goes to the cooperation Campina, and is transported all over the world. As baby milk powder to Chine or as desserts to Russia?
Wat ze er van maken of waar het heen gaat weet ik niet?" (Van der Peet, 2016).
What they make out of it, or where it goes is a question to Martin. His farm is in the family for generations. In the beginning it was a mixed company, as it often was in those days. Later, other farmers have become arable farmers, and Martin has become a cow farmer."

- *Is there a counter-reaction taking place in the Haarlemmermeer to introduce more sustainable ways of farming and more close relationships between consumer-producer?*

There are a few larger companies with biological products such as estate 'de Olmenhorst' and some organic farmers that work for the Dutch market (meerboeren.nl) . Though most of these emerging movements are often very small and it is difficult to compete with large scale companies. People in the Haarlemmermeer need to get more aware of their surrounding regional food landscape. Some of these sustainable, food-aware projects that emerge in the Haarlemmermeer are further explained by stories from the workshop 'aardappeleters':

Farmer Paul Bos
Paul owns a sheep herd that is grazing on the Geniedijk. With these sheeps Paul delivers wool for felt makers in the Haarlemmermeer, meat for local restaurants and he provides maintenance on the Geniedijk. Paul is also in contact with Schiphol to talk about the relationship with the airport and agriculture in the Haarlemmermeer. As he mentions, regional products are not just a nicely wrapped food product, but rather a result from collaboration. *"Een streekproduct is niet zozeer een mooi ingepakt kaasje als wel het resultaat van samenwerking"* (Bos, 2016).

Employees at Voedselbank Haarlemmermeer Hans de Bats & Ria Barendregt
Hans works for the Voedselbank Haarlemmermeer through which he tries to make healthy food accessible to all. At the Voedselbank they try to search for 'failed' harvests to divide amongst people who need it. In the Haarlemmermeer this results in food-packages that are filled above the national average. *"In Haarlemmermeer zijn de kratten van de voedselbank beter gevuld dat ergens anders. Een huishouden krijgt hier twee kratten per week"* (de Bats, 2016). 10% of the food in the packages originates from the direct region within the Haarlemmermeer (Barendregt, 2016).

Initiator local shop 'van fair en dichtbij' Antonina Sardaro
Antonina founded the driving shop: 'van fair en dichtbij' which sells food from within the region of the Haarlemmermeer, and other fairtrade products. She started this project because asked herself why we would buy vegetables from distant countries, while they are produced at our neighbouring polder grounds? She wants to make people aware of their lifestyle and tries to make this more conscious. "waarom kopen we hollandse groente -zoals wortels - uit Egypte als ze hier vers vanuit de poldergrond komen?" (Sardaro, 2016).

Initiator shared public meals Anneke van der Helm-Chandansingh
There is a lot of loneliness amongst one person households, which also results in less joy in the habit of eating. Also in the Haarlemmermeer this social aspect of food shows presence as Anneke van der Helm- Chandansingh explains: *"In de Haarlemmermeer eten de mensen vooral met hun gezin. Maar er zijn heel veel mensen die alleen zijn komen te wonen. Zo is er de postbezorger, de weduwe, diegene die bij de KLM heeft gewerkt, we zitten allemaal samen aan tafel. Ik wil dat er meer eettafels komen in Haarlemmermeer" (Van der* Helm- Chandansingh, 2016). Therefore, Anneke organizes shared meals for people in the Haarlemmermeer who would otherwise eat alone. Through these meals, she brings people together and introduces them to sustainable regional products. *"Ik wil ook anders eten. Nieuwe dingen aanbieden, duurzaam eten, ik zou ook graag meer producten uit Haarlemmermeer verwerken. Van kennissen, of overschotten of wat dan ook" (Van der* Helm- Chandansingh, 2016).

- *(How) Did you experience the influence of Schiphol in the Haarlemmermeer?*

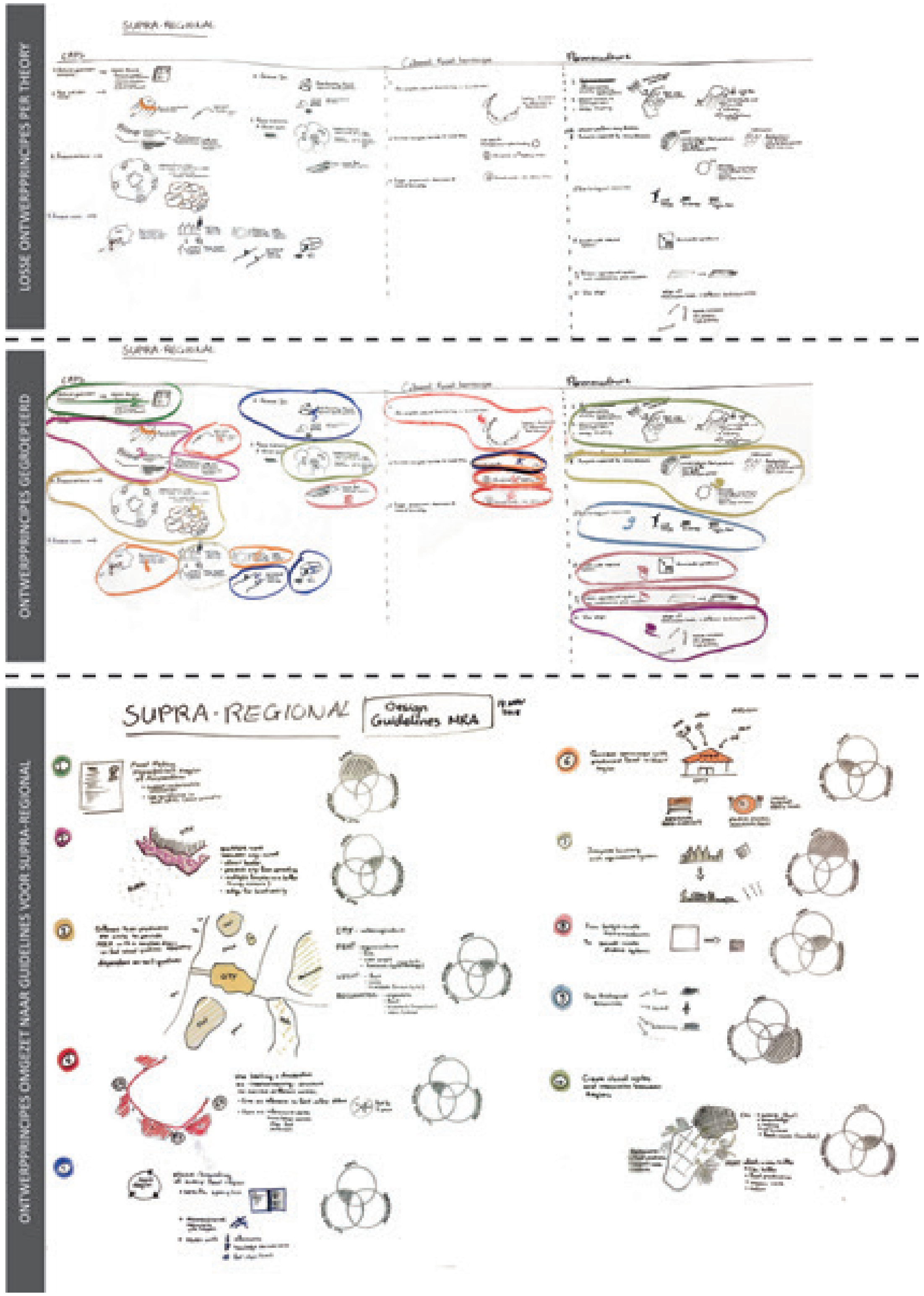
Schiphol's influence in the Haarlemmermeer is enormous. This is visible through Schiphol's dominated land use, the choice of crops around the flight strips (e.g. olifantsgras), but also through their integration in small scale initiatives (through boards or sponsoring) they are strongly integrated into the society of the Haarlemmermeer.

A story of the workshop 'aardappeleters': former employee at Schiphol Marga Zurburg
As Marga worked for many years at the airport Schiphol, she got to know different types of food, through her international colleagues. During lunchbreaks, people from different cultures such as Surinam's, Indonesian, Pakistan's and Eritrea's brought food from their originating country. Often this food was shared and new dishes were introduced to Marga: Food connects! ('voedsel verbindt!). *"Het werkzame leven op het "Metropolische Schiphol" met al die verschillende eetculturen heeft van mij een rijk mens gemaakt en met alle buitenlandse reizen die ik maakte een gelukkig mens, waarvan ik de vrijheid als vrouw elke dag weer omarm"* (Zurburg, 2016).

- *What is your vision on the future of food in the Haarlemmermeer?*

A lot of food arrives by planes at Schiphol, and in the same time there are farmers around Schiphol in the Haarlemmermeer who produce for the world market. It would be good if the food production in the Haarlemmermeer would shift towards more biological ways of farming, taking into account the soil and the environment, and produce for the local market. Same as for example, farmer Paul Bos advocates. With the local market I do not just mean people who live in the Haarlemmermeer and Amsterdam, but also all those people who eat at Schiphol, on the planes, and in the companies around Schiphol. For farmer Paul Bos, the production of agriculture is not just the physical product but also the wisdom and beauty that agriculture brings and from which people can learn a lot. An interesting audience to for this 'learning around food' are people who work in the many companies on and around the airport Schiphol. Especially in the East of the Haarlemmermeer you see so many of these business employees making a detour in their lunchbreak, a phenomenon that can be anticipated upon.

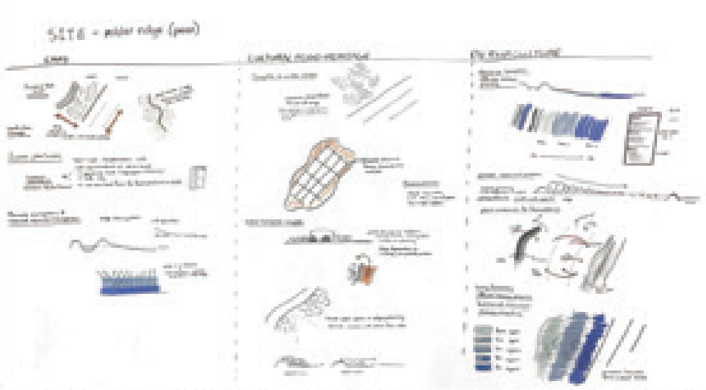
APPENDIX G1: design guidelines process supra-regional: Metropolitan region of Amsterdam



APPENDIX G2: design guidelines process regional: Haarlemmermeer

APPENDIX G3: design guidelines process site: component 'polder edge' in the Haarlemmermeer

LOSSE ONTWERPPRINCIPES PER THEORY



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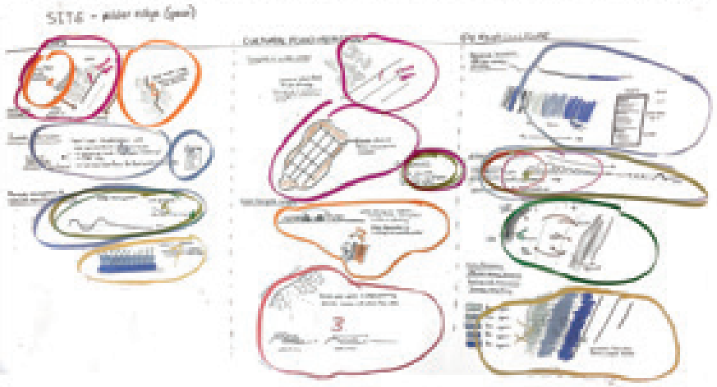
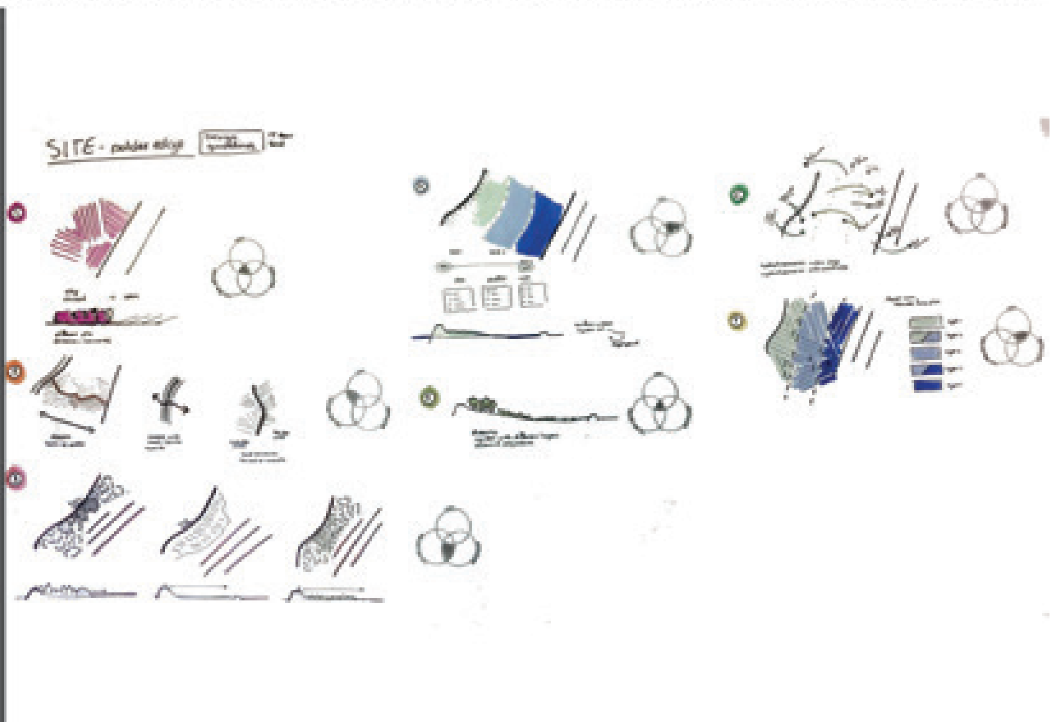
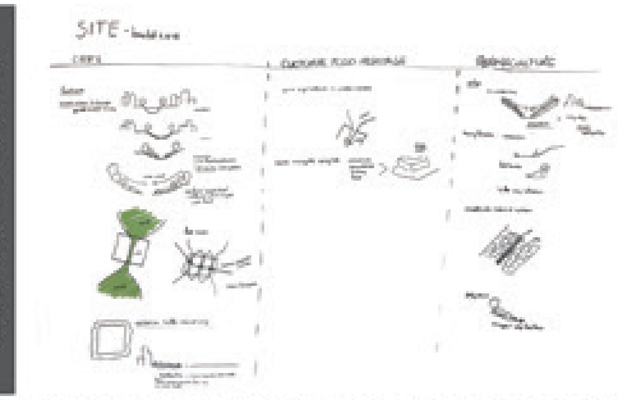


ONTWERPPRINCIPES OMGEZET NAAR GUIDELINES VOOR SITE - edge polder



LOSSE ONTWERPPRINCIPES PER THEORY



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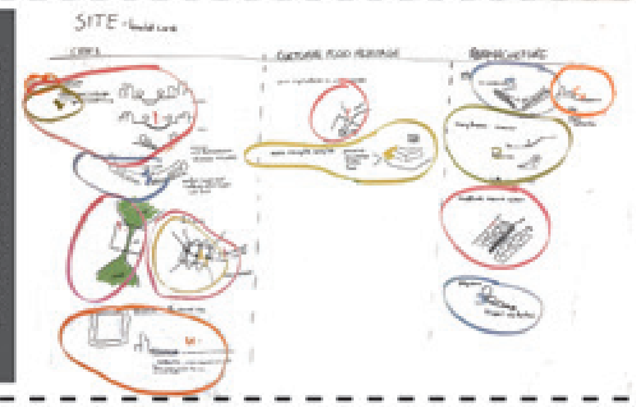
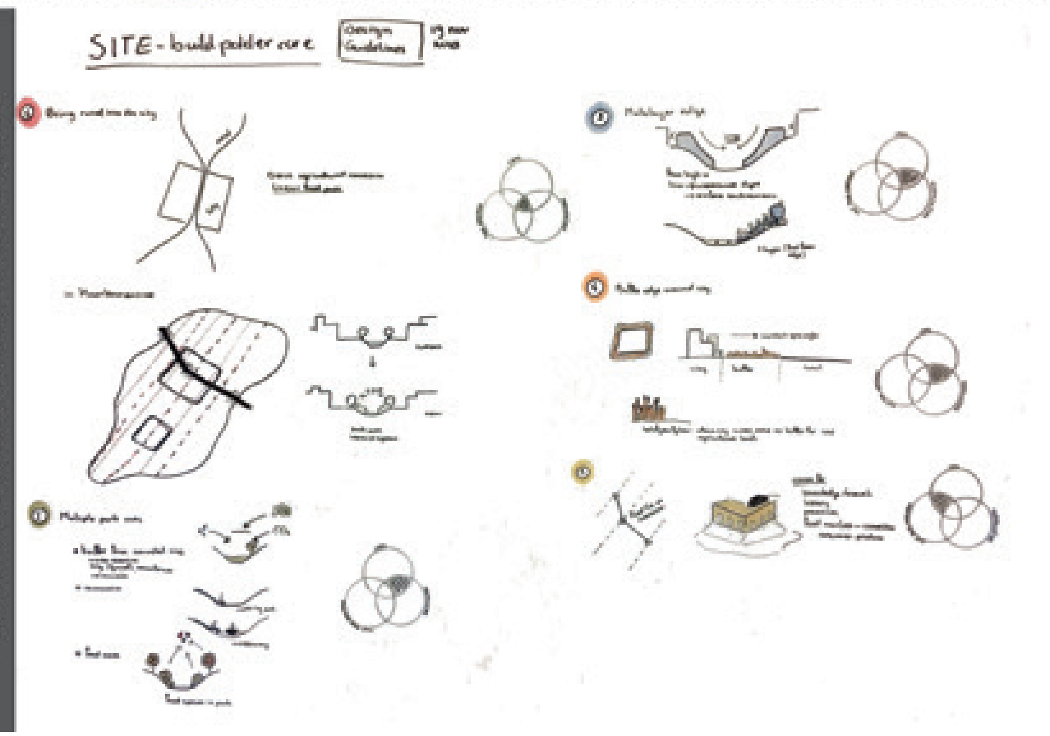
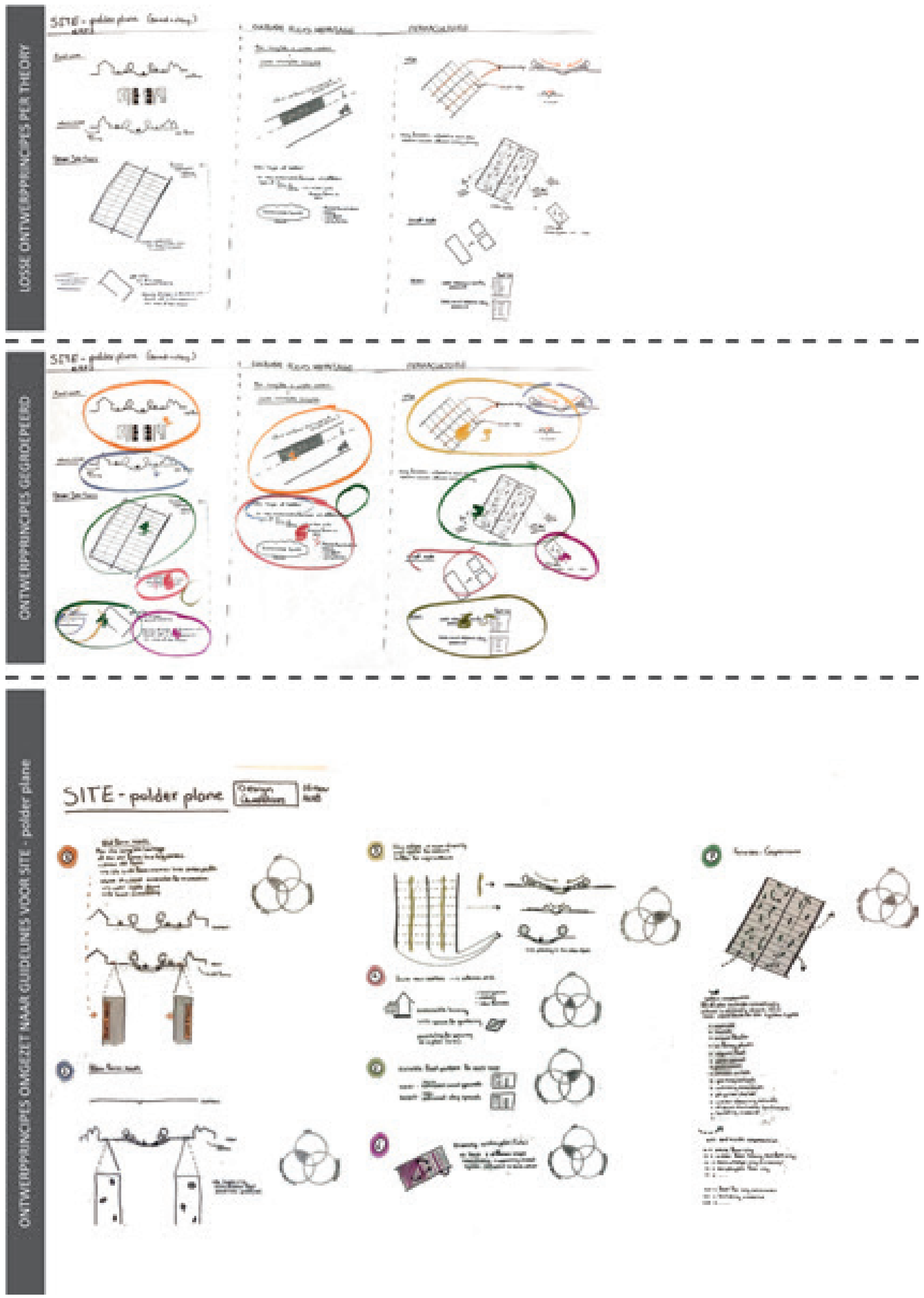


ONTWERPPRINCIPES OMGEZET NAAR GUIDELINES VOOR SITE - build core





APPENDIX H: specie index for plant matrix

Specie Index

sources: (Ottenburg et al., 2013), (PFAF, 2012), (van Rijsselberghe, 2018), (Permacultuur Nederland, 2018), (Fern, 1997), (van Dam et al., 2007), (Appleton et al., 2015)

Sandy grounds (most salination) > 2 mm per day

Specie (Latin/English)	Shape *(aquatic, climber, root vegetable, creeper, herbaceous, shrub, tree)*	Life style + harvest *(annual/perennial)*	Habitat *(wet, moist, dry)*	Uses *(Human food, animal food, soil improvement, site protection, building material, energy production, insect control, pollinator, etc.)*
Acer pseudoplatanus - sycamore maple	tree 30 m	perennial – flower: April-June seeds: September-October	light sand – heavy clay well drained, moist soil tolerant for maritime exposure	human food: maple (trunk), sweet food flavour (leaves) - wind protection - packing material (leaves) - wood for fuel/carving
Ginkgo biloba - ginkgo	tree 30 m	perennial – flower: April-May seeds: October-November	light sand – heavy clay well drained, dry/moist soil tolerant for atmospheric pollution	human food: seeds (raw/cooked/oil) - medicinal (seeds and leaves) – insect repelling
Quercus ilex - evergreen oak	tree 25 m	perennial flower: May-June seeds: September-October	light sand – heavy clay moist soil, tolerant for maritime exposure	human food: seeds (raw/cooked/oil) – wind protection – wood for furniture/fuel – mulch from leaves - repels slugs/grubs
Salix alba - white willow	tree 25 m	perennial flower: April-May seeds: June	light sand – heavy clay moist/wet soil, tolerant for maritime exposure	human food: tea (leaves) -medicinal (bark, branches, leaves) – branches as building material/fuel – compost material – wildlife attractor
Juglans ailanthifolia - japanese walnut	tree 20 m	perennial flower: June seeds: September	light sand – heavy clay well drained, moist soil	human food: seeds (raw/cooked/oil) – dye (bark) – wood for furniture
Prunus avium - wild cherry	tree 18 m	perennial flower: April-May seeds: July-August	light sand – heavy clay well drained, moist soil	human food: fruit, gum from the bark - medicinal (fruit) – dye (leaves) – wood for furniture/instruments –wildlife attractor
Pinus cembra - swiss pine	tree 15 m	perennial flower: May-June seeds: September	light sand – heavy clay well drained, dry/moist soil tolerant for strong winds	human food: seeds (raw/cooked/oil) - medicinal (resin) – dye (needles) – resin for vanish – wood for furniture
Prunus cerasifera - cherry plum	tree 9 m	perennial flower: March seeds: August-September	light sand – heavy clay well drained, moist soil tolerant for strong winds	human food: fruit – dye (leaves) – wind protection
Juniperus communis - common juniper	tree/shrub 9 m	perennial flower: May-June seeds: October	light sand – heavy clay well drained, dry/moist soil tolerant for maritime exposure	human food: fruit (flavouring/gin/oil), tea (leaves/fruit) - medicinal (fruit) – fragrances (fruit) – insect repelling – bark for tinder – wood for fuel
Salix viminalis - basket willow	tree/shrub 6 m	perennial flower: April-May seeds: June	light sand – heavy clay moist/wet soil tolerant for strong winds, tolerant for atmospheric pollution	branches as building material/fuel – compost material – wildlife attractor – prevents soil erosion
Monogyna crataegus - common hawthorn	shrub 6 m	perennial flower: May-June seeds: September-November	light sand – heavy clay dry/moist/wet soil tolerant for maritime exposure, tolerant for atmospheric pollution	human food: fruit (jam, dried), tea (leaves), syrup (flowers) - medicinal (fruit/flowers) – barrier (thorns) and wind protection – wood for fuel – insect attractor
Sambucus nigra - black elder	shrub 6 m	perennial flower: June-July seeds: August-September	light sand – heavy clay moist soil tolerant for maritime exposure, tolerant for atmospheric pollution	human food: fruit (fresh/dried), flowers (raw/cooked) - tea (flowers) - medicinal (flowers, leaves, fruit) – skin lotion (flowers) – dye (leaves/bark) – animal food – wood for small items – wind protection – compost activator – insect repelling – wildlife attractor
Hippophae rhamnoides - sea buckthorn	shrub 6 m	perennial flower: April seeds: September-October	light sand – heavy clay dry/moist/wet soil tolerant for maritime exposure	human food: fruit (raw/cooked) - medicinal (leaves/fruit) – barrier and wind protection – soil enricher (nitrogen), dye (fruit/leaves) – wood for small items/fuel
Cornus sanguinea - common dogwood	shrub 3 m	perennial flower: June-July seeds: August-September	light sand – heavy clay moist soil	human food: fruit – soap (seeds) – dye (fruit) – wood for small items/fuel
Rosa rugosa - beach rose	shrub 2.5 m	perennial flower: June-August seeds: August-October	light sand – heavy clay well drained, dry/moist soil tolerant for maritime exposure	human food: fruit, flowers - tea (fruit/leaves) - medicinal (leaves/flowers/fruit) – wind protection
Chenopodium quinoa - quinoa	herbaceous 2 m	annual flower: July-August seeds: August-September	light sand – heavy clay well drained, dry/moist soil tolerant for strong winds	human food: seeds – dye (whole plant) – insect/bird repelling

Cucumis sativus - cucumber	creeper/climber 2 m	annual flower: July-September seeds: August-October	light sand – heavy clay well drained, moist soil	human food: fruit, oil (seeds) - medicinal (fruit/leaves) – beauty products (fruit)
Solanum lycopersicum 'Raf' - raf tomato	herbaceous 2 m	annual July/September	light sand – heavy clay well drained, moist soil	human food: fruit – insect repelling
Amaranthus caudatus - amaranth	herbaceous 2 m	annual flower: July-September seeds: August-September	light sand – heavy clay well drained, dry/moist soil	human food: leaves (raw/cooked), seeds (cooked) – dye (whole plant)
Secale cereal - Rye	herbaceous 1.8 m	annual flower: May-July seeds: August-September	light sand – heavy clay well drained, dry/moist soil tolerant for strong winds	human food: seed (flour/beer) – biomass for fuel/mulch – straw as packing material – soil stabilizer (prevent erosion/nutrient leach)
Asparagus officinalis - asparagus	herbaceous 1.5 m	perennial flower: August seeds: September-October	light sand – heavy clay well drained, moist soil tolerant for maritime exposure	human food: shoots (raw/cooked) - medicinal (roots/shoots) – wildlife attractor
Triticum aestivum - wheat	herbaceous 1.5 m	annual flower: June-July seeds: August-September	light sand – heavy clay well drained, moist soil tolerant for strong winds	human food: seed (flour) – biomass for fuel/mulch
Beta vulgaris maritima - sea beet	herbaceous 1.2 m	Annual/perennial flower: July-September	light sand – heavy clay well drained, moist soil	human food: tuber, leaves (raw/cooked)
Hordeum vulgare - barley	herbaceous 1 m	annual flower: June-August	light sand – heavy clay well drained, moist soil tolerant for strong winds	human food: seed (flour/beer) – biomass for fuel/mulch
Cichorium endivia - endive	herbaceous 1 m	Perennial (two years) flower: July	light sand – heavy clay well drained, moist soil	human food: leaves (raw/cooked)
Beta vulgaris rubra - beetroot	root vegetable 1 m	perennial (two years) May-November	light sand – heavy clay well drained, moist soil	human food: tuber
Medicago sativa - lucerne/alfalfa	herbaceous 1 m	perennial flower: June-July seeds: March-October	light sand – heavy clay dry/moist soil	human food: leaves (raw/cooked), seeds – tea (leaves) – medicinal – animal food – dye (seeds) – Green manure – nitrogen fixer (atmospheric) - biomass
Avena sativa - oat	herbaceous 90 cm	annual flower: June-July seeds: August-October	light sand – heavy clay well drained, dry/moist soil	human food: seeds (oat) - medicinal (seeds) – animal food – biomass for fuel/mulch (straw)
Cyperus esculentus - nut grass	root vegetable 90 cm	perennial	light sand – heavy clay moist/wet soil	human food: tuber (raw/cooked/oil) – soap (tubers) – weaving (leaves)
Carum carvi - caraway/fennel	herbaceous 60 cm	Perennial (two years) – flower: June-July seeds: July-August	light sand – heavy clay well drained, moist soil	human food: seed (oil/herb), leaves - tea (seeds) - medicinal (seeds) – soap (seeds)
Papaver somniferum - poppy	herbaceous 60 cm	annual flower: July-August	light sand – heavy clay well drained, moist soil	human food: seed (raw/cooked) - medicinal – oil – soap – butterfly/bee attractor
Diplotaxis tenuifolia - wild rucola	herbaceous 60 cm	perennial flower: May-September seeds: June-October	light sand – heavy clay dry/moist soil	human food: leaves (raw/cooked)
Crambe maritima - sea cole	herbaceous 60 cm	perennial flower: June-August	light sand – heavy clay dry/most soil tolerant for maritime exposure	human food: leaves (raw/cooked), shoots (cooked), flowers (raw/cooked) – ground cover – wildlife attractor
Borago officinalis - starflower	herbaceous 60 cm	annual flower: July-October seeds: July-October	light sand – heavy clay well drained, dry/moist soil	human food: leaves (raw/cooked/herb), flowers - tea (leaves/flowers) - edible dye (flowers) - medicinal (flowers/leaves) – insect repelling
Beta vulgaris altissima - sugar beet	root vegetable 50 cm	perennial (two years) May/November	light sand – heavy clay well drained, moist soil	human food: root (raw/cooked), leaves (raw/cooked) - biomass
Limonium vulgare - sea lavender	herbaceous 50 cm	Perennial April-November	light sand – heavy clay well drained, moist soil tolerant for maritime exposure	human food: leaves
Crambe maritima sprouts - sea sprouts	herbaceous	perennial November-March	light sand – heavy clay well drained, moist soil tolerant for maritime exposure	human food: leaves
Crithmum maritimum - samphire	herbaceous 30 cm	perennial flower: June-August seeds: August-October	light sand well drained, dry/moist soil tolerant for maritime exposure	human food: leaves (raw/cooked) – perfumery (oil)
Salicornia - sea asparagus	herbaceous 30 cm	annual flower: August seeds: September	light sand – heavy clay well drained, dry/moist soil tolerant for maritime exposure	human food: young stems (raw/cooked) - soap

Mertensia maritima - oysterleaf	herbaceous 20 cm	perennial flower: June-August seeds: July-September	light sand – loam well drained, dry/moist soil tolerant for maritime exposure	human food: root (raw/cooked), flowers (raw)
Mesembryanthemum crystallinum - ice plant	herbaceous 10 cm	perennial flower: July-September seeds: August-October	light sand well drained, dry/moist soil tolerant for maritime exposure	human food: young stems and leaves (raw/cooked) - soap

Clay grounds (average salination) > 0.25 – 2 mm per day

Specie (Latin/English)	Shape *(aquatic, climber, root vegetable, creeper, herbaceous, shrub, tree)*	Life style + harvest *(annual/perennial)*	Habitat *(wet, moist, dry)*	Uses *(Human food, animal food, soil improvement, site protection, building material, energy production, insect control, pollinator, etc.)*
Acer pseudoplatanus - sycamore maple	tree 30 m	perennial flower: April-June seeds: September-October	light sand – heavy clay well drained, moist soil tolerant for maritime exposure	human food: maple (trunk), sweet food flavour (leaves) - wind protection - packing material (leaves) - wood for fuel/carving
Ginkgo biloba - ginkgo	tree 30 m	perennial flower: April-May seeds: October-November	light sand – heavy clay well drained, dry/moist soil tolerant for atmospheric pollution	human food: seeds (raw/cooked/oil) - medicinal (seeds and leaves) – insect repelling
Quercus ilex - evergreen oak	tree 25 m	perennial flower: May-June seeds: September-October	light sand – heavy clay moist soil, tolerant for maritime exposure	human food: seeds (raw/cooked/oil) – wind protection – wood for furniture/fuel – mulch from leaves repels slugs/grubs
Juglans ailanthifolia - japanese walnut	tree 20 m	perennial flower: June seeds: September	light sand – heavy clay well drained, moist soil	human food: seeds (raw/cooked/oil) – dye (bark) – wood for furniture
Alnus rubra - red alder	tree 20 m	perennial flower: March seeds: September-October	loam - heavy clay moist/wet soil Tolerant for maritime exposure	wind protection – erosion control - nitrogen fixer -heavy leave fall as soil enricher – Wood for lumber/fuel/charcoal
Prunus avium - wild cherry	tree 18 m	perennial flower: April-May seeds: July-August	light sand – heavy clay well drained, moist soil	human food: fruit, gum from the bark - medicinal (fruit) – dye (leaves) – wood for furniture/instruments – bee attractor – wildlife attractor
Pinus cembra - swiss pine	tree 15 m	perennial flower: May-June seeds: September	light sand – heavy clay well drained, dry/moist soil tolerant for strong winds	human food: seeds (raw/cooked/oil) - medicinal (resin) – dye (needles) – resin for vanish – wood for furniture
Malus sylvestris - crab apple	Tree 10 m	perennial flower: May seeds: September-October	light sand – heavy clay well drained, moist soil	Human food: fruit (raw/cooked) – wood as fuel
Prunus cerasifera - cherry plum	tree 9 m	perennial flower: March seeds: August-September	light sand – heavy clay well drained, moist soil tolerant for strong winds	human food: fruit – dye (leaves) – wind protection
Juniperus communis - common juniper	tree/shrub 9 m	perennial flower: May-June seeds: October	light sand – heavy clay well drained, dry/moist soil tolerant for maritime exposure	human food: fruit (flavouring/gin/oil), tea (leaves/fruit) - medicinal (fruit) – fragrances (fruit) – insect repelling – bark for tinder – wood for fuel
Arbutus unedo - strawberry tree	tree 9 m	perennial flower: October-December seeds: October-December	light sand – loam well drained, dry/moist soil tolerant for maritime exposure	human food: fruit (raw/cooked) – wood for charcoal
Cydonia oblonga - quince	tree 7.5 m	perennial flower: May seeds: November	light sand – heavy clay moist soil	human food: fruit (raw/cooked)
Mespilus germanica - medlar	tree 6 m	perennial flower: May-June seeds: November	light sand – heavy clay well drained, moist soil tolerant for strong winds	human food: fruit (raw/cooked) – wood for building material
Amelanchier canadensis - currant-tree	shrub 6 m	perennial flower: April seeds: July	light sand – heavy clay moist soil tolerant for strong winds	human food: fruit (raw/cooked) – wind protection – wood for small items – bird attractor
Sambucus nigra - black elder	shrub 6 m	perennial flower: June-July seeds: August-September	light sand – heavy clay moist soil tolerant for maritime exposure, tolerant for atmospheric pollution	human food: fruit (fresh/dried), flowers (raw/cooked), tea (flowers) - medicinal (flowers, leaves, fruit) – skin lotion (flowers) – dye (leaves/bark) – animal food – wood for small items – wind protection – compost activator – insect repelling – wildlife attractor

Ficus carica - common fig	tree 6 m	perennial flower: June-September seeds: August-September	light sand – heavy clay well drained, dry/moist soil	human food: fruit (raw/cooked/dried) – wood for ornaments
Corylus avellana - common hazel	tree 6 m	perennial flower: January-April seeds: September-October	light sand – heavy clay moist soil tolerant for strong winds	human food: seeds (raw/roasted/oil) – non drying oil for polish – wind protection – wood for small items
Cornus sanguinea - common dogwood	shrub 3 m	perennial flower: June-July seeds: August-September	light sand – heavy clay moist soil	human food: fruit – soap (seeds) – dye (fruit) – wood for small items/fuel
Chaenomeles cathayensis - Chinese quince	shrub 3m	perennial flower: April seeds: October	light sand – heavy clay well drained, moist soil tolerant for atmospheric pollution	human food: fruit (raw/cooked)
Helianthus tuberosus - Jerusalem artichoke	shrub 2.4 m	Perennial flower: October seeds: November	light sand- heavy clay well drained, dry/moist soil tolerant for strong winds	human food: tubers (raw/cooked) – biomass – alcohol
Rosa rugosa - beach rose	shrub 2 m	perennial flower: June-August seeds: August-October	light sand – heavy clay well drained, dry/moist soil tolerant for maritime exposure	human food: fruit, flowers, tea (fruit/leaves) - medicinal (leaves/flowers/fruit) – wind protection
Rumex patientia - herb patience	herbaceous 1.5 m	perennial flower: June-July seeds: August	light sand- heavy clay well drained, moist soil	human food: leaves (raw/cooked) – wildlife attractor
Rheum x cultorum - rhubarb	herbaceous 1.5 m	perennial flower: June seeds: July-August	loam – heavy clay well drained, moist soil	human food: leaf stem (raw/cooked)
Symphytum officinale - comfrey	herbaceous 1.2 m	perennial flower: May-June seeds: June-July	light sand- heavy clay moist soil	human food: leaves (raw/cooked) – tea (leaves) – medicinal (leaves/root) – animal food - green compost (rich in minerals/nitrogen, potassium)
Filipendula ulmaria - meadowsweet	herbaceous 1.2 m	perennial flower: June-August seeds: August-September	light sand- heavy clay moist/wet soil	human food: roots, leaves (cooked) – tea (leaves) – alcoholic flavour (flowers) – medicinal (leaves/flowers) – dye – perfumery (flower)
Hemerocallis fulva - common day lily	herbaceous 1 m	perennial flower: June-August	light sand- heavy clay dry/moist soil	human food: leaves/shoots (cooked), flowers (raw/cooked) – ground cover -
Monarda didyma - bergamot	herbaceous 90 cm	Perennial flower: June-September seeds: August-October	light sand- heavy clay moist soil	human food: leaves, shoots (raw/cooked) – tea (leaves/flowers) – medicinal (leaves/flowers) – perfumery – wildlife attractor
Mentha pulegium - pennyroyal	herbaceous 40 cm	Perennial flower: August-October seeds: September-October	light sand- heavy clay moist soil	human food: leaves (raw/cooked) – tea (leaves) – medicinal – soap (whole plant oil) – vermin repelling
Allium schoenoprasum - chives	bulb 30 cm	flower: June-July seeds: July-August	light sand – heavy clay well drained, moist soil	human food: leaves (raw/cooked), bulbs – medicinal – insect repelling
Camassia quamash - quamash	bulb 30 cm	flower: May-June seeds: July-August	light sand- heavy clay moist soil	human food: bulb (raw/cooked) – wildlife attractor
Pulmonaria officinalis - lungwort	herbaceous 30 cm	Perennial flower: March-May seeds: May-June	light sand- heavy clay dry/moist soil	human food: leaves (raw/cooked) – medicinal (leaves/flowers) – ground cover – wildlife attractor
Fragaria vesca semperflorens - Alpine strawberry	herbaceous 30 cm	Perennial flower: May-November seeds: June-November	light sand- heavy clay well drained, moist soil	human food: fruit (raw/cooked) – tea (leaves) – skin care (fruit) – flowers as compost activator
Alchemilla xanthochlora - lady's mantle	herbaceous 30 cm	perennial flower: June-September seeds: August-October	light sand- heavy clay well drained, dry/moist soil	human food: leaves (raw/cooked) – tea (leaves) – medicinal (leaves) – ground cover

wet Peat grounds (little salination) > 0 – 0.5 mm per day

Specie (Latin/English)	Shape *(aquatic, climber, root vegetable, creeper, herbaceous, shrub, tree)*	Life style + harvest *(annual/perennial)*	Habitat *(wet, moist, dry)*	Uses *(Human food, animal food, soil improvement, site protection, building material, energy production, insect control, pollinator, etc.)*
Salix alba - white willow	tree 25 m	perennial flower: April-May seeds: June	light sand – heavy clay moist/wet soil, tolerant for maritime exposure	human food: tea (leaves) -medicinal (bark, branches, leaves) – branches as building material/fuel – compost material – wildlife attractor
Alnus glutinosa - black alder	Tree 25 m	perennial flower: March-November seeds: September-November	loam – heavy clay moist/wet soil tolerant for maritime exposure	Wind protection – biomass – nutrient provider (nitrogen) – wood for furniture
Salix viminalis - basket willow	tree/shrub 6 m	perennial flower: April-May seeds: June	light sand – heavy clay moist/wet soil tolerant for strong winds, tolerant for atmospheric pollution	branches as building material/fuel – compost material – wildlife attractor – prevents soil erosion
Monogyna crataegus - common hawthorn	shrub 6 m	perennial flower: May-June seeds: September-November	light sand – heavy clay dry/moist/wet soil tolerant for maritime exposure, tolerant for atmospheric pollution	human food: fruit (jam, dried), tea (leaves), syrup (flowers) - medicinal (fruit/flowers) – barrier (thorns) and wind protection – wood for fuel – insect attractor
Pseudosasa japonica - bamboo	shrub 4,5 m	perennial	light sand – heavy clay well drained, moist/wet soil tolerant for maritime exposure	erosion protection – wind protection – stems as plant support/building material
Miscanthus sinensis - Ornamental grass	Shrub 4 m	perennial flower: August-September	light sand – heavy clay well drained, moist soil tolerant for strong winds	biomass – green mulch - ground cover
Phragmites australis - common reed	water plant 3.6 m	perennial flower: July-September seeds: August-October	light sand – heavy clay wet soil – water tolerant for maritime exposure	human food: roots (raw/cooked) – alcohol – stems for thatching roofs – biomass – flood control – water purifier – animal habitat
Tropaeolum majus - Indian cress	climber 3.5 m	perennial flower: July-September seeds: August-October	light sand – loam moist soil	human food: leaves (raw), flowers (raw) – medicinal (leaves/flowers) – dye (seeds) – insect repelling
Typha latifolia - reedmace/cattail	water plant 3 m	perennial flower: June-August	light sand – heavy clay wet soil – water	human food: roots (raw/cooked) – pollen (flour)alcohol – stems for thatching roofs - biomass – flood control – water purifier – wildlife attractor
Typha angustifolia - small reedmace/cattail	water plant 3 m	perennial flower: June-July	light sand – heavy clay wet soil – water	human food: roots (raw/cooked) – pollen (flour)alcohol – stems for thatching roofs - biomass – flood control – water purifier – wildlife attractor
Rosa canina - dog rose	shrub 3 m	perennial flower: June- July seeds: October-December	light sand – heavy clay well drained, moist/wet soil tolerant for strong winds	human food: fruit (raw/cooked), flower (raw/cooked) – tea (fruit)
Myrica gale - bog myrtle	shrub 2m	perennial flower: March-May seeds: August-September	light sand – heavy clay wet soil – water	human food: fruits and leaves - beer (flavouring) – tea (leaves) – insect repelling
Asclepias incarnata - swamp milkweed	herbaceous 1.2 m	perennial flower: July-August seeds: September	light sand – loam Dry/moist/wet soil	human food: young shoots (cooked), flower buds (cooked) – fibre from bark
Filipendula ulmaria - meadowsweet	herbaceous 1,2m	perennial flower: June-August seeds: August-September	light sand – heavy clay moist/wet soil	human food: roots and leaves (cooked), flowers (syrup) – tea (leaves/flowers/roots) – medicinal (leaves/flowers)
Sagittaria sagittifolia - arrow head	water plant 1 m	perennial flower: July-August seeds: August-September	light sand – heavy clay wet soil - water	human food: tubers (cooked)
Nasturtium officinale - watercress	water plant 50 cm	perennial flower: May-October seeds: July-October	light sand – heavy clay wet soil - water	human food: leaves and flowers (raw/cooked), seeds as mustard flavour – medicinal (leaves)
Menyanthes trifoliata - bogbean	water plant 30 cm	perennial flower: May-July	light sand – heavy clay wet soil - water	human food: roots (cooked), beer (leaves as hops) – medicinal
Vaccinium oxycoccus - small cranberry	shrub 10 cm	perennial flower: June- August	light sand – loam moist/wet soil	human food: fruit (raw/cooked) – ground cover
Azolla filiculoides - water fern	water plant 10 cm	perennial	Grows in water	water purifier – nitrogen-rich biomass – fertilizer – green manure

Fungi (spore scan be grown on carbon-rich materials such as tree trunks, straw, old newspapers and coffee grounds)
Pleurotus ostreatus - Oyster mushroom
Pleurotus eryngii - King trumpet mushroom
Lentinula edodes - Shiitake

Animals

Land	Water
Cow	Perch
Goat	Bream
Sheep	Carp
Chicken	Zander
Duck	Trout
Bee	Eel

Permanent polder food

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