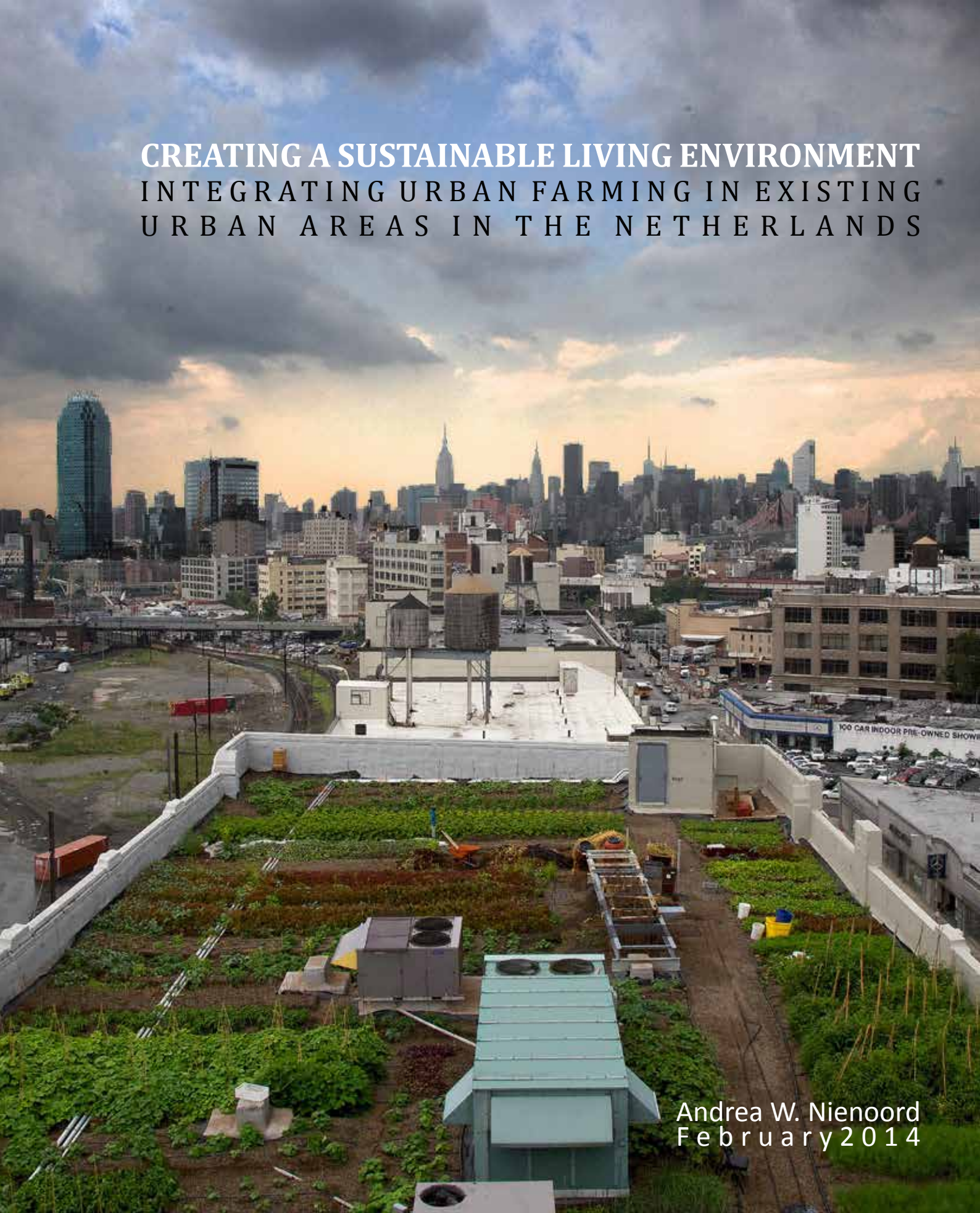
CREATING A SUSTAINABLE LIVING ENVIRONMENT

INTEGRATING URBAN FARMING IN EXISTING URBAN AREAS IN THE NETHERLANDS



Andrea W. Nienoord

February 2014

Fig. 1 *Brooklyn Grange farm [from: Inhabitat.com]*

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Master Thesis Written in name of
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Master Thesis Written by
Andrea W. Nienoord

Contact
Student number: 1364936
Email: anienoord@hotmail.com
Phone number: +31 (0)6 18 19 98 69

Mentors
Research: K.P.M. Aalbers
Architecture: R. Nottrot
Building technology: J. van de Voort

TU Delft

PREFACE

This Master Thesis is part of my graduation for my Master degree in Architecture at the faculty of Architecture of the Delft University of Technology, done in the track of 'Explore Lab'. A fascination for a certain issue is the starting point of the graduation process within Explore Lab. My fascination is to find out in which way a rather unknown topic as urban farming can be used in architectural design. Based on this fascination, a research is written. In continuation of the research and as main part of the graduation, a design is made. The thesis is written in addition to the design phase of my graduation the using the opportunities and avoiding the issues of urban farming within existing urban areas.

My fascination developed during the Master Architecture by focussing on sustainability within architecture. In addition, my internship at Broekbakema and my study stay abroad triggered my interest for greenery within the built environment.

In my view, creating a sustainable world goes along with the improvement of the current (living) standards and practices. Make people willing to change to an improvement. I would like to contribute to a better world, to better living conditions and to find a way in which architecture can play a role into that. I think sustainability can provide a positive impact to the build environment.

Ask someone where he or she prefers to live. If his or her answer is: 'living in a city', this is probably cause of the availability of a wide range of facilities but not for the quality living environment. Although most people live in cities, its living environment lacks qualities. Cities are mostly grey and have bad air quality. After reading 'The Hungry City' of Carolyn Steel my interest for greenery expanded with food production. Urban farming is a hot topic now. To make this clear, New York City already contains 700 urban farms compared to the 263 Starbucks (that seems to be 'on every corner' in the city) (Five Borough farm, 2013).

Those insight during my personal development, both in- and outside the Delft University of Technology, resulted in the topic my graduation: 'Creating a sustainable living environment: Integrating urban farming in existing urban areas in the Netherlands'. In my vision, urban farming happens all over the city, in all possible types. My design focuses on the creation of a second ground surface on the roofs of the city The Hague. Parts of this surface designed as a continue route through the city by bridges and vertical transportation points.

I would like to thank my mentors within Delft University of Technology. Kristel Aalbers as my research mentor, Robert Nottrot as my architecture mentor and Jan van de Voort as my building technology mentor for their support during my graduation process. In addition, I would like to thank all people for their time and energy to help me gathering the necessary information for the completion my research. Also I would like to thank my family for their believe in my talents, their understanding and constructive support during my study. I would like to thank my friend Johan in his opportunistic support during the whole challenge, his open character and interest in the topic and his good care for me at our home. Last, my friends and all others who listened, helped me, and took care of the necessary distractions so I have been able to succeed.

Andrea Nienoord

February 2014, Delft

SUMMARY

In this thesis urban farming is discussed as a way to improve and sustain the living environment in existing urban areas. Urban farming seem to have a multiple positive influences on the living environment in cities. Urban farming is a rather unexplored field in architecture as spatial considerations are concerned. To get an insight in the actual state of knowledge and experiences in this field, the following research question should be answered:

In what way can urban farming be shaped, and become spatial integrated in existing urban areas in the Netherlands in a way that it will contribute to a sustainable living environment?

The main research question is divided in the following sub questions.

1. What is a sustainable living environment?
2. What is urban farming?
    a. Which types of urban farming do exist?
    b. How and where can urban farming be implemented?
    c. What are the spatial conditions of urban farming in existing urban areas?
    d. What is the importance of integrating urban farming in existing urban areas?
    e. What are experiences of existing projects with urban farming?
3. What is the relation between urban farming and a sustainable living environment?
    a. How does the concept urban farming contribute to the goals of a sustainable living environment?
    b. In what way does the spatial design of urban farming contribute to a sustainable living environment?

To answer the research questions a literature study is done. In chapter 2 and 3 the theory of sustainable living environment and urban farming is described. In addition, five different case studies about urban farming are described in chapter 4. The case studies are:

- Hoeve Biesland in Delfgauw (near Delft)
- Moe'sTuin in Delft
- Dakakker in Rotterdam
- Marconistrip in Rotterdam
- Villa Augustus in Dordrecht

In chapter 5 the case studies are analysed. The comparison generates overall outcomes. Chapter 6 starts with a framework for creating a sustainable living environment with the use of urban farming. In this framework, the outcomes of the case studies are combined with the theoretical part of this research. In this chapter, also attention is paid to the spatial considerations of urban farming in existing urban areas in the Netherlands. Finally, chapter 7 conclusions are drawn based on previous chapters and recommendation for further research are given.

SUSTAINABLE LIVING ENVIRONMENT

Chapter two describes the development of cites in West European countries. In cities, most land is build on or is paved. Available ground surfaces are scarcer and economy feasible functions are preferred. Predictions are that the population growth in these cities will continue. This development influences the living environment of citizens. Negative effects on the living environment are for instance hot temperatures, polluted air and stagnating water

drainage during (heavy) rainfall, limited recreational spaces. Most of these influences do affect the health of people. In cities, social ties are loosening as cities become denser and people more mobile. People take less responsibility for their environment because of the increasing individualization of citizens.

During the development of cities, greenery and food production needed to make place for more economical feasible functions. Therefore, cities are more and more depending on the food supply from outside cities. This creates a long distances relation between food production and its consumers. As cities are growing there is an increased need for food transport. A negative influence on people's awareness about the food cycle is the result. People are no longer aware of the origin of their food: ingredients and processes. The ignorance of food does not prohibit bad eating habits and food wastes. The transparency of ingredients of labels can be misleading. The food industry does add by times unnecessary ingredients to the food and uses misleading packaging. The farming industry uses monocultures, crop selection, use of artificial fertilizers, pesticides, less nutrition food, the need for 'good looking' results in food waste and a lot of packaging. The issues of the globalized food system lead to a revival local produced food. Urban farming is the mean to reach this.

Knowledge about the food process can to redesign the flushing system. Current cities make use of a linear way of using resources: from input to output. When output becomes input, sources do not get lost. If not, depletion, pollution and harmful effects as described by Kees Duijvestein, are happening. Redesigning the flushing system in a circular one helps to create a more sustainable living environment.

Within sustainable living environments, it is important to find a balance between environmental, economical and social qualities. Environmental qualities are water remediation, cooling down temperatures, filtering the air by subtracting CO2 and particular matter and stimulate biodiversity. Economic qualities are the increased property value and decrease of patient care. Social qualities include health and cohesion. Theory shows that greenery contributes to a sustainable living environment.

URBAN FARMING

Food production in and around the city, this is called urban farming. This phenomenon is rediscovered as the number of projects shows and the amount of literature increases. Types of urban farming distinguish different organizations (from private to public) and cultivation methods (from low tech to high tech). The possible farming methods are forest gardening, SPIN-farming, hydro culture and an aquaponics. These methods differ in kind of medium, input, weight and need for labour and capital used. The farming methods cover a wide range of goals that can be achieved by urban farming. The following six goals abstract from food production, increasing biodiversity, care, education, meeting, participation and creating an incubator.

The possibilities of farming in the city are limited by available locations and influences of urban conditions. Location choice is depending on city density and scale, vacant land and buildings, technical consideration of plants and the built environment. While plants depend on the right environment to flower, architecture can create facilities to optimize the growth conditions for plants.

Referring to the qualities of sustainable living environment, the opportunities and issues of urban farming in existing urban areas are inventoried. The following opportunities are distinguished:
Environmental qualities:

- Improvement of the ecological performance of cities
- Less need for food transport and packaging
- Excludes the use of artificial fertilizers and pesticides

Economic qualities:

- Increase the value of surrounding property
- Generates yields in terms of food products
- Food production is close to its consumers.
- Generates employment
- Can attract media attention that stimulates visitors to the city
- City warmth and CO2 stimulate plant growth

Social qualities:

- Physical and mental health
- Awareness about the food cycle
- Community building, the celebration of food
- Education

On the other hand, urban farming has to cope with some issues. As they are:

Environmental issues:

- Polluted soil and air

Economical issues:

- Labour costs
- Need of grants, investment costs
- Relative high product prices (compared to rural farming)
- Legislations
- Market circumstances (supply of sources such as location, labour and capital)
- Mechanization is less suitable

Social issues:

- Feeling of not safety in case of bad maintenance
- Weather depended (nice work weather in summer, less in winter)
- Most maintenance needed during holidays

The increased attention for urban farming shows a shift in the balance between opportunities and issues.
The opportunities are becoming more important. Urban farming is now used on an experimental scale. In the future issues might be overcome by broad implementation of urban farming on the city scale. Learning from existing urban farming projects, step by step this implementation can be achieved. Crucial for its success is the involvement of citizens.

CASE STUDIES

Chapter four is about five case studies. For Hoeve Bieland (Delfgauw), Moe'sTuin (Delft), Dakakker (Rotterdam), Marconistrip (Rotterdam) and Villa Augustus (Dordrecht) the general information of the project, the spatial organization, its contribution to sustainability (social, environmental and economical aspects) and project related to existing urban areas are described. An analysis of these cases result in several design considerations that are integrated in chapter five.

Fig. i *Sustainability triangle, concept according to Nienoord [from: Nienoord, 2013]*

SPATIAL CONSIDERATIONS

Chapter six gives a framework of the spatial considerations of urban farming within existing urban areas in the Netherlands. Several sustainability goals are set up as prerequisites to indicate if the living environment in existing urban areas is sustainable or not (figure i). Different aspects found in literature and case studies are incorporated within an existing model of sustainability of social, environmental and economical aspects (figure 2). The spatial considerations depend on location and space, farming specifications, spatial organization, usage and buildings. Those requirements lead to urban farming typologies per building type. In the conclusions will be referred to those spatial considerations, which should be taken care of idealistically.

TABLE OF CONTENTS

1. INTRODUCTION

This chapter gives an introduction toward the research by defining it. It contains the topic background that resulted in the problem description, the objective, the research questions, concepts and delineation, research method and structure of the thesis.

1.1 PURPOSE AND BACKGROUND

The world is in a need for responsible human behaviour. Resources being used in large amounts are starting to run out while waste flows are accumulating. This current "flushing" living behaviour is damaging the world drastically. One should take better care of the world, by starting to influence positively our behaviour in order to improve the current living environment. This change should result into the development of a sustainable world.

In Europe, at the moment, more than 75% of the population lives in urban areas (Brockerhoff, 2000, pp. 3-7). Predictions are that this development will continue. Cities need to expand or are intensifying the usage of available space . The available free land inside cities is reducing. In cities, most of the land is occupied by buildings or is paved. This on-going development causes tension on the still available land. Less economical feasible land-uses are on a losing hand.

Cities attract people because of the work opportunities and its large range of facilities. As most people live in cities, this does not mean cities do have the most beautiful or healthy living environment. Due to the economical crisis and structurally stagnating building sector (Noordanus, 2010) and the need for sustainable (living) environments, there is a search for new ways of city development. The quality of green spaces is underestimated during the last decennia and therefore many green spaces, mostly with high maintenance cost, needed to make place for more economical profitable functions. Due to this development, the amount of greenery in m^2 per person decreased in cities. Complementary, the quality of existing greenery is not always adequate or well maintained. Greenery in the city, in both qualitative and quantitative ways, is getting increasingly important. For example, Maas emphasizes in her doctoral thesis the positive impact of greenery on the health of people (Maas, 2008).

Functions that are more profitable pushed food production also out of the city. The food production developed into a globalized system. Long distances caused a lost awareness of most citizens of the food cycle, the need for food transportation and pollution combating technology. The lack of awareness of the origin of food resulted in bad eating habits as well.

So why not combine the implementation of more greenery with the cultivation of food? Urban farming, the production of food in or close to the city, is rediscovered. Urban farming can serve different goals. Therefore, urban farming gives many opportunities. Around the city, there often is enough space to combine different functions of urban farming at one location. In the city such combinations are much more difficult to realize, because of its limited available space. An urban farm has a benefit within a city if its makes use of the urban conditions and involves it citizens.

On the other hand, in the cities there is a higher need for more qualitative green, because of the amount of people and negative aspects as air pollution etc. From this point of view emerges the objective of my research.

1.2 OBJECTIVE

The objective of this research is exploring the opportunities of urban farming in existing urban areas in the Netherlands and how it can contribute to make a sustainable living environment.

1.3 *RESEARCH QUESTIONS*

Based on preceding problem statement and research objective the formulated research question is:

In what way can urban farming be shaped, and become spatial integrated in existing urban areas in the Netherlands in a way that it will contribute to a sustainable living environment?

To narrow down the research question, the following sub questions are:

1. What is a sustainable living environment?
2. What is urban farming?
   a. Which types of urban farming do exist?
   b. How and where can urban farming be implemented?
   c. What are the spatial conditions of urban farming in existing urban areas?
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1.4 *CONCEPTS AND DELINEATION RESEARCH*

This research is focussing on the concepts of sustainability, living environment, urban farming and existing urban areas. In this chapter a more detailed explanation is given of the concepts used in the objective and research question and will delineate the research focus.

1.4.1 Sustainability

Sustainability is a word used every day, but the meaning is getting more implausible. There are different meanings of the word, which makes it easy for businesses to claim to be sustainable. Sustainability contains many different aspects, like economical, ecological, technical, as well as social and cultural aspects.

Sustainability is described in the Brundtland report as: *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'* (Brundtland, 1987). On account of the United Nations Conference on Environment and Development in Rio de Janeiro (1992) a differentiation is made between the environmental-, economic- and social aspects within sustainable development (European Communities, 2002). It is believed that a balance between these three aspects will lead to sustainability. John Elkington was the first to call these issues “people, planet and profit” as the now well-known “triple-p”. The purpose of this differentiation is to indicate and to intertwine inextricably and to assess if something is sustainable or not. At the Johannes World Summit 2002 in continuation, the P of Profit changed into Prosperity. This change emphasized that wealth should also be expressed in societal values, as well as economical value (European Communities, 2002).

In 2004, Kees Duijvestein, previous professor at the TU Delft, added a fourth P of Project to this row. This is called the 4p tetraëder. The fourth P is dealing with design quality within the spatial environment (Duijvestein, 2008b).

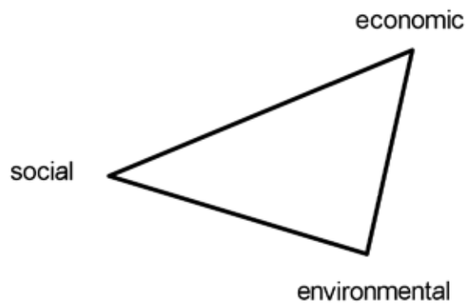

Fig. 2 *Sustainability triangle since Rio de Janeiro 1992 [from: Nienoord, 2014]*

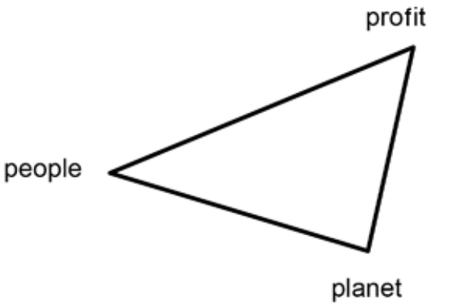

Fig. 3 *Sustainability triangle according to Elkington [from: Nienoord, 2014]*

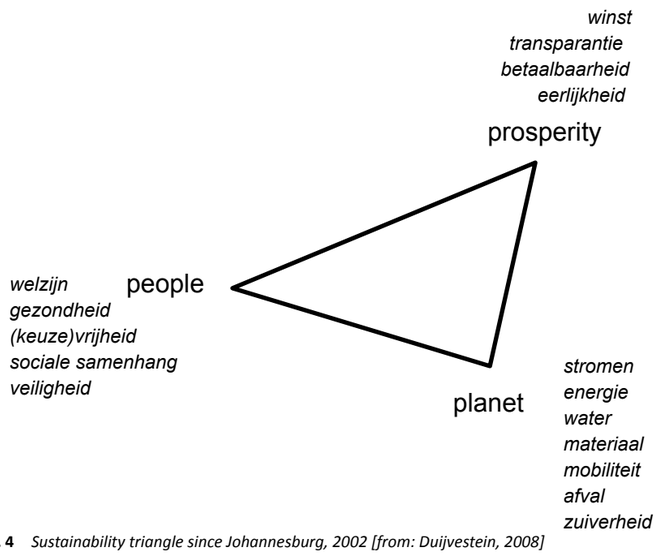

Fig. 4 *Sustainability triangle since Johannesburg, 2002 [from: Duijvestein, 2008]*

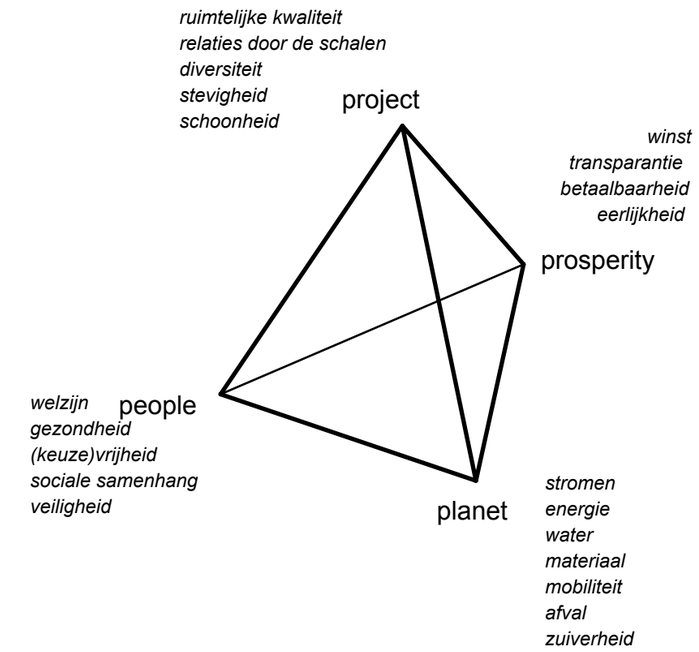

Fig. 5 *Sustainability tetraëder [from: Duijvestein, 2008]*

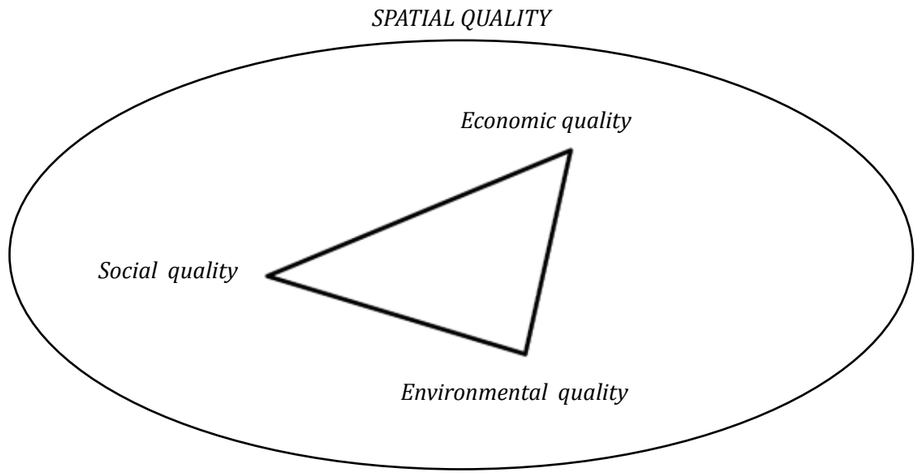

Fig. 6 *Sustainability triangle according to Nienoord [from: Nienoord, 2014]*

As described above, sustainability focuses on the future impact of our behaviour, instead of short-term gains. New is a focus on the future, taking into account the interests of next generations. To create a sustainable world there is a need for changes in our current way of living. A positive influence on the current living environment should be encouraged, in a way to aim for a sustainable future. Liveability focuses on here and now and therefore is an indispensable part of sustainability (Röling & Timmeren, 2005).

To reach sustainability, people need to get aware of their impact and (if they do) appreciation of their living environment. As we people are kept responsible for changing the world's natural cycles and our own living environment, we are also the ones that can start to improve our behaviour and our current living environment. Sustainability aims to solve a problem at its source.

In this thesis, sustainability is about a valuable balance of environmental-, economic- and social qualities. No judgement is given as the qualities are presented in a random sequence in this thesis. Its meaning becomes manifest in spatial environment. The visibility within the spatial environment will make people aware of all processes within the city.

1.4.2 Living environment

Living is a characteristic of organisms, which share the common nature to reproduce it self. Whittaker made a well-known division of organisms into the following five kingdoms, namely the Animalia, Fungi, Plantae, Protista and of the Monera (Hagen, 1996). People belong to the kingdom of the Animalia and its class is Mammalia. The focus is on people does not mean a total exclusion of all other organisms in this research, since most organisms are essential for human life.

In view of the above, the meaning of living environment will be an environment in which people are living. People can live in different kind of environments, often distinguished by the amount of people living in the same place. This research will focus on the living environments of people in high densely populated areas, called cities.

1.4.3 Urban farming

The definition used by the Canadian International Development Research Centre during the Cities Feeding People program is *"An industry located within (intra-urban) or on the fringe (peri-urban) of a town, a city, or a metropolis, which grows or raises, processes, and distributes a diversity of food and non-food products. It (re)uses on a daily basis human and natural resources, products, and services largely to that urban area" (Muogeot, 2006).*This definition points out that urban farming is the production of food in and around the city and contributes to different processes and serves mainly to the city. In the close future, urban farming will not be able to produce enough food to feed all citizens. The aim of this research is not to use urban farming as a tool to feed all city inhabitants. The research focuses on a wide range of urban farming perspectives with the aim of creating a sustainable living environment. In addition, the specific nutrition ratio for optimal plant growth is out of the scope of this research.

Population growth in urban areas resulted in a need for more food. The food production industry intensified and developed into a globalized large-scale production to adapt to these urban conditions. Within the food supply chain a lot of interventions are needed because of the long transportation distances. The consequences are lower nutrients containing food and the need for a lot of packaging. Knowledge about food production or what basic food looks like has become increasingly scarce. This enabled food producers to process food with unnecessary additions

in order to make it cheaper and gain profits that are more economical. The production of food away from place of consumption resulted in a society in which the awareness of food production is lost.

1.4.4 Existing urban areas

Sustainability within the building sector is getting more attention. New buildings take integration of sustainable aspects often into their designs. There are even examples of new built cities with sustainability as main principle. Masdar city is such a new city developed in Abu Dhabi. It is not feasible to build cities all over to make them sustainable from scratch, as largest percentage of all people live in cities. Adjustments in the current built environment should improve the current living environment in cities. The fact that most people are living in cities resulted in the focus of this research upon existing urban areas. In this way, urban farming has to deal with the opportunities and restrictions of the built environment. For this research, existing urban areas will be defined by the existing built environment with a relative high density. This density is pragmatically defined, not by criteria as amount of citizens per m2 , by the visual distinction on the continuous built environment and open area's.

1.5 RELEVANCE

1.5.1 Social relevance

Most cities developed mostly in a rapid way from money driven perspective. The development eliminated greenery increasingly. This resulted in living environments that have a negative influence on the health of its inhabitants. The inhabitants should be the focus point again.

Actually, people are less dependent on social relations at the local scale because of the increasing mobility. This resulted in individualization of people within neighbourhoods. The social aims of creating sustainable living environments becomes more meaningful as sustainability gets a higher priority. The current development approach of the build environment is changing. It is increasingly necessary to develop cities from the viewpoint of a living environment created for its inhabitants.

Urban farming becomes more popular. Projects overload the media. Most urban farming projects make use of (temporary) vacant plots or the implementation on a small scale within the city. A wide range of perspectives is pleading for the application of urban farming. Most perspectives are in line with sustainable living environments, including social, environmental and economical aspects. As the need for greenery is highest in existing urban areas, it is interesting to look how urban farming can contribute to the development of sustainable living environment.

1.5.2 Scientific relevance

The economic crisis and the need for sustainability asks for new ways of city development that will have a positive influence on people's health. A lot of research investigated sustainable development and the influence of urban farming, like Muynck (2011). In the field of architecture, there is not enough information available about the way spatial considerations of urban farming can contribute to a sustainable living environment in existing urban areas. This research studies the possibilities of urban farming and how it can contribute to a sustainable living environment. The result of the research is a spatial framework to implement urban farming within existing urban areas. This framework includes spatial considerations, for the development of urban farming in existing urban areas. These considerations should be taken into account to make the design more sustainable.

Therefore, it is interesting to examine a concept of urban farming in existing urban areas to make a more

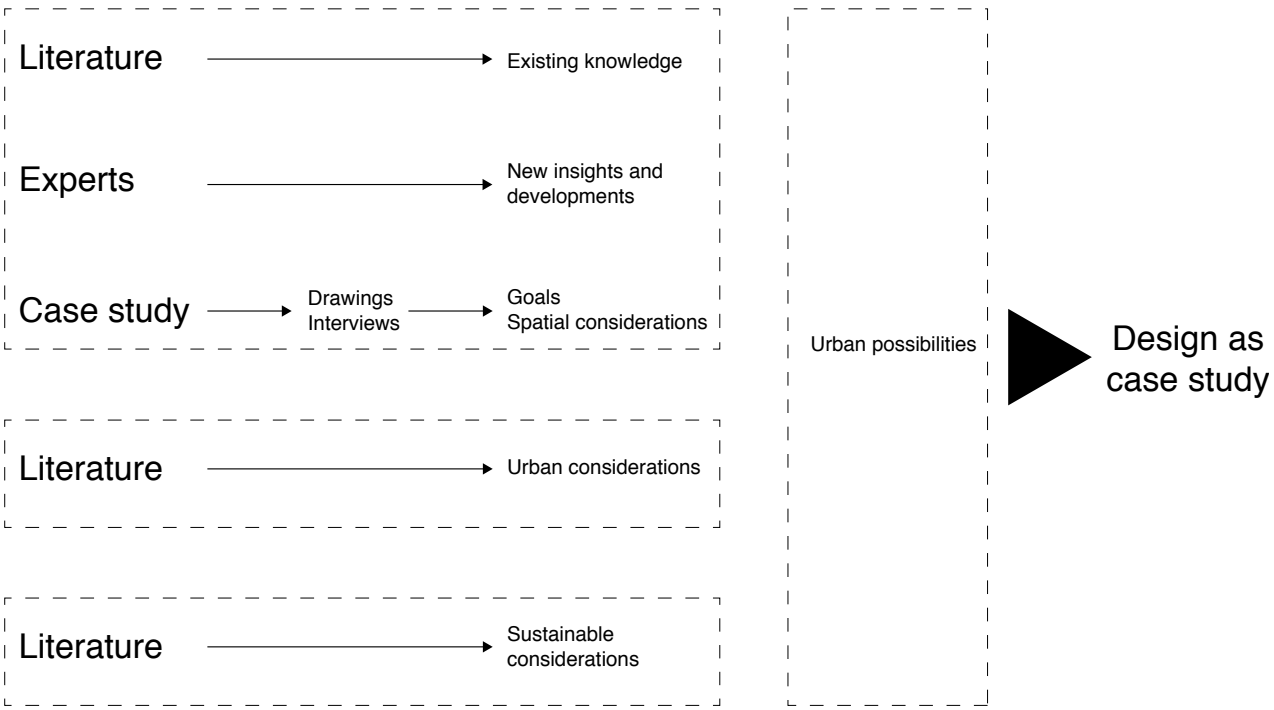

Fig. 7 *Visualization of research method [from: Nienoord, 2014*

sustainable living environment. This research is scientific relevant because it connects the theories and scientific knowledge of urban farming to the practice in existing urban areas.

1.6 RESEARCH APPROACH AND METHOD

The literature study and case studies are done in the period February 2013 - November 2013. There are different types of sources used for this research, like

- Literature about the main subjects: sustainability and urban farming;
- Articles and websites about urban farming;
- Volunteering at the Dakakker to gain information about the project;
- Interview by phone with H. de Leede to gain information about the Marconistrip project.
- Information gained by expert interviews with P. de Graaf and J. Duijndam about their view on urban farming. The latter also gave information about the case study about Hoeve Biesland.

Next to literature research, practical examples and experiences supplied information. The five cases studied are:

- Hoeve Biesland in Delfgauw (near Delft)
- Moe'sTuin in Delft
- Dakakker in Rotterdam
- Marconistrip in Rotterdam
- Villa Augustus in Dordrecht

The criteria applied to select these five case studies are:

- Located in the Netherlands (for practical reasons)
- The location of the project in relation to the city
- Different project sizes
- Diversity in aspired project goals
- The accessibility of information about the projects

The cases are studied in the following way by:

- Studying literature, websites and articles about the cases
- Volunteering at the Dakakker
- Contact by mail or phone
- Visiting the locations

General outcomes are the result of comparing the five case studies. Afterwards, conclusions and recommendations are drawn from theory and practice. These will help to set up a framework for the spatial considerations of urban farms in existing urban areas. The considerations will be guidance for the design project, a mandatory part of the graduation.

1.7 THESIS STRUCTURE

Chapter 1 gives the introduction toward the research. It contains the topic background that resulted in the problem description, the objective, the research questions, concepts and delineation, research method and structure of the

thesis.

The 2nd chapter gives the theoretical background of the development of cities as they are now and their (negative) impact on the living environment. Afterwards the globalized food system will be described according to all aspects of the food industry. The last paragraph emphasizes why cities should be more sustainable and how greenery can influence living environment within existing urban areas.

In chapter 3, the theoretical frame of urban farming is described. The first paragraph goes into detail about the concept of urban farming, including the food produced, possible cultivation methods and the context of the city. The next paragraph gives attention to the opportunities and issues of urban farming.

Chapter 4 describes all five case studies, namely Hoeve Biesland in Delfgauw, Moe'sTuin in Delft, Dakakker and Marconistrip in Rotterdam and Villa Augustus in Dordrecht. The case studies are described regarding to general information, the spatial organization, sustainability aspects and their relation with existing urban areas.
In chapter 5, an analysis compares the case studies according to these same aspects. The comparison generates overall outcomes.

Chapter 6 starts with a framework for a sustainable living environment with the use of urban farming. In this framework, the outcomes of the case studies are combined with the theoretical part of this research to create an ideal situation. This framework will be used for the design, the mandatory part of the graduation, to determine if the design creates a sustainable living environment or not. In this chapter, also attention is paid to the spatial considerations of urban farming in existing urban areas in the Netherlands.

Finally, in the 7th chapter conclusions are drawn. Here the outcomes from theory and practice will be used to answers the research questions. The recommendations will give feedback upon the urban farming within the ideal situation, described in chapter 6, and the changes made afterwards in the design project, which is the mandatory part of the graduation.

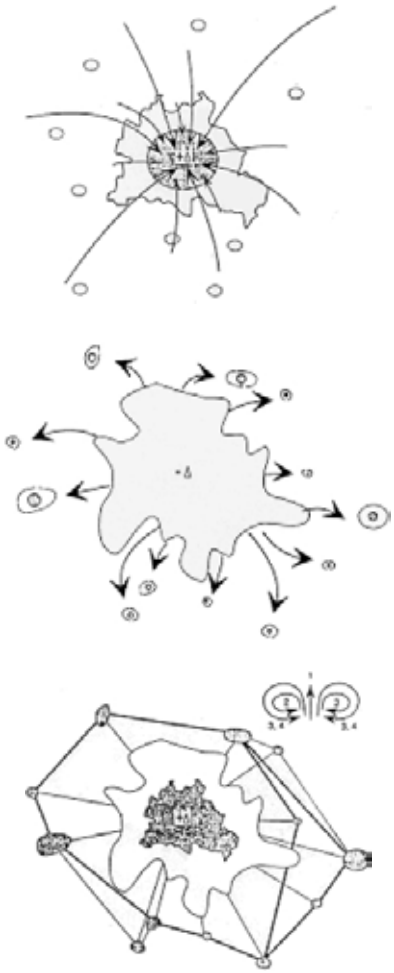

Fig. 8 *Visualization of urbanization, suburbanization and re-urbanization [from: kuleuven.be]*

2. SUSTAINABLE LIVING ENVIRONMENT

This chapter explains the general city development in Western European cities and emphasizes why cities should be more sustainable. First part explains the development and growth of these cities. It is assumed that the development of cities in The Netherlands has followed the West European pattern. The second paragraph described the (negative) impact of these developments. The third paragraph describes the impact of city development on food production which resulted in a lack of sustainability in the current food supply chain. Fourth paragraph will go into necessary developments needed to make cities more sustainable and in what way greenery can have influence in existing urban areas.

2.1 DEVELOPMENT OF CITIES

The development of cities can roughly be divided into four phases, namely the period before industrialization, a period of urbanization after industrialization, a period of suburbanization and re-urbanization. This chapter illustrates these phases.

Originally, people fed themselves by hunting and gathering their food. Necessarily they needed to move from one to another place, depending on the amount of food in their surrounding. Later, small settlements could develop thanks to new farming methods. The city wall reflects the contradiction between the build environment and the green countryside around it. The size of it was, and still is, very dependent on the produced amount of food to feed its inhabitants. Cities developed in a more organic way, depending on the actual needs.

Around 1900 the industrial revolution started due to the invention of the steam engine. Throughout this period, mechanized processes took over manual labour. In addition, the way of transport changed drastically. With the introduction of different transportation techniques, like trains, distances became less important. Because of this independence, cities could grow bigger. In this period, 20% of all people on earth lived in urban areas. Cities offered more employment than its surroundings because of the mass industry, technology and services that created many jobs. This employment attracted people and a demographic transition from rural to urban living started. Urbanization is the term for this transition. The autonomic growth of the population is also of influence on the growth of cities.

As growth in old cities is limited on its space within city walls, modern cities develop in a fast and often uncontrolled way. This shift resulted in drastically changed city structures. In 1950, already 55% of the inhabitants of developed countries lived in cities.

Suburbanization started to take place in a large number of cities since ‘60. It includes the move of mostly high income and well-educated people from the city to the surrounding countryside. Attracted by the amount of greenery, space and rest by escaping from noisy and air polluted industrialized cities. This population group could afford a car and relatively expensive houses outside the city. Since than, the countryside needs to deal with much more people and commuter traffic. Following the commuters, also businesses moved to the suburbs, because of the lower price of land, more space and better accessibility. The development of the suburbs at commuting distance made the borders of cities diffuse and the countryside get scattered.

Traffic jams due to increased commuter traffic is one of the reason that people started to move back to the city again from ’80. Re-urbanization took place. The amount of people living in urban areas increased to 40% in 1990 and more

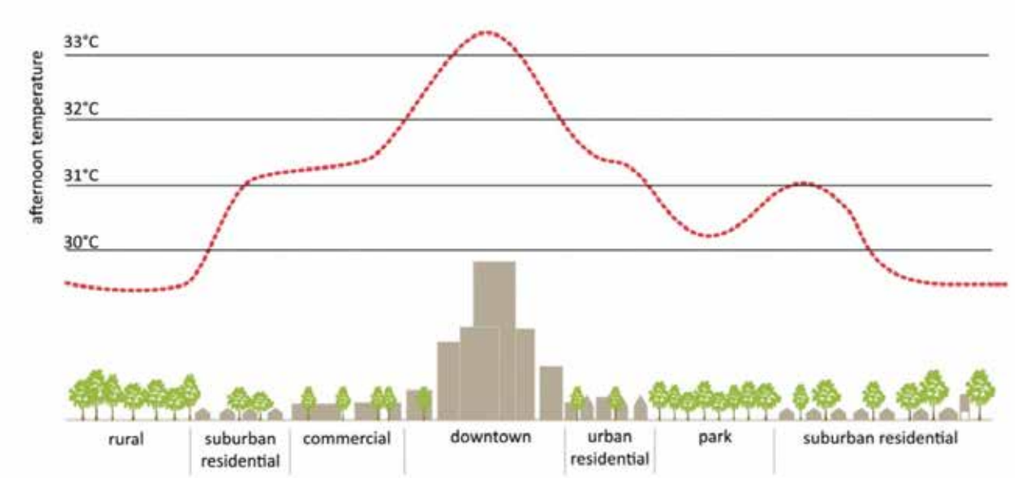

Fig. 9 *Urban heat Island [from: Pötz & Bleuzé, 2012 - derived from EPA, UHI Basics, 2008]*

Naar Voogt, 2000

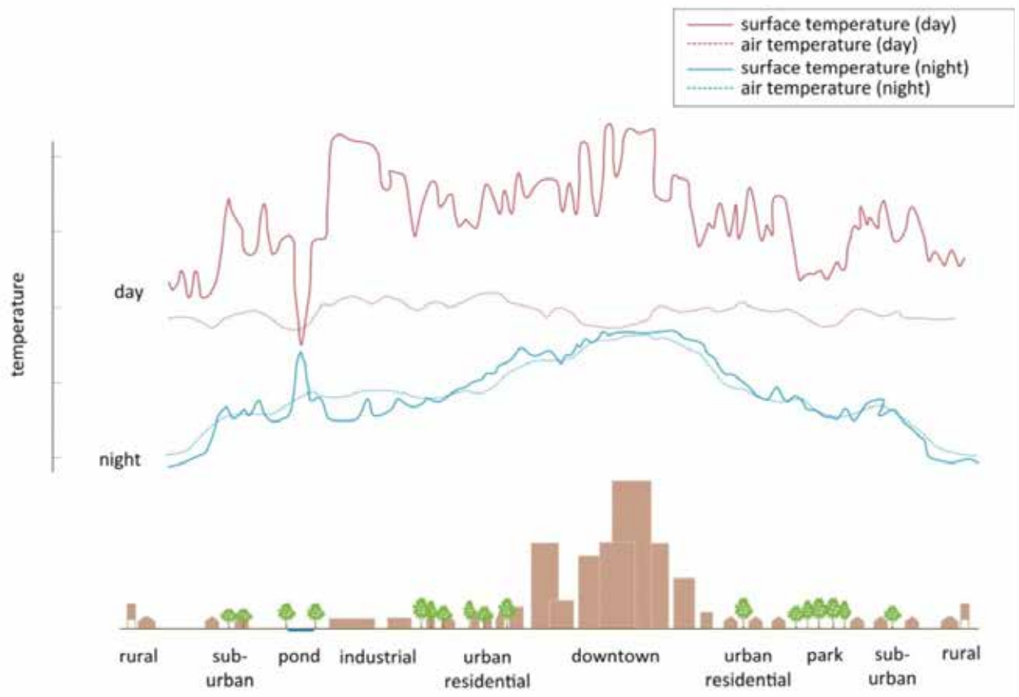

Fig. 10 *Air and surface temperature during the day and night [from: Pötz & Bleuzé, 2012 - derived from EPA, UHI Basics, 2008]*

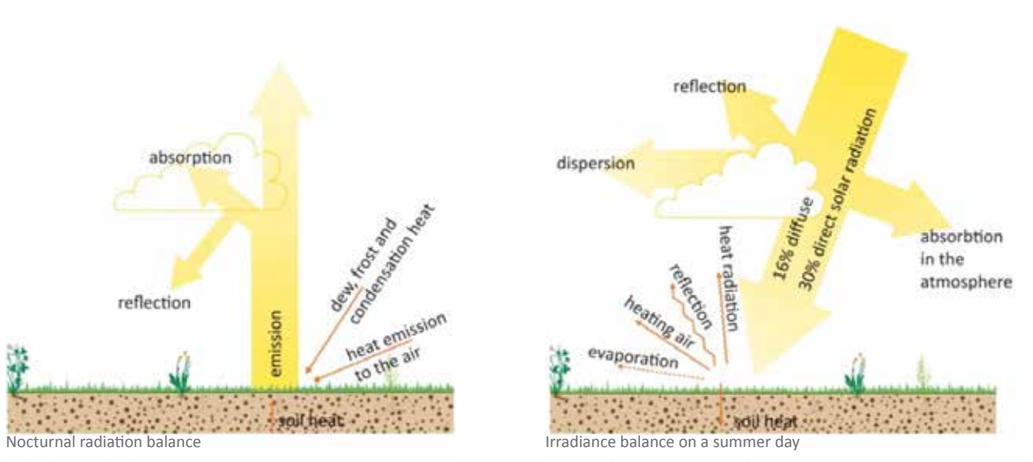

Fig. 12 *Radiation balance during the night on a summer day [from: Pötz & Bleuzé, 2012 - derived from Krusche et al., 1982]*

Fig. 11 *Burned car from sun reflection in London [from: scmp.com]*

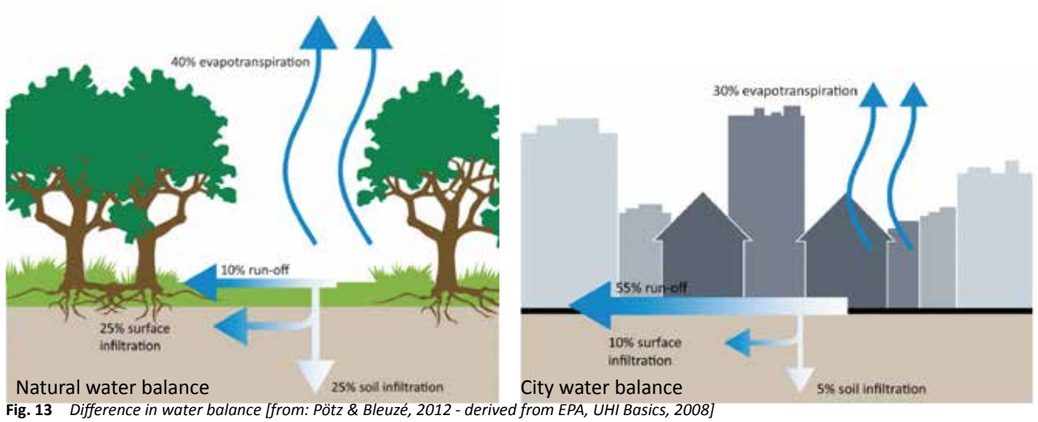

Fig. 13 *Difference in water balance [from: Pötz & Bleuzé, 2012 - derived from EPA, UHI Basics, 2008]*

than 50% of all people lived in urban areas in 2010. The urban areas extended but also intensified. The pressure on available land makes multi-use of built surfaces more common. Today world's biggest cities inhabit millions of people. Without supporting technological developments, big expansions were not achievable.

The population growth in urban areas continues. 90% growth of the world population between 2000- 2025 takes place in urban areas mostly in less developed countries. Predictions are that more than 80% of the population in developed countries will live in a city in 2025 and this development will still increase. In Europe, at the moment, more than 75% of the population lives in urban areas (Brockerhoff, 2000).

Although the rough structure of a city will stay rather robust over time, cities are constantly changing by the on-going process of building, transforming, and decay and breaking down of buildings. The economic crisis now results in slow development of (temporary) vacant land.

2.2 IMPACT ON THE LIVING ENVIRONMENT

The growth of cities continued throughout the ages. Available land became more and more scare while the need for more buildings and traffic lanes increased (Gehl, 2010). With all consequences, more and more land becomes paved or built on. This paragraph will describe environmental, economical and social issues (see figure 2) that came along with the growth of cities.

2.2.1 Environmental issues

In general, the quantity of greenery has dropped. What applies for all dense cities, is that the temperature is higher than in rural areas during hot days, caused by the heating up of the paved (grey) surfaces. A research in the Netherlands even shows that the surface temperature between rural areas and dense urban areas could reach a difference of 10 degrees on hot days (L. Klok et al., 2010). Because of these raised temperatures of paved surfaces in cities in comparison with rural landscapes are called 'urban heat island'. There is a deviation between the temperature measured of surfaces (Surface Urban Heat Island, SHI) and atmospheric temperatures above ground surface and till building heights and tree peaks (Urban Heat Island, UHI). The SHI and UHI varies during the day above the different land occupations (Pötz & Bleuzé, 2012). That the temperature in cities can rise up a lot is confirmed this summer, as sunrays of a half build sky scraper melted parts of a jaguar in London (Volkskrant, 2013). Duyzer et al., in a research from TNO, pointed out that the hottest urban areas are those of industry-, harbour and businesses (Pötz & Bleuzé, 2012).

Another issue is that built on and paved surfaces are not permeable to water. In a natural situation, ground functions as a sponge. The surface and soil can absorb half of the amount of rain. 40% of the rain disappears through evapotranspiration from the ground and plant pieces. From all rain, only 10% water runs off over the ground surface. A paved surface increases this percentage up to 55%. More than half of the rain fallen cannot be absorbed in the ground. During heavy rainstorms less water will be infiltrated and therefore enlarges the chance of flooding.

With the arrival of more paved surfaces the living territory of flora and fauna drastically changed. The biodiversity of flora and fauna diminished.

In nature, there is no waste. Old cities harbour small-scale cycles because of the relation with the surrounding farmland (Deelstra et al, 2005). Another aspect is the enlarged scale of current city cycles. The space of the earth actually needed for the yearly consumption and digestion of waste for a person, called the ecological footprint, has rose drastically. In addition, the air in cities is more polluted.

Fig. 14 *Different type of carrots [from: Newyork.thecityatlas.org]*

2.2.2 Economic issues

Economic developments in cities come with raised temperatures and polluted air. This is an unhealthy living environment for citizens. An unhealthy living environment does have a negative influence on people's well being. Yearly a lot of money is spend on healthcare because of workers report illness. Leave of absence due to illness cost 13 miljard euro a year (KPGM, 2012). The costs of healthcare form an economical issue. The lack of responsibility of citizens for greenery in their close surroundings ensures that the government need to invest a lot of money for maintaining the public domain.

2.2.3 Social issues

That most people live in a city does not mean that cities provide the best living environments. A number of environmental aspects are of influence on the well being of people. Temperature is of influence on the productivity of people and inhaling polluted air will have a negative influence on the public health (Pötz & Bleuzé, 2012). The continuous growth and intensifying cities also result in less space for recreation and exercise.

The increased scale of cities resulted in drastically change of daily life. As social structures were very important in old cities, people's mobility made it possible to have social connections at distance. The urgency of social connections between neighbours decreased and resulted in the individualization of citizens within neighbourhoods. Individualization in combination with raised living standard, people did not feel responsibility for their surroundings any more.

The rise of consumer's usage behaviour abstracted the border between necessary products and additional products. People bought more products than needed and therefore the amount of packages raised. More packages mean more waste. The amount of waste became too much and it became too difficult to let the waste play a part in the city cycle.

2.3 GLOBALIZED FOOD SYSTEM

The ecological footprint of cities is about the number of m2 to feed the city. The growth of the population in urban areas resulted in a need for more food. Given the development of distance independence it was no longer necessary to produce food in the close environments. Agricultural sites moved outside the city and over time, it became possible to import food from any place in the world. The food system is developed in a globalized system. Today, food production and people consuming it developed in a long distance relation. The distance independency to produce food is the result. City land was needed for other (more valuable) developments and agricultural sites moved outside the city. Mechanized machines, crop selection and the application of fertilizers and pesticides are used to maximize crop yields. The food production industry intensified and developed into a large-scale production to fulfil the needs of the growing population in existing urban areas.

The food production is segregated from its consumers. Overtime it became possible to import food from any place in the world. The food system developed in a globalized-system. The globalization of the food system resulted in a lost awareness of the food cycle. Most people do not realize that there exist more different species of a vegetable than the one offered in the supermarket. For some it is also hard to imagine that carrots do not always have the same colour or (straight) shape.

On the contrary, Chinese cities as Beijing and Shanghai still use the adjacent land areas for food production. With a high intensive cropping system these cities are largely self-sufficient in food (Deelstra & Girardet, 1999). This

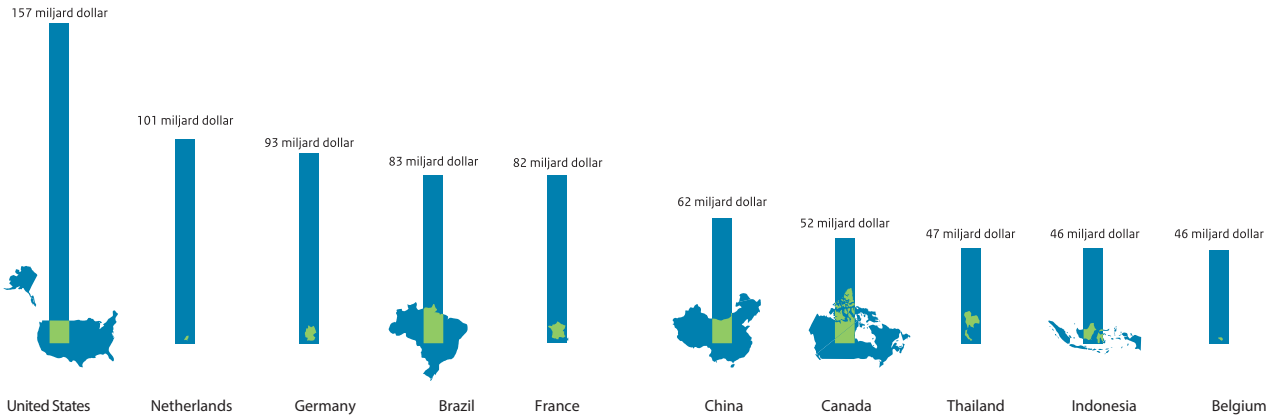

Fig. 15 *World's largest agricultural exporters [from: Pbl, 2012]*

Fig. 16 *Global wheat harvest in monocultures [from: en.mercopress.com]*

situation of food production around cities refers to the European situation in the Middle Ages.

The concept of creating a sustainable society implies question marks by all aspects of the food supply chain, namely production of the food, processing, distribution, consumer purchase, consumer use, and end of life (Baldwin, 2009). This chapter is build up according to these different aspects of the food supply chain.

2.3.1 Production

In accordance to a research done by Ballarby in 2008, the share of global greenhouse gas emissions by agricultural production is 17-32 % (Baldwin, 2009). Global greenhouse gas (GHG) appears to heat up the earth. Direct emissions of land and livestock, the use of fossil fuels in farm operations, production of agrochemicals and energy costs of the overall food system causes this percentage of global greenhouse gas emissions. The single largest contributors to GHG in agriculture are direct emissions from land and animals, like excess use of fertilizers releases nitrous oxide and methane emissions by ruminants. The need for more food in cities resulted in an increased farm scale and the use of monocultures. These adjustments are not possible without the use of fertilizers. Next to fertilizers for the maintenance of the large-scale monocultures, there is a need for massive applications of pesticides. Monocultures are easy victim of pests (insects, pathogens, and weeds). In 2008 Pimentel and Pimentel show that even with the use of pesticides there is a loss of 37% of all crops, globally. Crop growth in monocultures to maximize crop yields and maximize profits resulted in a lack of genetic diversity (Francis, C., & Wart, J. van., 2009). According to Brown (1981), only 10 to 20 crops provide 80-90% of the world's calories for example (Francis, C., & Wart, J. van., 2009).

Another astonishing fact is the amount of food losses from the moment of harvesting to the moment consumers can buy it. Niranjan and Shilton estimated in 1994 that the postharvest losses have to be about 21% of the total food in our current supply chain (Dieu, Tran Thi My, 2009).

Productivity and production rose increasingly using technologies in especially the US and the EU. The overproduction goes far beyond international needs and local markets, with export as a way out. Export has contributed to the up scaling of businesses into major corporations. The agricultural system of developed countries transformed in a polluting branch of industry.

Through city expansions and the globalized food system, the transport time of fresh food to its final destination increased. Freshly harvested food loses much valuable nutrition after they are seasoned. Fresh food like vegetables and fruits has to be picked when they are seasoned. Vegetables and fruits are most vulnerable when they are mellow and its ripening process continues after harvesting. Therefore, they are not resistant to long transportation distances. The production of food far from where it will be consumed requires the need to preserve and pack products for transportation and to provide protection until the moment of use.

Considering the accessibility of food and better nutrition West European cities it embraces the fact that fruits and vegetables are picked before its ripening process is finished or that the food industry 'fiddles' with food. Products contain less nutrients or more additional ingredients than necessary.

As the northern countries produce way to much food there are still a lot people in the south who do not have food at all. Therefore, the accessibility of food and better nutrition is less important for West European cities compared to developing countries.

2.3.2 Processing

The lost of this relation between food production and consumers makes it for the food industry easier to 'fiddle' with food one can buy in supermarkets. The food industry transformed products to make them cheaper, more colourful,

Fig. 17 *Influencing consumers purchase by adding colours [from: unknown]*

change the taste and to preserve foods for longer. This resulted in products that contain a lot more additional ingredients than necessary. According to Michael Pollan (2009), margarine is such a special product. In his book 'In defence of food' he describes margarine as an 'invention' of the food industry for cheap butter. What makes this product so outrageous is that the producer can change almost all the ingredients without anyone to notice. Let alone that margarine contains a variety of additives.

The growth of big companies made it hard for the customer to have influence on the final product and therefore the production of products became vague for consumers. Even if it is mandatory for producers to label its products including all ingredients, this is not always the case. In the Netherlands, topics about food are regularly in the news with a critical note for producers who are fiddling with food products. Certain instant lasagnes contained horse meat next to beef (APN, 2013).

2.3.3 Distribution

The current generation is used to an extensive variety of products, from all over the world, in the supermarkets the whole year through. A delayed supermarket supply may result in fewer options what to make for diner. People are not prepared to situations like this and that indicates the dependency of people about the food offered by supermarkets.

Owing to the globalized food system, the transportation distance increased drastically. The distance needed for the transport of food from its production until it reaches its consumer is called food miles. To overlap the food miles, the amount of transport increased and that resulted in busier transportation routes. With a lot more CO2 and particle emissions (thanks to the transport methods that are still running on fossil fuels), noise nuisance, traffic jams as result.

The need for transportation asks for the need of packaging to protect the food for damaging, to preserve the food and to be able to transport it in large quantities. The production of packages also increases the need for energy. Same situation holds for the products that need to maintain a certain temperature for preservation that also requires. These luxury food-preservation techniques are possible because of rising incomes.

2.3.4 Consumer purchase

The range of products in supermarket decreased to a selected choice of products that are tasty, smooth looking and have relative long preservation dates than other products. In addition, the food industry is influencing the customers on their purchase behaviour. The functional purpose of packaging (for protection and preservation) developed to purposes that are more cosmetic. Packages might contain a lot of bright colours and attractive sentences to mislead consumers and even represent as if they are healthy. As consumers are often misleading with their food purchase, they often buy more food than needed. In a society in which citizens and cities lost connection to the producer of their food, the awareness of the production of food is gone. This caused different troubles, for example overweight.

2.3.5 Consumer use

The mental question of consumers' diet patterns is most important related to the sustainable issue according to Jansma, researcher on urban farming at the University of Wageningen (Vré, 2012).

Buying more food results in eating more than needed or the need to throw away more food due to deterioration. People lost the connection with their food production and cannot estimate when a product is out of date or not. Products might be thrown away immediately after shelf life. All producers are obligatory to put the

Fig. 18 *Avoidable and unavoidable kg food waste in the Netherlands [from: CREM, 2013]*

Fig. 19 *Black box according to Duijvestein [from: Duijvestein, 2008]*

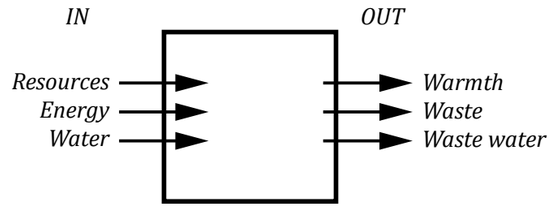

Fig. 20 *Sources needed for functioning according to Duijvestein [from: Duijvestein]*

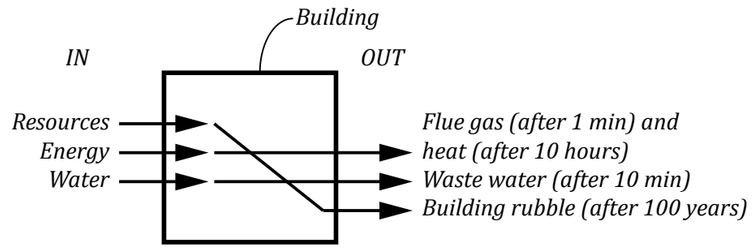

Fig. 21 *Strong differences in flow rates between flows [from: Duijvestein, 2008]*

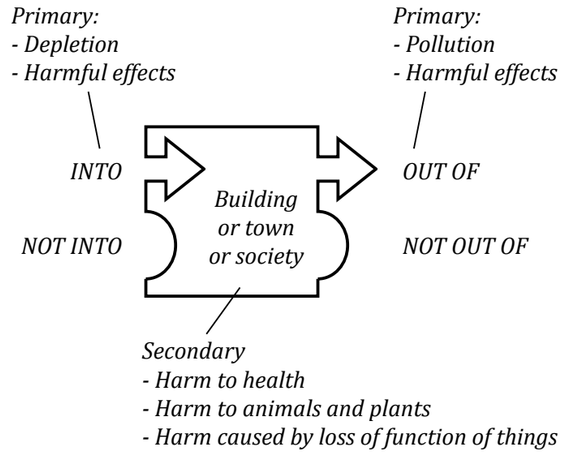

Fig. 22 *Sources related to environmental problems [from: Duijvestein, 2008]*

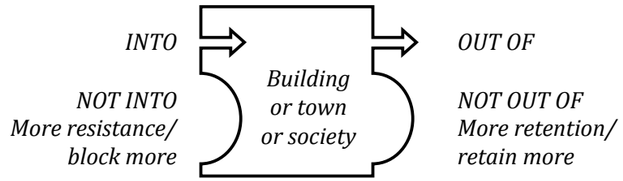

Fig. 23 *Flushing system [from: Duijvestein, 2008]*

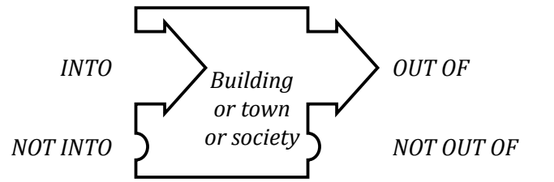

Fig. 24 *A control system [from: Duijvestein, 2008]*

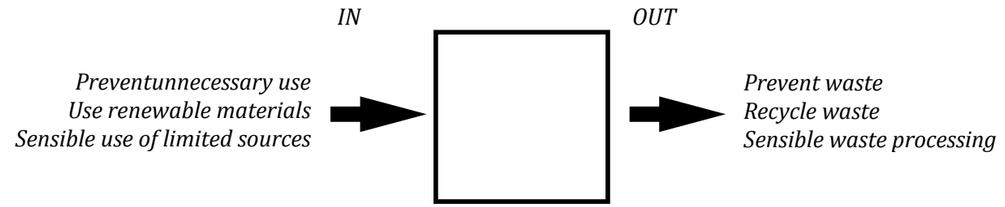

Fig. 25 *Three-step strategy [from: Nienoord, 2014 - derived from Duijvestein, 2008]*

perishable date on their products, but it does not always mean that the product is not suitable for consuming any more. In combination with the purchase of too much food, a lot of food might be thrown away.

2.3.6 End of life

Purchasing more food than necessary means more waste. A report published by CREM shows that 43,7 kg of food thrown away, out of 73 kg, can be avoided (Westerhoven, 2013). Even if food is not thrown away, there is still a lot of packaging left over. Waste recycling is coming up (paper, plastic, biodegradable waste) but it is still done too few. Still many resources will get lost.

2.4 TOWARDS MORE SUSTAINABLE CITIES

Due to economic crisis and the need for a sustainable society, the actual way of living in general is questioned. Existing production methods and processes are evaluated to make them less, or in the best case, not harmful for our environment. The first paragraph describes necessarily to close cities cycles. The second paragraph describes what this research means with sustainable living environment and the influence of greenery to reach this.

2.4.1 Closing cities cycles

A Kyoto protocol is initiated as a first international agreement by setting internationally binding emission reduction targets. As described by Duijvestein a city can be seen as a black box (2008a). City needs several supply inputs to function and after using these supplies different outputs are generated. Incoming supplies, as energy, water and materials, lead to depletion and harmful effects. On the other hand, outputs, like different waste flows, lead to environmental problems through pollution and harmful effects. Duijvestein calls depletion, harmful effects and pollution “primary” environmental problems. People are getting aware of these “primary” environmental problems. In nature, the metabolism of an ecosystem is a circular system. One of the requirements to make a sustainable city is close its cycles.

The amount of input and output is scaled up during the ages and therefore a continuously higher pressure is put on the environment. Duijvestein describes the functioning of the black box now as a “flushing system”. Shield functions need to be adding to the black box to prevent things from deteriorating further. Shield functions specify the functions that should not go in the system, or should not go out of the system. It offers resistance to supplies going into the system and retention of waste flows coming out of the system. Inputs and outputs should be reduced to lower the environmental problems.

For both IN- and OUT-side there is a “three-step strategy” to make the functions more efficient. The IN-side of the system includes the sequence order of preventing unnecessary use, the use of renewable materials and making sensible use of limited sources. The limited sources can be used in a clean way or with a high efficiency.

The “three-step strategy” for OUT-side is in the sequence order of prevent waste, recycle waste and a sensible waste processing. Waste can be prevented for instance by disassembling, recycling of materials and extending the life span of goods. Waste recycling is for example done by separation of waste. Sensible waste processing should be done or as clean as possible or waste should be retained for future use. Most important is that no sources get lost.

Fig. 26 *Water balance by unpaved and paved surfaces [from: Pötz & Bleuzé, 2012]*

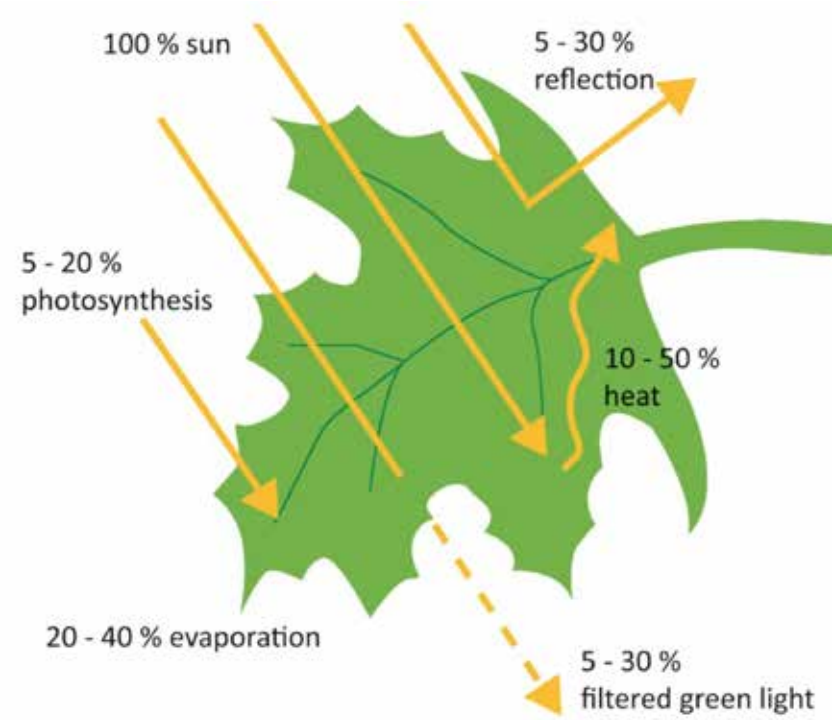

Fig. 27 *Energy balance of a leaf [from Pötz & Bleuzé, 2012 - derived from Krusche et al., 1982]*

2.4.2 Sustainable living environment

Science is ambiguous about the cause of the world's climate change, Al Gore (2006) argues that it is a result of human (polluting) activities as others argue it is part of a natural process (Labohm, H. H. J., 2004). Independent of climate change, it is noticeable that the current living environment in cities might require improvement. New ways of city development are needed, as well as changes in our current way of living.

Cities need to minimize their share of environmental problems and reduce dependency on energy-intensive usage of fossil fuels and product transportation over distances. New city developments need to have a positive influence on people's health. City development can invite to change the current way of living by adapting the need for more awareness of healthy live style.

As mentioned in chapter 1, the definition of sustainability in this thesis is: *Sustainability is about high quality and is to be found in a valuable balance of social-, environmental- and economical qualities. All this needs to become a manifest in spatial environment.*

When the above mentioned social-, environmental- and economical qualities are in balance, they apply for a sustainable living environment. Chapter 6 elaborates the specific prerequisites to provide or a high quality living environment for people.

2.4.3 Influence of greenery

In an economy, focussed on money, positive aspects of greenery are omitted. That it represents great economical value within the dwelling-, working- and living environment is almost unknown (Bade, Smid, & Tonneijck, 2011). This extended construction drift caused inclusion of existing green places and parks in and around urban areas. However, urban planers tend to be known with the fact that greenery increases the quality of city life since the first city parks. Green areas traditionally have the function as representation of health and city hygiene in Western cities (Pötz & Bleuzé, 2012).

The quality of greenery is hard to measure in terms of money and its maintenance costs weighs relatively heavy. Greenery has been graded less valuable and therefore needed to make place for more economical feasible functions in the city. Lowering the maintenance cost mostly results in a lack of the greenery quality. Related to the exclusion of greenery in cities, agricultural sites moved out of the city.

Now we are (again) getting aware of the positive influences of green areas on the living environment society. This paragraph will describe the positive effect of greenery according to the environment, economical and social aspect.

Environmental qualities

Related to the (living) environment, the soil and greenery can remediate water. Pavement cannot. Water remediation has a positive influence on the temperatures in cities. Water can cool down the air. Greenery also creates shadow and cools down the surface and air temperatures by evaporation. In addition, greenery can filter the air with absorbing CO2 and sulphur dioxide and can tie on particulate matter. A full-grown city tree can almost tie 1,5 kilo particulate matter a year. (Pötz & Bleuzé, 2012). The amount of foliage determines the amount of air filtered. Large trees can get rid of 70 times more particular matter than small trees, according to the 'kroonprojectie' (Bade et al., 2011).

Fig. 28 *Passageway in Middlesbrough [from: Dailymail.co.uk, 2013]*

Fig. 29 *Community transformed Victorian passageway in Middlesbrough [from: Dailymail.co.uk, 2013]*

Plants that do not lose their leafs can also remove particular matter during winter and are thus more effective than plants that do loose there leafs (Bade et al., 2011). Replacing paved surfaces into green surfaces gains high environmental impact by affecting the removal capability to a relative high amount of particular matter. Besides, the sun is not able to heat up the replaced paved surfaces any more.

Plant growth can also contribute to conserve soil (Deelstra & Girardet, 1999). Although greenery contributes to improve the air and soil quality, it does not solve the source of the air and soil pollution. In addition, plants also give a nice view and pleasant odour. More qualitative greenery will also influence the perception of the living environment and increases strengthen the environmental quality.

Economic qualities

A Dutch research of Jókövi and Luttik pointed that there is a relationship between greenery, water and housing prices. Houses in close surrounding of water or greenery can have a higher property value that can increase. Depending on the location of the house and the type of water or greenery, the housing price can increase with 4% to 12% (Jókövi & Luttik, 2003). The highest percentage increase of property value is for property in close location of accessible, high quality nature and a view over surface water. Water and greenery also create a higher touristic value and ensure a higher income for recreational activities (Pötz & Bleuzé, 2012).

Multiple researches emphasize the vital role of greenery in the health of people. This means that adding greenery in the living environment can lower cost for patient care (Bade et al., 2011 and KPGM, 2012). As mentioned in paragraph 2.2.2 the maintenance cost for the public domain are relatively high, this includes the maintenance for greenery. Greenery can function as catalysis during the revalidation process, reducing the need for medial help and increasing the living quality for patients (Pötz & Bleuzé, 2012).

In 'Groen Loont!' its writers argue that because greenery is multifunctional, divers portfolios within municipalities as portfolios outside of municipalities should finance its maintenance. Possible portfolios are water management, health and welfare, sport and recreation, traffic and transportation, environment and energy, building and living, finance and taxes.

More research need to be done on the relation between health and well-being and the impact of small green surfaces as neighbourhood green, street trees, green roofs- and facades and private gardens. These green areas not included in the research of Maas (2008). In addition, attention should be paid to the design of the greenery as fenced off greenery is experienced as unsafe in high dense areas. (Maas, 2008).

Social qualities

Green areas relate to different health issue, both physical as mental. Greenery nearby, in both qualitative and quantitative ways, is getting increasingly important. Maas (2008)emphasizes in her doctoral thesis the positive impact of greenery on the health of people. Greenery in the living environment can reduce the chance of depression or other illnesses. The more greenery, the healthier people feel and are. This relation is strongest by children, youth, elderly and people with a low social economical ranking.

A literature review of Malakoff points out that the impact of a plant on people can already have impact by just looking at it. It reduces stress, fear and anger, and lower blood pressure and muscle tension. These impacts have good effects in prison environment and patient care (Brown & Jameton, 2000). The latter because recovery is fastened and so less hospitals and less painkillers needed (Ulrich, 1984). Within cities, green areas can provide place to relax and to retire from the noise and commotion of city life (Brown & Jameton, 2000). Working with greenery

does have a therapeutically quality. For the development of children, it is important to have opportunities to play in nature for development of social -and concentration skills. Green areas provide spaces for recreation or to do physical exercises, from maintaining the plant to more sporty exercises.

There is also a relation visible between the quantity of green in the living environment and the feeling of safety (Maas, 2008). Crime rates are around 42% lower in greener neighbourhoods (Bade et al., 2011).

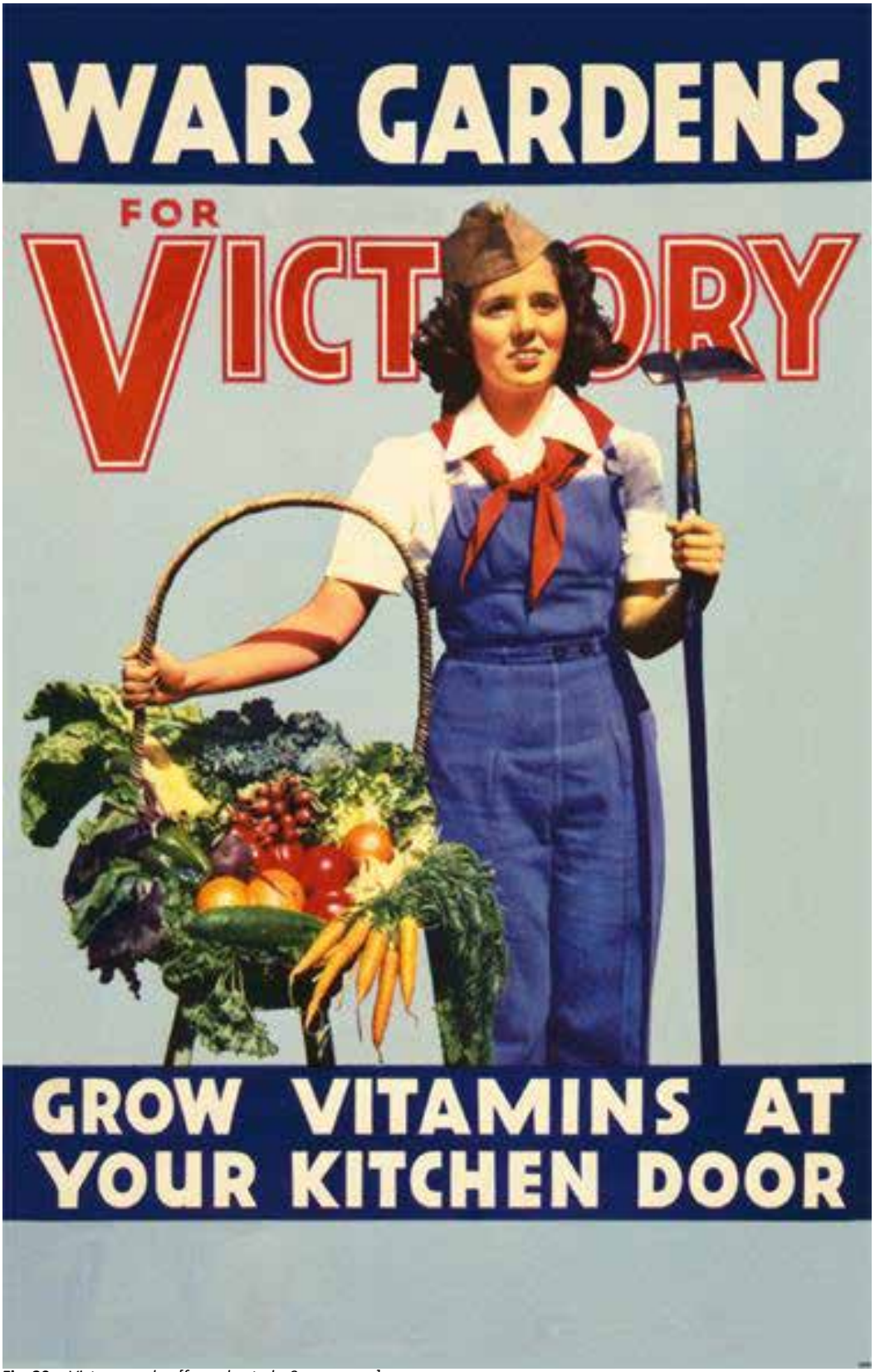

Fig. 30 *Victory garden [from: hosted-p0.vresp.com]*

3. URBAN FARMING

This chapter goes deeper into the topic of urban farming. The first paragraph of this chapter gives a short introduction on urban farming and reasons why this phenomenon is rediscovered. The second paragraph describes the concept of urban farming, including the cultivation types or kept on an urban farm, it describes different organizations, and will go deeper into the different cultivation methods. The focus of farming in the city is on possible locations and the influence of urban conditions or architecture. The third paragraph discusses the opportunities of urban faming as paragraph four discusses the issues of urban farming.

3.1 CONCEPT

Urban farming, the production of food in or close to the city, is rediscovered. According to Van der Schans (2011a) in 'Agrarian urbanism the new Utopia?' is urban agriculture known as a surviving strategy for the poor in Third World countries. In the Third World countries, there is not enough food to feed the whole population.

Not to forget that developed countries also experienced a shortage of food during WW II. The United States produced 40% of the nation's grown fresh vegetables in Victory Gardens in 1944. The war disrupted the food supply, thus people created urban farms to survive. This example underlines the dependency upon the food sector for most people in developed countries as well. Allotments started in the 19e century in the Netherlands, because people did not own a garden.

Nowadays, more developed countries are coping with getting enough food transported to the city and how to get people in contact with the food production. The globalized food system (see chapter 2.3) has resulted in a society with disconnected citizens and cities from the production of their food. The awareness of food production is gone. This causes different troubles, for example overweight. Citizens are harvesting at the supermarkets so to say. The growth of cities is still proceeding and therefore more transport of food.

Problems of food production and transportation can be combined with the need for more greenery in cities. Why shall one not realize more greenery that gives something in return? Increasing the amount of agriculture in the city will make greenery and fresh food more accessible. This is especially attractive for those with less green areas in the direct surrounding of their dwelling.

3.1.1 Food production

The production of food in or around the city and can include the cultivation of nuts, vegetables, fruits, spices, mushrooms and keeping livestock and bee's. Bees play an important role in the pollination process of flowers for the development of vegetables and fruits. This process can be boosted when flowers are planted close to the cultivation grounds. The seasonal diversity of crops has influence on the aesthetic view. Currently aesthetics and crop cultivation are seen as two separated issues. The spatial component of crop cultivation disappeared thanks to the use of monocultures. These two issues in fact have overlaying aspects.

New projects are getting aware of the (aesthetical) opportunities of food cultivation. An eco-neighbourhood EVA-Lanxmeer in Culembourg encompasses landscapes with edible plants throughout the neighbourhood as public greenery.

The use of an urban farm can vary from private to semi-private to public owned farms. One or more private persons or organisations can use these farms. Organizations can be institutional or commercial based. Public farms are mostly

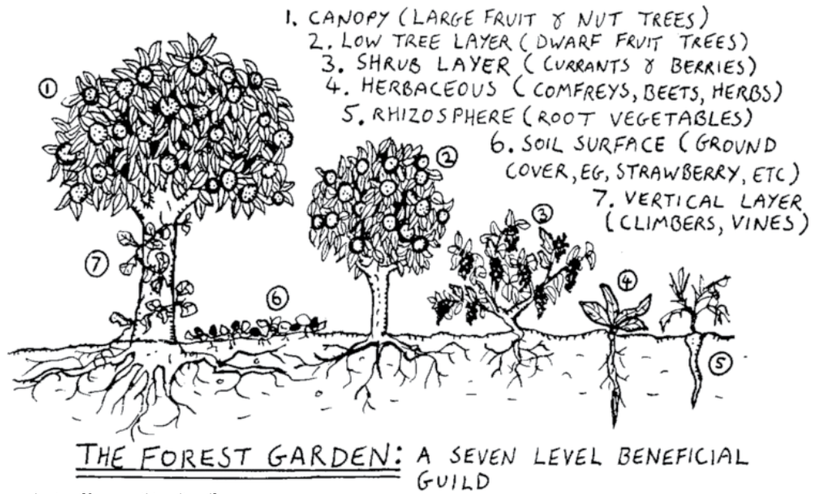

Fig. 31 *Forest gardening [from: wikipedia.nl]*

Fig. 32 *SPIN- Farming at Villa Augustus [from: Nienoord, 2013]*

Fig. 33 *Hydroculture [from: Nienoord, 2013 at 'Urban farming open day' in the Netherlands]*

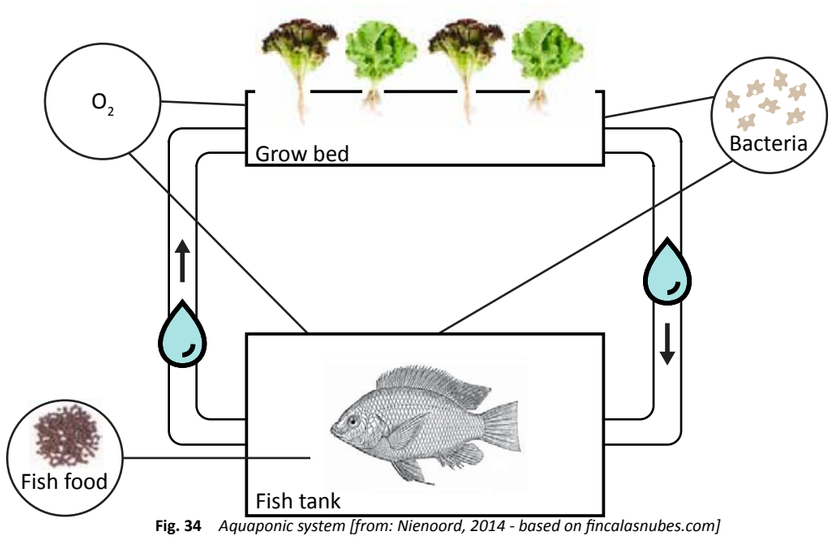

Fig. 34 *Aquaponic system [from: Nienoord, 2014 - based on fincalasnubes.com]*

community based.

With the existence of the new neighbourhood EVA-Lanxmeer, an urban farm is initiated named Caetshage. Although it is a commercial urban farm, the farmland is accessible to visitor for experiencing its designed farm landscape during opening hours or just as a passageway. In that way, the urban farm becomes more valuable for its surroundings.

3.1.2 Cultivation methods

Different cultivation methods can be used from low-tech to more high-tech methods. The to be applied method differs according to the spatial requirements of the city and the type of crop as possibility for the city. Paul de Graaf makes a division of four types of urban farming in his report "*Ruimte voor stadslandbouw in Rotterdam* (Space for urban farming in Rotterdam)". The division is made based on the different cultivation methods, namely:

1. Forest gardening
2. SPIN farming (Small Plot Intensive)
3. Hydroculture
4. Aquaponics

Next, these methods will be described. Attention will be paid to scale, growth medium, weight, the amount of maintenance, investment capital and develop time.

1. Forest gardening is a productive garden designed as a self-maintaining ecosystem introduced by Robert Hart. The ecosystem contains a closed nutrient cycle that makes it a knowledge intensive practice. The productive garden is fixed to its location, as it is a long-term investment that takes around ten years for the ecosystem is full grown after implementation. It is an energy extensive cultivation method as harvesting is the main maintenance activity. Harvesting takes more time thanks to the diversity of products. The focus is on an optimal balance between (less) labour and resources and (maximum) yields. It can be used as an alternative for green maintenances, as it provides seasonal greenery. De Graaf sees forest gardening as a method to improve the aesthetical and ecological quality of existing green areas, rather than making cities greener. Forest gardening is the ultimate potential within public areas, to function as a park for example. Except from water buffering the productive garden does not exchange or influence on cities metabolism.

The three remaining farming methods are more focused on the relation between highest yields on the smallest surface.

2. Open field cultivation is most common. This cultivation method is dependent on the quality of the ground soil. SPIN farming (Small Plot Intensive Farming) is making use of open field cultivation on highly productive small plots, introduced by Wally Satzewich. SPIN farming can be done on the ground, in containers at the ground or on roofs. Cultivation on roof replaces soil by light weighted materials as lava stone. SPIN farming is labour intensive instead of capital intensive. Only the cultivation on a roof needs extra investments. The cultivation on roofs or in containers on the roof is less ground fixed. The criterion for roof cultivation is the capability of the building to bear the weight of the amount of soil. The weight can decline by concentrating the soil beds only at cultivation places or by usage of lighter materials (use on roofs). If possible, open field cultivation is preferred because of its climate advantages and its aesthetical potentials.

Fig. 35 *Crop cultivation structure with lava stone [from: Nienoord, 2013 at 'Urban farming open day' in the Netherlands]*

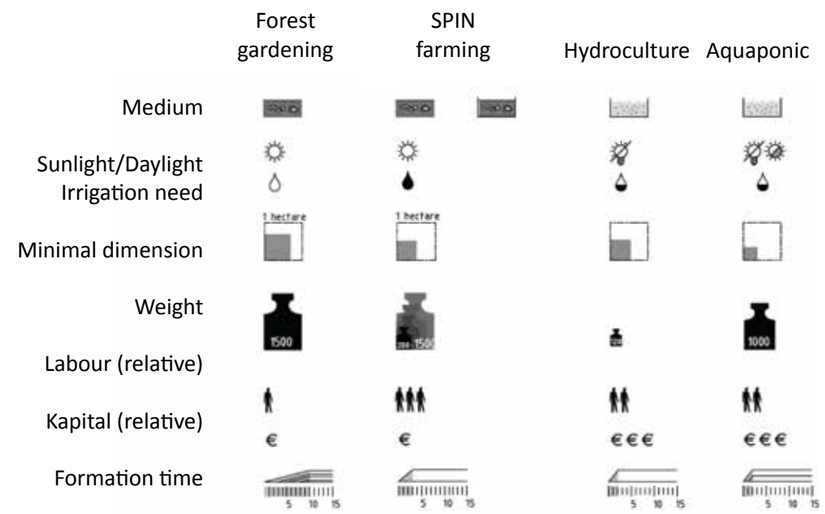

Fig. 36 *Considerations per urban farming type [from: de Graaf, 2011]*

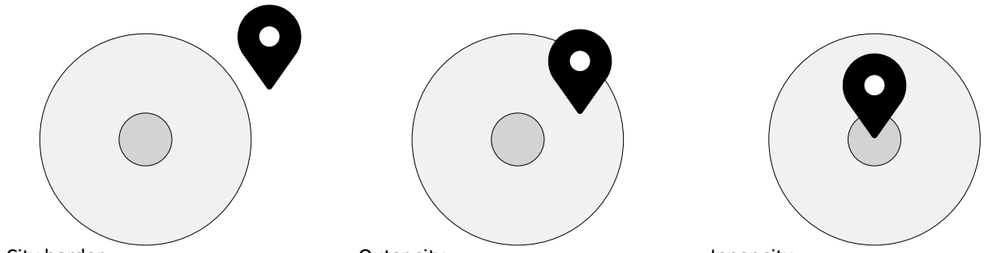

Fig. 37 *Possible urban farming locations at city level [from: Nienoord, 2013]*

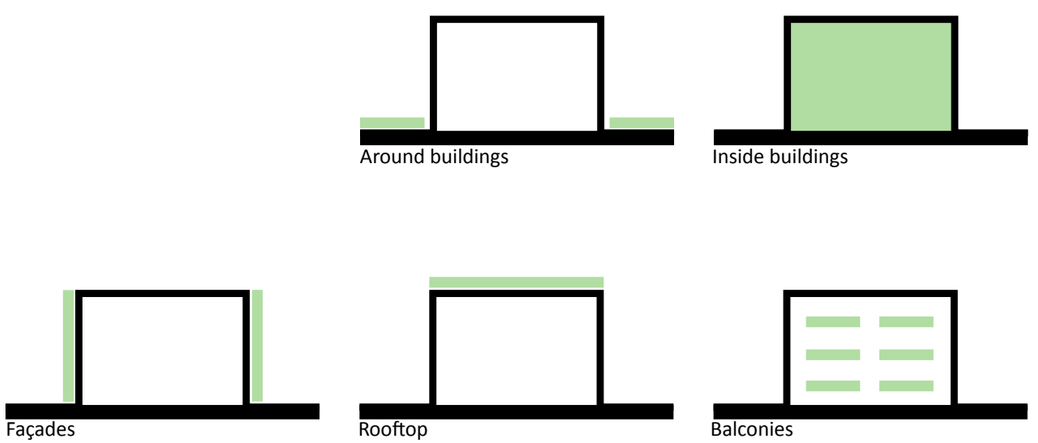

Fig. 38 *Possible urban farming locations at building level [from: Nienoord, 2013]*

3. Hydroculture makes use of water as growth medium and is a cultivation method that can generate high yields. The plants constantly receive a right mix of nutrients. The system is light weighted and therefore can be used in glasshouses on roofs. The investment costs are higher then the previous ones and the system is therefore more capital intensive. It offers the possibility to re-use nutrients.
4. Aquaponics is a combined system of hydroculture and fish keeping. The fish provide nutrients for the plants as bacteria generate organic waste from poop and pee, and the plants clear the water from this organic waste for the fish. Fish food is the only supply that needs to be added into the system. It is a more expensive production method and it is also energy intensive. This method can be cultivated in a glasshouse or in buildings. Its potential is to connect it to city waste streams.

3.1.3 Farming in the city

Urban farming distinguishes itself from rural farming in a way that it is executed in or around the city, where it keeps in touch with its citizens and processes. A leading criterion for urban farming is in what way it differentiates itself from rural urban farming by making use of urban conditions. The combination of food production in urban areas with secondary activities is necessity. Urban farming does not have any existence in the city if it does not involve its citizens (Nienoord, 2013d).

The city provides many different sites with varying site condition and scales. Its temperature is mostly one or a few degrees higher (see chapter 2.2.1) and ensures multiple cultivation cycles and a short distance to the market. As cities are much denser than its rural land, therefore the food production in cities will take place on a relative small scale. The size of an urban farm will be determined by the amount of space available within the city. The variation in size makes it possible to adapted it to persons-scale circumstances (Deelstra & Girardet, 1999). This also accounts for the variety of cultivation methods.

Available spaces are determined partly by the density of a city. In general, the further one will go into the city the denser its built environment will be. Less space is available by a higher city-density. The location of urban farms can be roughly divided into three different parts, namely on the border of the city, in the outer city or in the city centre. The city may contain parks, plazas, waterfronts, and buildings.

Many urban farming initiatives make use of the stagnating building sector (the project of Marconistrip for example). Vacant land often offers larger surfaces within the city and is therefore well suited for urban farms. Besides vacant land, attention is growing for cultivation within buildings. The use of vacant land mostly goes along with a temporary availability of the land. This emphasizes the binary time character of urban farming to be temporary based or permanent. Examples for crops cultivation within vacant buildings exists but are not implemented on a large scale yet.

Urban farming can be implemented on many different places within the scale of a building. Spaces around buildings can be used for cultivation, but also inside buildings, on the façades (hanging gardens), at rooftops or balconies. Several technical considerations are needed to choose a right location for urban farming.

Fig. 39 *'City-sheeps' in Groningen [from: Focusgroningen.nl]*

Fig. 40 *Crop cultivation in climate controlled room with LED light [from: Plantlab.nl]*

The main technical considerations as described in 'Designing urban agriculture opportunities for southeast False Creek' (Holland Barrs Planning Group, 2007). These are:

- *Soil type and depth*
- *Drainage*
- *Wind exposure*
- *Access*
- *Water sources and uses*
- *Size and dimension of beds*
- *Orientation/exposure*
- *Materials*
- *Supporting structure*

The location of urban farms has influence on the way it will be maintained. Most activities needed at the countryside, like sowing and harvesting, are done mechanised. This mechanisation is less suitable for activities within the city, because most farming plots are much smaller and these large vehicles require a lot of space. On the other hand, the city already provides a large developed (public) infrastructure for transporting people to the urban farm.

Within the city, it is not allowed to use pesticides. The exclusion of pesticides sounds like a biological cultivation method. However, biological crops should be cultivated in soil beds in open air according to EU-norms. As described in the previous chapter, that is not always the case within urban farming in cities.

Every crop does have specific environmental and spatial needs. Compliant environmental needs do not guarantee the same spatial needs. An overlap is needed between the spatial requirements of plants and the present elements in built environment. Livestock as sheep, pork and beef do have relative large spatial needs. Sheep are currently used for the maintenance of public greenery in the city Groningen (Nuver, 2007).

Architecture can manipulate the environment for crops and livestock. This can makes farming less depended on weather conditions (Broyles, 2008). (Heated) glasshouses for example, can extend the growth season of crops or can be used for cultivated all year round. Crop cultivation inside buildings makes use of natural light through windows, like window gardens or use artificial light to imitate natural light. New technologies make it even possible to cultivate crops without natural sun or daylight. This way food is grown stacked upon each other vertically, called vertical farming. Dickson Despommier, professor at Columbia University, amongst others, sees *vertical farming* as a potential future solution for cities. Some systems even pass on the exclude natural sun or daylight and use climate-controlled rooms to optimize crop production. Climate-controlled rooms ensure a year round growth season for all crops. Plantlab is one of the companies that develop and optimizes system for crop cultivation in climate-controlled rooms. Year round growth and the use of available space makes these cultivation methods more efficient.

3.2 OPPORTUNITIES OF URBAN FARMING

Veenhuizen (2006) describes food security and healthy nutrients as probably the most important contributions of urban farming. Van der Schans and Witskerke (2011b) point out that the delivery of products and services to the city will be the strength of urban farming. Its function is often a combination from food production with other aspects. The preceding chapter describes aspects related to urban farming. A description is given of the influence of greenery in the living environment in chapter 2.4.2. Urban farming includes the cultivation of crops. Crops are plants and

therefore might have the same influence as greenery. Chapter 2.3 describes the aspects of our globally developed food industry that can be improved. Urban farming can play a significant role to solve a lot of these previous described problems. This paragraph gives an overview of the influence of urban farming and describes how urban farming can contribute to solve these problems and how it can add qualities. Again, the paragraphs are structured based on social, environmental and economical aspects (figure 2).

3.2.1 Environmental qualities

The implementation of urban farms improves the ecological performance of cities (Deelstra & Girardet, 1999). It can contribute in managing storm water and open spaces by lowering the temperature in cities, subtracting CO2 and particular matter, and by conserving the soil and creating biodiversity.

The higher temperatures and more CO2 in cities create actually advantageous conditions for faster growth of plants. Uptake capacity for CO2 of vegetation is highest during its growth phase and, as crop growth is constantly in this phase, it can abstracts relatively a lot of CO2 from the air. For forest gardening or SPIN-farming it is essential to have locations that receive enough sunrays. Rooftops are relatively the sunniest locations within cities as they flee from all activities in the city. The sunrays will raise the temperature of a bitumen roof to 70˚ degree. Green roofs covers the bitumen layer and lower the temperature on a sunny day to 29˚ degree (Pötz & Bleuzé, 2012). Rainwater will be filtered by green roofs and is therefore cleaner. Collecting rainwater and use it for the watering of crops will limit the use of drinking water for these activities. An exchange of flows can be created with the building underneath.

Urban farming can limit resources or make use of unutilized resources in the city (Schans & Wiskerke, 2011b), household waste for example. The total household waste consist out of 20% biodegradable household waste (Deelstra & Girardet, 1999). This part of the household waste might serve as fodder for livestock or should be digested to organic fertilizer. The organic waste can be sold to rural farmer or inhabitants of cities owning a private garden.

Non-biodegradable household waste can be reduced by local production as the need for transportation- and preservation packaging decreases.

The use of urban farming reduces or excludes the following aspects within the food production chain. The cultivation of urban farms is done mostly in poly-cultures and without the use of synthetic fertilizers and pesticides. A *diverse* range in crops and flowers selection increases diversity in food supply and *enhances natural habitat* and *ecological health*. The enhancement for natural habitat is beneficial for natural predators of garden pests (Holland Barrs Planning Group, 2007). More natural habitat will also help threatened animal species as bees.

Small scale farming distributed throughout the city ensures distances to counteract the spread of food borne illnesses (Broyles, 2008). The small-scale food production also eliminates mechanization. The production of food close to its consumers will reduce the amount of kilometres needed for transportation. The above mentioned aspects lead to the use of less fossil fuel within the process, and are therefore reducing the ecological footprint of a city and are therefore more sustainable.

3.2.2 Economical qualities

The presence of greenery within the built environment increases property value (see chapter 2.4.3). Besides, the

presence urban farming creates *productive landscapes* that gain economical benefits from the products. Another quality can be found in the production location of the farm close to its market, the citizens.

Urban farms need to be maintained and therefore generate employment. Jobs can also be created by the start of new catering activities. This employment gives a boost to development of local economics. People who have time or energy available might maintain urban farms to lower the maintenance costs (Van der Schans, 2011b). Implement urban farms in the close surrounding of citizens make the urban farm more *accessible* and invites for frequentional use.

An urban farming project can generate a lot of (international) media attention (see chapter 4). Cities also obtain high profile due to this international attention. As a result, the city might attract more tourists and thus gain economical benefits.

In order to stimulate sustainability, Dutch cities sometimes provide subsidy for the implementation of green roofs. This subsidy differs in every city but is an additional financial support. Implementation on the roof emphasizes the possibilities of *multi use* for urban farming in combination with other facilities. Urban farming does not have to displace other functions in the city.

3.2.3 Social qualities

Urban farming can contribute to physical and mental health of people. Physical health of urban farming includes good effects to people in an enclosed environment, improved patient care and providing places for recreation and positive mental aspects of urban farming on crime reduction, safety and exercise (see chapter 2.4.3). The improvement of physical and mental health is especially of influence on elderly people (Wakefield, Yeudall, Taron, Reynolds, & Skinner, 2007).

Physical health of urban farming includes production of healthy food. The production of food in the surroundings of its consumers ensures that fruits and vegetables can be picked when ripe. More nutritious products will be the result.

As people can see how their food is grown, they can develop a better understanding what is healthy to eat. In this way, urban farming contributes to people's awareness about healthy foods. Products that contain less nutrients and more additional ingredients than necessary might become undesirable.

For people originating from a different country as they live in, it is not always possible to buy all their desired products. In this way urban farming can contribute to (cultural) diets (Wakefield et al., 2007). The emergence of urban farming is also supported with a relative new movement to eat biological, fresh and local produced products. Citizens' want to know more and more about the origin of the food they eat (Pötz & Bleuzé, 2012).

Green areas can stimulate people to do exercise. Related to urban farming the main exercise will be the maintenance of the crops and livestock. Maintenance is a functional exercise including seeding, harvesting, watering and working on the land. Urban farming thus contributes to an increased physical activity increased.

Mental health of urban farming can be found in community building and education farming can be a connecting factor when working together on a common goal, the production of food. It stimulates social inclusion and gender (Veenhuizen, 2006). A community can also be created around the *celebration of food* by facilitating infrastructure for food preparation, outdoor eating, and special events areas (Holland Barrs Planning Group, 2007). Special events can be created around the food celebration, like sowing and harvesting festivals. Social ties will be developed and

increase the social capital. Individualisation might be counteracted. It can also increase the appreciation of social diversity. The creation of local communities plays a role in the improvement of security and safety (Wakefield et al., 2007). Urban farming can positively transform the image of an area that now may have a negative association with people (Nienoord, 2013d). Implementing urban farming might create more spatial quality for physical features of the community. It might result in a community proud on their living environment. The *visibility* and *appearance* of the urban farm is thus important.

That people lost the relation with their food production emphasizes the need for educated. Through education, people can get familiar with all aspects within the food production chain. It is necessary to educate people about healthy diets (Holland Barrs Planning Group, 2007) and environmental health (Deelstra & Girardet, 1999) to generate food awareness and environmental awareness. Urban farming is also used as job skills training, for example as a way to rehabilitate people with an addiction. Many different target groups might have benefit from the implementation of urban farming.

3.3 ISSUES OF URBAN FARMING

The City of Vancouver has identified food systems and urban agriculture as a central component to urban health and sustainability. It sounds like a panacea for cities to improve the living conditions (Holland Barrs Planning Group, 2007). Paul de Graaf his research in Rotterdam makes us realize that we should be aware of the functioning of urban farming. He indicates that in recent design proposals urban agriculture is used as a cuddly, without the understanding of the potentials in the dynamical and economical aspects of (urban) agriculture (Graaf, 2011). Van der Schans emphasizes that people need to start urban farming on a small scale in order to try it out and get an understanding how it works, after which it can be scaled up. The project will be vulnerable, not flexible and perhaps even out dated when immediately is started on a large scale. (Diepen & Raats, 2011).

3.3.1 Environmental issues

As described in chapter 2 cities are polluted. The products will assimilate those polluted sources. The pollution of the soil, the air and the water concerns people when cultivating their crops. Previous land uses can be a reason for contaminated urban soils. Therefore, it is necessary to test the soil in the early development phase if contamination is present at the forthcoming cultivation site. Urban farming projects can decide to remove the polluted soil and replace it with clean (more fertile) soil (Marconistrip, Rotterdam). This soil replacement signifies higher investment costs.

One source mentions a preliminary test that concludes that city-grown vegetables were no more contaminated compared to its counterparts (Wakefield et al., 2007). Another source, research done by the University of Wageningen, emphasizes that plants do not assimilate 'bad' gasses (Vré, 2012). Even Deelstra & Girardet write about immobilization of heavy metals in the soils. The with heavy metal polluted land can be tackled by maintaining high pH by means of the addition of plenty of lime and high organic matter levels (Deelstra & Girardet, 1999). These findings are promising for the future perspective of urban farming. Overall, one need to be careful within the food production chain as food is primary human need. Food used for selling needs to comply with food legislations above all.

As urban farming will exclude the use of pesticides, it cannot exclude all large emissions of GHG. As an example, Pig City, development by the architectural office MVRDV, shows a possibility to keep pigs on a relative small ground

surface. This project does not limit the emission from the pigs' dung. The amount of emission will still be the same when keeping livestock in the city compared to into the country site. These emissions are also reason for bad smells that make livestock undesirable within the city. Livestock also produce a certain amount of noise that can be unintentionally.

Keeping livestock as pigs and cows on a large scale in the city is limited in the nearby future. Livestock is prone to diseases that also can infect people. An outbreak as food and mouth disease and bird flue caused the loss of lives. It is too risky to bring many possible contaminated disease carrying animals to densely inhabited areas.

Farming on roofs separates crops cultivation from the ground soil and is limited to the roof surface. These issues make this cultivation method only contributes to the rainwater remediation to a certain amount of water. The absorption of water will be less and less during heavy rainfall. Rainwater saturates the limited roof surface in time.

3.3.2 Economical issues

Maintenance of an urban farm needs frequent labour. Labour is on of the largest costs and can be seen as the biggest challenge (Five Borough farm, 2013). Therefore, the deployment of volunteers is often used to lower the costs (Dakakker, Rotterdam). Also many urban farming projects are dependent on grant funds, because it takes a while before the project will be profitable (Marconistrip, Rotterdam). Products of current commercial urban farms are in a relative higher price range and sold via their shops or restaurants (see chapter 4). This makes it accessible for the more wealthy class of the population. To make urban farming mainstream it should be affordable for everyone (Diepen & Raats, 2011).

On the other hand, greenery (thus urban farms) does increase the value of properties (see chapter 2.4.3). Cities contain high property value because of the limited amount of available space. The implementation of many urban farms ensures the rise of property value within the city even more. Increased property value might scare particular target groups that will flee the city.

Urban farming projects contribute to many urban issues and as Dutch examples show, even municipalities can obtain a higher profile. In the meantime, these municipalities facilitate the projects but do not help with the project finance (Nienoord, 2013d and Nienoord, 2013b). Urban farms contribute to different aspects of general interest and should therefore receive money for compensation (see chapter 2.4.3).

The municipality might be an obstruction when current legislation interferes with the development of urban farming projects. Dutch building codes determine functions allowed on specific locations. These codes do (almost) not include the execution of urban farming within city borders that makes it hard to realize an urban farm in the inner city. Dutch rules and regulations also make it impossible to use biodegradable waste from households for fertilizing the land. These examples do not leave much room for interpretation for urban farming initiators to work with (Nienoord, 2013d).

Within the existing built environment, the construction of a building needs to be over-dimensioned to be suitable for the implementation of cultivation ground or a glasshouse on the roof. If not applicable, adjustments to the building construction are needed. These adjustments mean increasing investment costs. The accessibility of a roof is limited to the amount of people it can bear.

Existing farming projects on building roofs are mostly financed by a marketing- or public relation budget of the building owners (Nienoord, 2013d). Building constructions that often are over-dimensioned are parking's. In this situation, the use of an urban farm needs to compete with to compete with the parking yields earned with the previous parking deck. Urban farming on roofs also competes with the placement of solar panels.

Regular (sustainable) farming creates lower yields, urban farming produces even on a smaller and less efficient scale within the city. Urban farming does not generate enough yields if trying to compete with regular farming practices. Urban farming will be interesting if it creates a spin-off with other activities.

Urban farms competing with farmers outside of the city should be prevented. In addition, the knowledge of these farmers can be valuable for the practice of urban farms. To create a link between urban farms and farmers outside of the city can therefore be important for both parties.

The use of hydroponics in climate controlled room needs high investment costs. An aquaponic system also has relative high investment cost and the weight of such system ensures best implementation possibilities to buildings or the surrounding of buildings. Both have a low contribution to the social qualities in the city. Additional prices of hot property limit the use of these methods to the less expansive borders of a city. A significant contribution of both methods in the inner cities can be assured if applied for educational or incubator purposes on a small scale.

3.3.3 Social issues

Urban farming needs people to make it possible. Similar as for the experience of greenery, cultivation grounds need to be maintained well to have a qualitative quality. In case of community gardens, the fact that cultivation gives food in return does not ensure that the garden will be maintained well. The willingness to maintain crop field is depending on its location. Research showed that community gardens close to peoples house is of influence on regularly and consistently use of their cultivation plot (Wakefield et al., 2007).

Cultivation grounds looks lively in summertime. The crops are green or even colourful because of flowering. This is experienced in a limited extend during wintertime. Most crops cannot survive in wintertime and if they do, they are mostly growing underneath the surface. Cold and rainy weather conditions make people to stay inside and prevent commitment with the garden and its participants. Additional activities or indoor space is needed so that people can come together. In summertime, the weather conditions are more pleasant and inviting for people to go outside. Attention needs to be paid that people do not sunburn.

A lot of maintenance labour is needed in summertime. The sun is shining and lot and plants need to be saved from dehydration. As most people go on vacation outside the city during summer holidays, neglected cultivation grounds can be the result. Agreements need to be set up for the continuation of the cultivation plots and its qualitative qualities.

Even if urban farming sounds as a great tool to connect citizens with each other, it is impossible to let all people participate. Not all people want to growth food or cannot find the time to help and it is no option to force them. People need to be invited for and have the possibility to join farming activities even if this is just for seeding and harvesting activities.

Fig. 41 *Hoeve Biesland, Delftgauw [from: Hoevebiesland.nl]*

Fig. 42 *Moe'sTuin, Delft [from: Poptahof.nl]*

Fig. 43 *Dakakker, Rotterdam [from: routedunord.nl]*

4. CASE STUDIES

Five case studies will be discussed in this chapter. These case studies are done in order to see to what extend the cases do contribute to a sustainable living environment. All case studies are described starting with general information of the project, followed by its contribution to sustainability (social, environmental and economical aspects) and the spatial aspects of the project organization including its relation with the existing urban area.

Fig. 44 *Marconistrip, Rotterdam [from: pic.twitter.com]*

Fig. 45 *Villa Augustus, Dordrecht [from: Expedia.nl]*

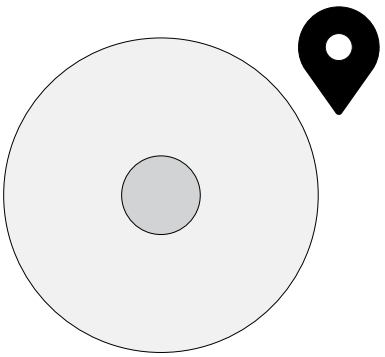

Fig. 46 *Location [from: Nienoord, 2013]*

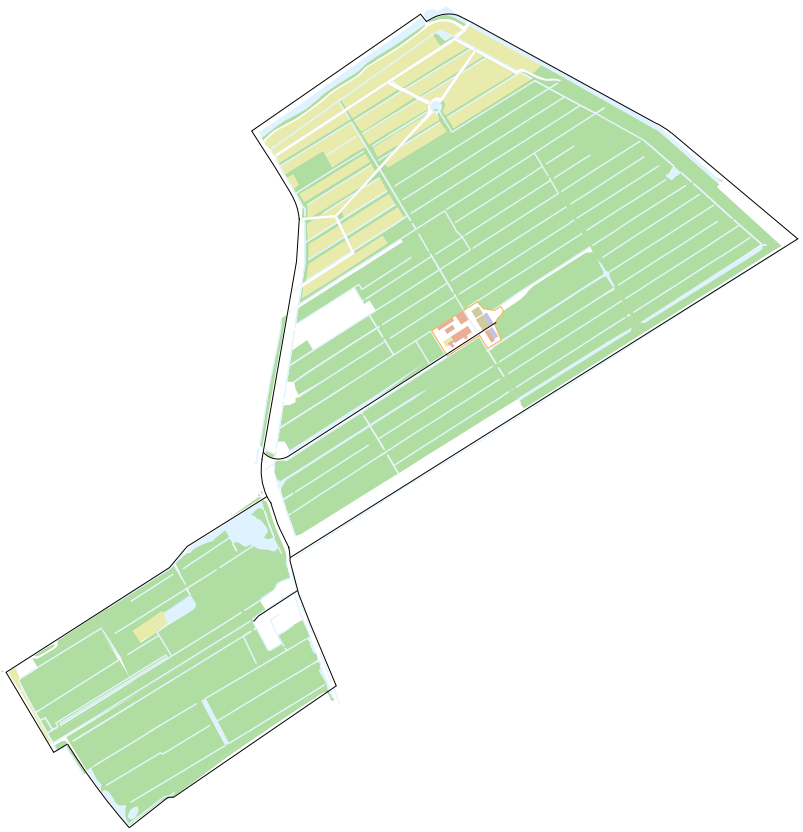

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Fig. 47 *Situation [from: Nienoord, 2013]*

4.1 HOEVE BIESLAND

4.1.1 General information

Hoeve Biesland is family based urban farm at the border of Delft. The property belongs to the municipality Pijnacker-Delfgauw-Nootdorp. Family Duijndam owns the farm for three generations. Guided by the economy, the earning model changed to more nature based processes since 1997. It started with the use of the biodynamical farming method. A method that implies closed cycles and a healthy relation between human, animal, nature and cosmos. In 2002 the business principle of Hoeve Biesland could be associated with ‘farming for nature’ (Boer voor natuur). This principle integrates farming, livestock, nature and recreation in an optimal cycle to create higher nature and experience qualities. Since 2010 Demeter certificates the farm as biodynamical.

Hoeve Biesland consists of approximately 100 ha of land including different land pieces. These are Bielandse Boven Polder (including Bieslandsebos), Bieslandse Beneden Polder (owned properties) and parts of Bergschenhoek and Ackerdijkse Plassen, which is an important bird area. The last two are on loan from the municipality, used to support the business process and to maintain the land. All organic materials are used in the process, mostly as hay that is used as food but also for straw to cover the stables (Duijndam & Duijndam, 2013). The land includes also a lot of water. Some areas are pointed out as ‘wet spots’ and with heavy rainfall these areas may flood.

At the farm there are two bulls, sheep’s, some chickens and almost three hundred cows. The cows are hold for milk production and some for slaughter. Cows can only graze at farmland that does not contain a lot of bird nests. On location, a butcher prepares meat products that can be bought online. Since 2007 there is also a vegetable garden. On Saturdays, people are able to buy products from the vegetable garden between 10 and 17 o’clock. Products are made for the regional market and can be bought at the farm or via several supermarkets, nature stores, restaurants, cafés and caterings in the area (Duijndam & Duijndam, 2013).

Additional related activities are organized to let people experience the area. Events like Bieslanddagen and Streekmarkt (a regional market) do attract 10.000 and 1.000 people respectively. Other activities that are available on appointment include school and business trips or use of the catering. Apart from these events, 100 people visit the farm weekly (Nienoord, 2013c). All target groups have visited the farm once except for immigrants.

The investment costs for the change of business concept are unknown. Duijndam mentioned, that only the use of his animals and lands is equivalent of the old situation (Nienoord, 2013c). To fulfil the need of closed cycles, the energy used need to be sustainable. Private parties or people can invest in solar panels and will receive a fixed amount of money per year to spend on products of or activities on the farm for a period of seven years. Duijndam pays attention to the triple-P framework. All aspects need to have a place by practising its business process (Duijndam & Duijndam, 2013)..

Next to the 8 employees, 20 volunteers or servant farmers work weekly on the farm (Nienoord, 2013c).
The maintenance of the land is done in relation with servant farmers. The use of servant farmers increased publicity and indirect increased product sell. Hoeve Biesland gets many media attention and therefore the farmer has an overloaded agenda without structure.

In accordance to Duijndam the business concept is only at 20% of the total business concept realization. One of the

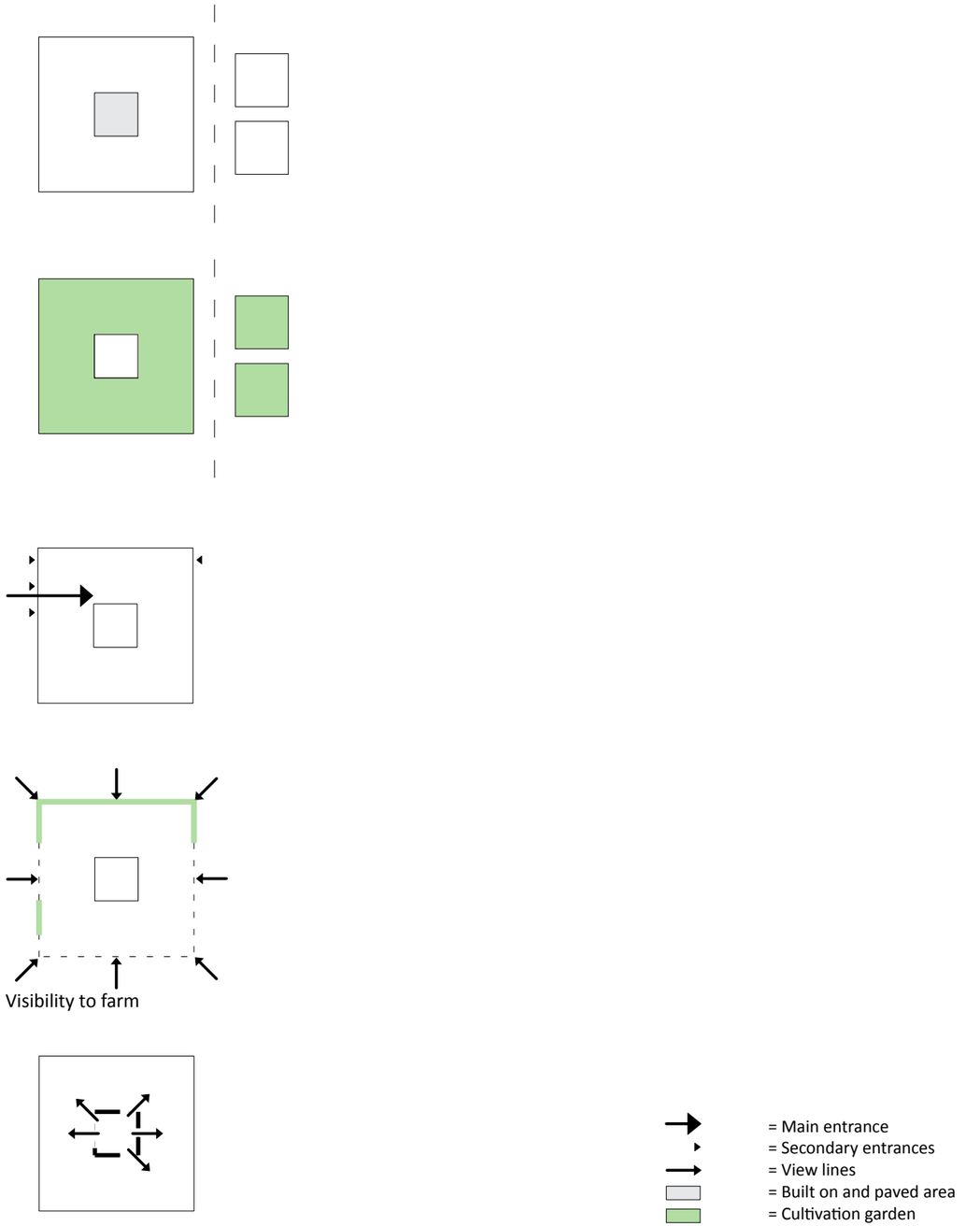

Fig. 48 *Schematic visualization of spatial aspects Hoeve Biesland [from: Nienoord, 2013]*

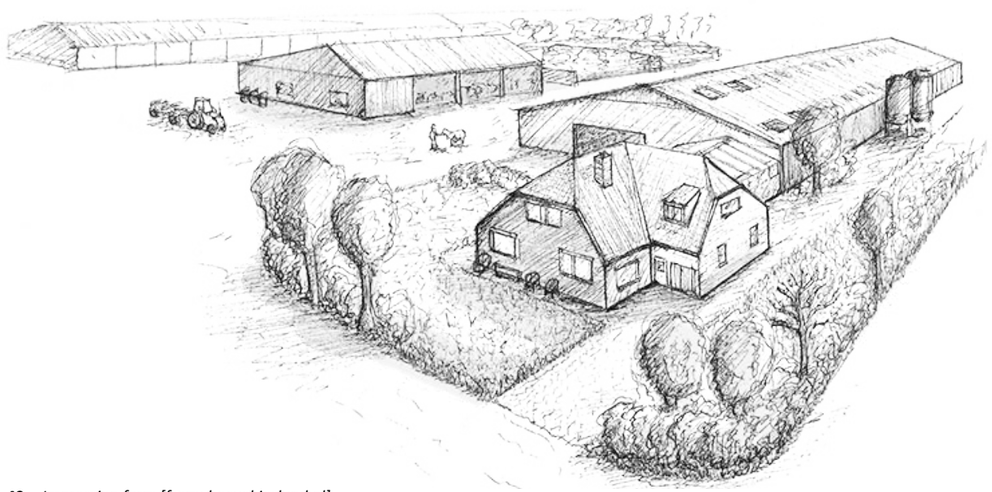

Fig. 49 *Impression farm [from: hoevebiesland.nl]*

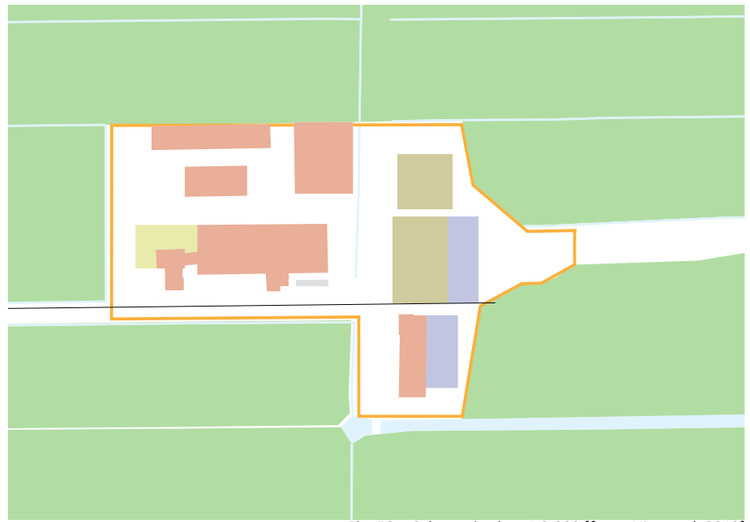

Fig. 50 *Schematic plan, 1:2.000 [from: Nienoord, 2013]*

= Connected functions
= Connected functions, but not directly accessible
= Bordering to cultivation ground
= Borders of building or courtyard/terrace
= Entrance

= Cultivation ground/ animal keeping
= Recreational greenery
= Building
= Compost
= Parking
= Other
= Courtyard

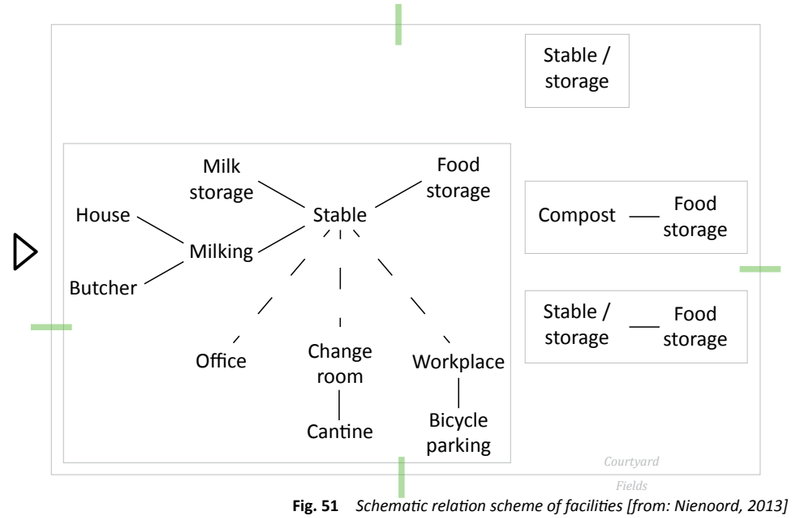

Fig. 51 *Schematic relation scheme of facilities [from: Nienoord, 2013]*

goals is to use stables that have more space per cow. A new plan is made for a 'cow garden' that contains 30 m^2 for each cow instead of the minimum of 7 m^2. It will be a transparent stable so it looks if the cows are still part of the landscape. The new stable floor will be covered with hay (organic material from the land) on which cows will poop. The mixture of hay and cow dung will be the used as compost. The compost will be used to fertilize the land. In the future emphasize will be on the experience and the society. Next steps will be making icons in the city that should increase the reputation of Hoeve Biesland (Nienoord, 2013c).

4.1.2 Spatial organization

The farmland exists out of three different types of areas at distance of each other. As nature is an important aspect in the business concept, all three areas have a natural landscape appearance. The main farmland encloses the farm and its courtyard that can be reached by a main approach road. Besides the main access, more accesses are available to enter the Biesland Bos by foot.

To keep the land as natural as possible, the land boundaries are define by twined fences, trees and ditches. At some places an electric fence is placed. The boundaries ensure a separation of the land properties, but not in a visual manner. A surrounding road supports the possibility to have a nice overview of the fields. The ditches in the Biesland Bos provide several views through the forest.

The house of the farming family is situated in front of the courtyard. In the garage and an extension of it, the butcher is situated. In front of the garage, there is space for two cars. More to the back, all the stables are situated. The main stable is leaning against the farmhouse and includes spaces for cow milking and milk storage. Accessible from the outside, there is a small workplace and a building that includes a changing room, a canteen and a small office for the employees. Bicycles can be parked next to the workspace.

In wintertime, the stables are mainly used to shelter the animals. When the animals graze in the farmland, the stables are mostly used for storage of food and machines. The stable walls facing the farmland are mostly closed. A future development, in line with the business concept, is an opened up stable to the farmland. In this way the animals will stay in connection to the farmland and from outside in. From outside, the cows still are part of the landscape.

A courtyard connects all functions located on the farm. This space in between the buildings is wide enough for the machines to go through. The wide courtyard also enables places for fodder storage silo's and places to park cars. While walking around on the courtyard, different views arise between the buildings to the surrounding farmland.

4.1.3 Sustainability

All sustainable aspects are included in the business process of farmer Duijndam. Duijndam is aware of these aspects. With the focus on on a right balance between the three aspects, the business is still developing

Environmental aspects

One of the main principles is to create natural qualities. This is achieved by the use of different kind of land types. The farmland includes next to the grassland also a small forest and a piece of land that is especially popular for birds. This maintenance method stimulates flora and fauna to develop. The biodiversity of the area is increased.

Fig. 52 *View to cultivation ground from surrounding roads [from: Nienoord, 2013]*

Fig. 53 *View from courtyard to cultivation ground [from: Nienoord, 2013]*

The farmland includes many ditches that store rainwater. The soil also absorbs the rainwater or plants evaporated it. Broader waterways also function as natural fences interspersed with plaited hedges.

Duijndam tries to close his business process as much as possible. Organic matter derived from his land is used again among others as straw or hey. The mixture of hey with dung is again used as compost. Energy use is being reduced through the use of solar panels

The process is not 100% closed yet, but it is an inspiring example for other businesses. The project shows the need for the large amount of land necessary for closing the cycles.

Economic aspects

The organization of business trips and other activities make sure the business yields will be increased. Also the high amount of media attentions raises publicity and therefore products can be sold easier. The sale of more products generates a higher turnover.

To be able to run his business process Duijndam uses, beside the fixed eight employees, around 20 cheap workers, like the servant farmers and volunteers. These workers do need more coaching to practice their jobs. Duijndam might receive subsidy to be able to give the servant farmers the right directions.

To be able to buy solar panels a loan system is initiated that makes it possible for private parties to invest in the solar panels for the farm. In total a higher amount of the investment will be paid back during time with gift vouchers to spend on products produced at the farm.

Social aspects

Duijndam makes use of servant farmers. These farmers will be educated or rehabilitated to develop work and jobs skills.

Next to the traditional activities of a farmer, different other activities are organized, like the Bieslanddagen. Such activities make it possible for surrounding inhabitants (and maybe even from further away) to have a glimpse of all processes on the farm. Hoeve Biesland is not a farm mainly intended for recreation, as it does not facilitate (catering) functions on regular days. In the Bieslandse bos people can enter one of the natural land parts that do provide recreational activities. The roads around the farmland can be used for functional routing but also recreational by experiencing all surrounded nature

The products sold have relative high prices and therefore attracts particular target groups. Immigrants is a target group that does not visit the farm, but it is unknown if the price of the products is cause of that.

4.1.4 Relation with existing urban areas

From Hoeve Biesland it can be extracted that the relation between nature, people and food production makes it a valuable business concept. The preservation of natural qualities is possible by the large amount of farmland. The dimension of farmland has more environmental impact. And even if the farmland is not accessible, the Bieslandse bos is accessible for pedestrians. Roads around it ensure that people could experience its extra landscape qualities. The use of natural land boundaries emphasizes the natural landscape qualities. The intention to close the environmental cycles is promising for a business process on such a scale.

The differentiation of functions related to the concept reaches out to a larger public than usual and makes it support the sales to a bigger group of customers.. A more segmented approach is needed, as there is not that much space available. Products are sold on the regional market. Whilst the location of the farm is beautiful situated in the middle of its farmland, there are no daily recreational activities on the farm. From the courtyard, several exciting

Fig. 54 *Water as natural barrier [from: Nienoord, 2013]*

Fig. 55 *Public entrance for Bieslandsebos [from: Nienoord, 2013]*

views are possible to the farmland.

The location of Hoeve Biesland on the border of the city makes is possible to have a lot of farmland. This amount of space is not available in existing urban areas. For that reason, it is hard to keep there the same amount of livestock inside the city area. Shelter in wintertime, food storage and undesirable smells will also arise social problems.
The large amount of square meters for stables is not applicable inside cities. The stretched farmland also requires mechanized equipment for maintenance that influences the width of the courtyard. No attention is paid to spatial requisites of big tractors within existing urban areas.

Fig. 56 *Location [from: Nienoord, 2013]*

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Fig. 57 *Situation [from: Nienoord, 2013]*

4.2 MOE'STUIN

4.2.1 General information

Moe'sTuin (mothers garden) is an urban farm in Poptahof Noord in Delft. This area contains 120 different nationalities. The project is intended as a tool to stimulate the communication between the inhabitants of different cultures (Cijs, 2005). Some inhabitants of the neighbourhood initiated the project in 2004, with the support of Woonbron Delft, the municipality and Wide Wealth Delft (Breed Welzijn Delft). The project is located on previous non-functional grassland in the middle of an existing neighbourhood. Moe'sTuin is around 470 m2 and consists of around 30 cultivation plots for people in the neighbourhood, adults, elderly and children. Woonbron is owner of the land and the small cabin for storage on the location (Nienoord, 2013e).

Since 2005, several active inhabitants meet once a week to work on the farm and to discuss topics of their concerns. From March till October, the Monday, Wednesday and Friday evening are ment to take care of the gardens together. In the gardens vegetables, fruits and spices are cultivated. Next to the weekly activities, a sowing and harvesting festival are organized.

The access is primary intended for the garden keepers, children and elderly. Plots for adults and elderly need to be cultivated by two persons and so there are 40 members signed. Every member can take home its crops.

The investment costs of the project lie between 7000 and 10.000 euro and are financed equally by Woonbron Delft, municipality, BWD and Fonds 1818. The latter mentioned, supports projects in the field of health, wealth, art, culture, nature, environment and education. All investing parties gain benefit from social aspects and the media attention for the project. Starting this year, neighbours need to sign in for a cultivation plot and pay a membership of 10 euro a year. The organization of the gardens is done by a volunteering commission and with the help of a social worker.

The fact that the inhabitants see the gardening as their own responsibility makes the projects a successful one. All participants wanted to have a voice. Because there were too many subscriptions, participants need to pay a membership fee from this year on. People that intend to make work of their vegetable garden are prioritized to get a spot. This caused some resistance, but all the gardens are rented and there is a waiting list. Its success is the cause that one of the initiators quitted.

For the practicing of crop cultivation, the participants still need a lot of guidance. A social worker employed by Woonbron helps the participants (Nienoord, 2013a). In the ideal situation, the participants can run the cultivation garden by them selves.

In last few years, the project organization tried to make Moe'sTuin a professional farming project. The project should stay from the surrounding inhabitant to keep it as successful as it started.

Moe'sTuin has a positive influence on the surrounding neighbourhood. It creates involvement with and solidarity between the participants (Cijs, 2005). This resulted in the addition of activities to the original plan like a harvest and seeding festival. Since the implementation, the project is extended with cultivation ground for children and elderly and a large table is added to facilitate the elderly.

4.2.1Spatial organization

Moe'sTuin contains different plots sizes that are arranged in a functional way, sided by pathways. The design of

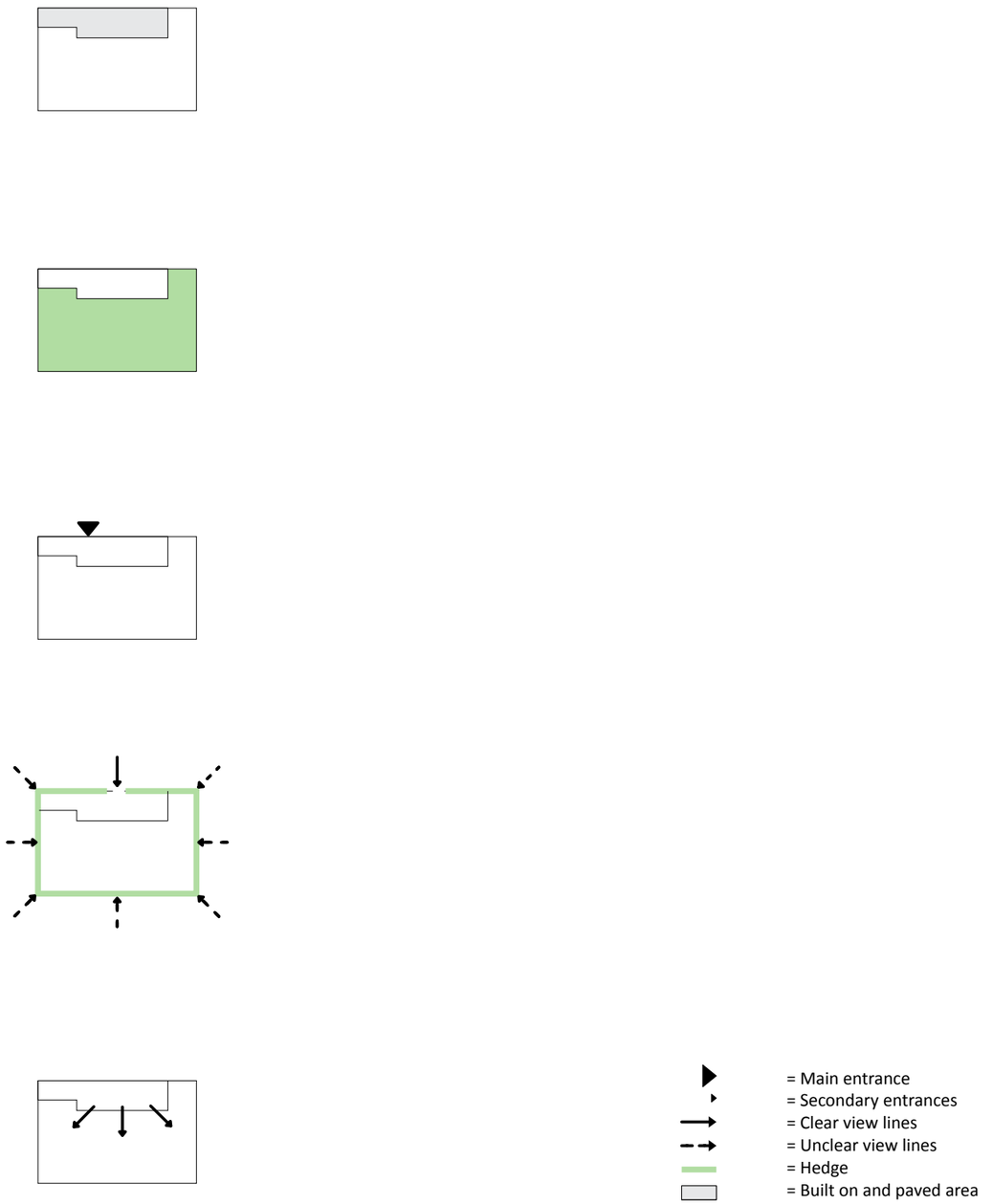

Fig. 58 *Schematic visualization of spatial aspects Moe'sTuin [from: Nienoord, 2013]*

Fig. 59 *Community garden [from: Nienoord, 2013 – derived from poptahof.nl]*

= Connected functions
= Bordering to cultivation ground
= Borders of building or courtyard/terrace

= Entrance

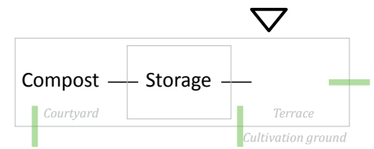

Fig. 60 *Schematic relation scheme of facilities [from: Nienoord, 2013]*

the garden is made by a garden designer in cooperation with the participants (Nienoord, 2013a). The cultivation plots of Moe'sTuin exist of three different types, namely the ones for children, adult participants and eldery. There are eleven plots for children with the size around 3 m2 and twenty plots in between 7.5 m2 and 9.5 m2 for the adult participants and the elderly. Every two participants need to share one plot. The children have their own plot (Nienoord, 2013a). Because the plots are private owned, the plots differ in use of space.

Behind the entrance of Moe'sTuin, there is a terrace (around 90 m2). From the terrace the cultivation ground and storage shed are accessible. Behind the storage shed, the compost bins are located out of sight. Small roads and a grass field visually close of the location. Physically a small hedge fences off Moe'sTuin and creates a distance to the people passing by. At the entrance there is a low wooden gate that isn't locked. The best overview on the garden is from this point.

Moe'sTuin has only one building; a small shed for storage. From the terrace all cultivation grounds are visible. Next to Moe'sTuin there is a play area for kids.

4.2.3 Sustainability

Environmental aspects

The biodiversity of the place is increased through the cultivation of different crops. The previous function of the location was a grass field. The amount of paved surface is increased as almost half of the site is now paved instead of grass.

Organic matter is collected in containers. It is not known if this organic matter is used to fertilize the ground, but because of the available facilities probably not. The project does not collect rainwater to water the plants.

Economic aspects

All participants gain a relative small profit from the vegetables they cultivate in exchange for a membership fee. Economic quality is also created through a more attractive area for all surrounding inhabitants with relative low investment costs. Woonbron and the municipality also gain economical quality as the neighbourhood is improved and more solidarity is created. The visibility of the garden is the best for people who live in a flat that have a view on the garden. Hedges block the view to the garden from ground surface.

The participants are dependent on the help of a social worker, paid by Woonbron. They are not able (yet) to cultivate the crops by them selves. As for the rest, the garden does not create jobs.

Social aspects

Moe'sTuin definitely creates added quality for participants and inhabitants surrounding the site. The garden creates an environment for participants to meet each other. Special evenings are initiated to work in the gardens together. This stimulated communication between the participants. The garden can function as a recreational garden for the participants. It is not intended for others to enter the garden. Participants can choose what to cultivate and can therefore include vegetables from their cultural diet.

A table on the terrace ensures that older people can also participate in the garden and can have a rest when needed. All participants have the opportunity to learn about gardening. Gardens are also provided for children so they will be educated about the food grow process.

All activities can only take place outside, so when the weather is bad people do not meet.

Fig. 61 *View to cultivation garden [from: Nienoord, 2013]*

Fig. 62 *View from cultivation garden [from: Nienoord, 2013]*

4.2.4 Relation with existing urban areas

Moe'sTuin is developed on a non-functional grass field enclosed by building blocks. Its transformation into a useful space is an addition to the existing neighbourhood. The project is meant for local people and by participation in the project they contribute to more solidarity amongst them, in the neighbourhood. The garden design includes a terrace for people to meet with each other. Each cultivation plot is used differently depending on its participants. Therefore the appearance of all the plots is very divers.

From the terrace a good overview over the garden is possible. Hedges diminish the view and accessibility of the garden by people who do not participate within the garden. Costs are relatively low because the simple garden design and the use of low-tech equipment for the crop cultivation. A small shed is the only build element. It separates the terrace from the compost bins. Not previewed is a common space to facilitate the continuation of activities during bad weather days. The impact of the project is restricted to the surrounding neighbourhood.

Fig. 63 *Location [from: Nienoord, 2013]*

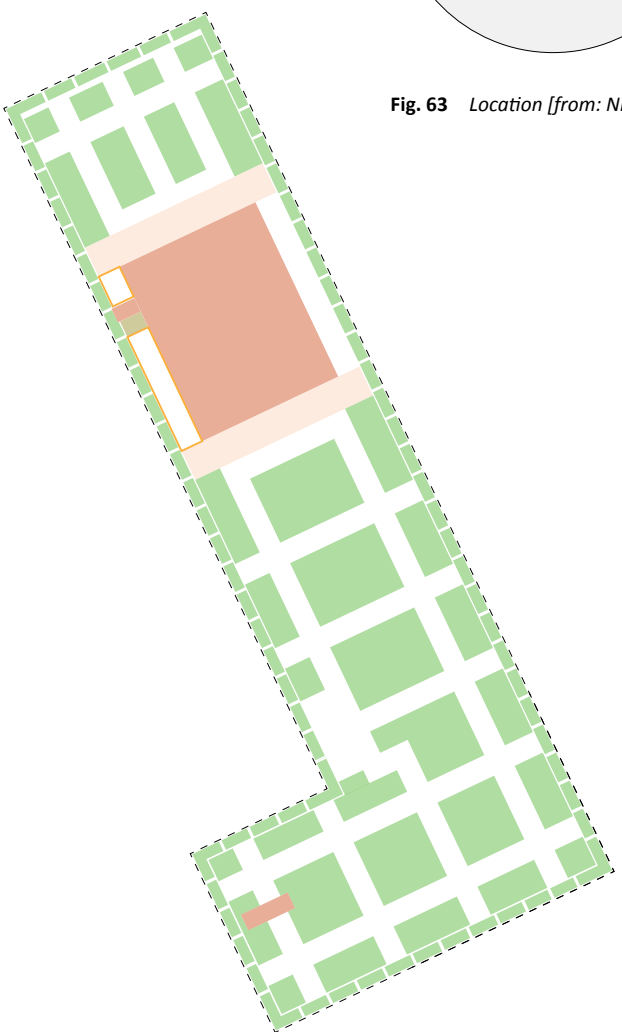

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Fig. 64 *Situation [from: Nienoord, 2013]*

4.3 DAKAKKER

4.3.1 General information

Dakakker is a key project in Roterdam Central District within the context of the 5th International Architecture Biënnale Rotterdam (IABR). The Dakakker is initiated by ZUS architects, Binder project group and Rotterdams Milieu Centrum (RMC, Environmental Centrum Rotterdam). The project is realised on the roofs of the 1st and 7th floor of an existing building (Schieblock) in the middle of the central district and are transformed in a green experiment. This building houses different creative companies and is owned by LSI project investment and OntwikkelingsBedrijf Rotterdam (OBR).

The project goals are to upgrade of the urban environment and to make use of the opportunities that have a positive contribution to the liveability of the city and its inhabitants (Bauman, 2013). The project introduces the first crop cultivation roof in the Randstad and creates an additional space on a height of 23,4 meter. It benefits all positive aspects of green roofs, like building insulation, water retention, reducing heat island effect and it filters the air.

The roof of the Schieblock consists of 1360 m2 surface. The bitumen roof is transformed in one with beds of volcanic matter (lighter than soil) to cultivate vegetables, fruits, spices, flowers and bee keeping. The project wants to emphasize the aesthetical function of a crop field. The roof on the 1st floor is covered with sedum. These plants will, when flourishing, attract bees that will pollinate the crops and make honey (Bauman, 2013). Organic matter is composted with the help of earthworms.

The caretaker of the building inhabited the roof of the 7th floor in the past. The roof now consists of a Dakpaviljoen (Roofpavilion) with a multifunctional room, kitchen, toilet, room for storage and a terrace. The terrace and kitchen are added later to increase the rental opportunities. Because of its location on the roof there is a limited accessibility of people.

Every Friday between 10 and 13-hour, about 15 to 20 volunteers are seeding, maintaining and harvesting of the crops. An employee of RMC coordinates all activities. This is the only person who gets paid. The roof is publicly accessible to experience the roof and for visitors to buy products during an open day during the volunteer work hours. An extra utility space on the top roof is openly accessible for tenants of the Schieblock. During the ‘Verborgen tuinen weekend’ (secret garden weekend) in Rotterdam almost 1000 interested people visited the Dakakker (Dakakker.nl, 2013). The Dakakker is also part of a nature and environmental education program and therefore provides education for children in an active way to create awareness of the food cycle (ZUS, 2011).

The almost 439.000 euro investment costs of the project is financed through the competition ‘het Stadsinitiatief 2012’ (the City initiative 2012) and Rabobank Rotterdam Fund. Once a year, the city of Rotterdam organizes once a year a competition in which everyone may apply projects that improve the city. Citizens may vote for the ‘best’ project that will receive money to be realized. The Rabobank Rotterdam Fund includes a part of the banking yields of Rabobank to improve the city.

The garden design with its roof covering is one of the highest expenses. The yearly returning costs are about 13.000 euro. (ZUS, 2011). Yields are the gained by the sale of products, catering, rent of the location and booked tours.

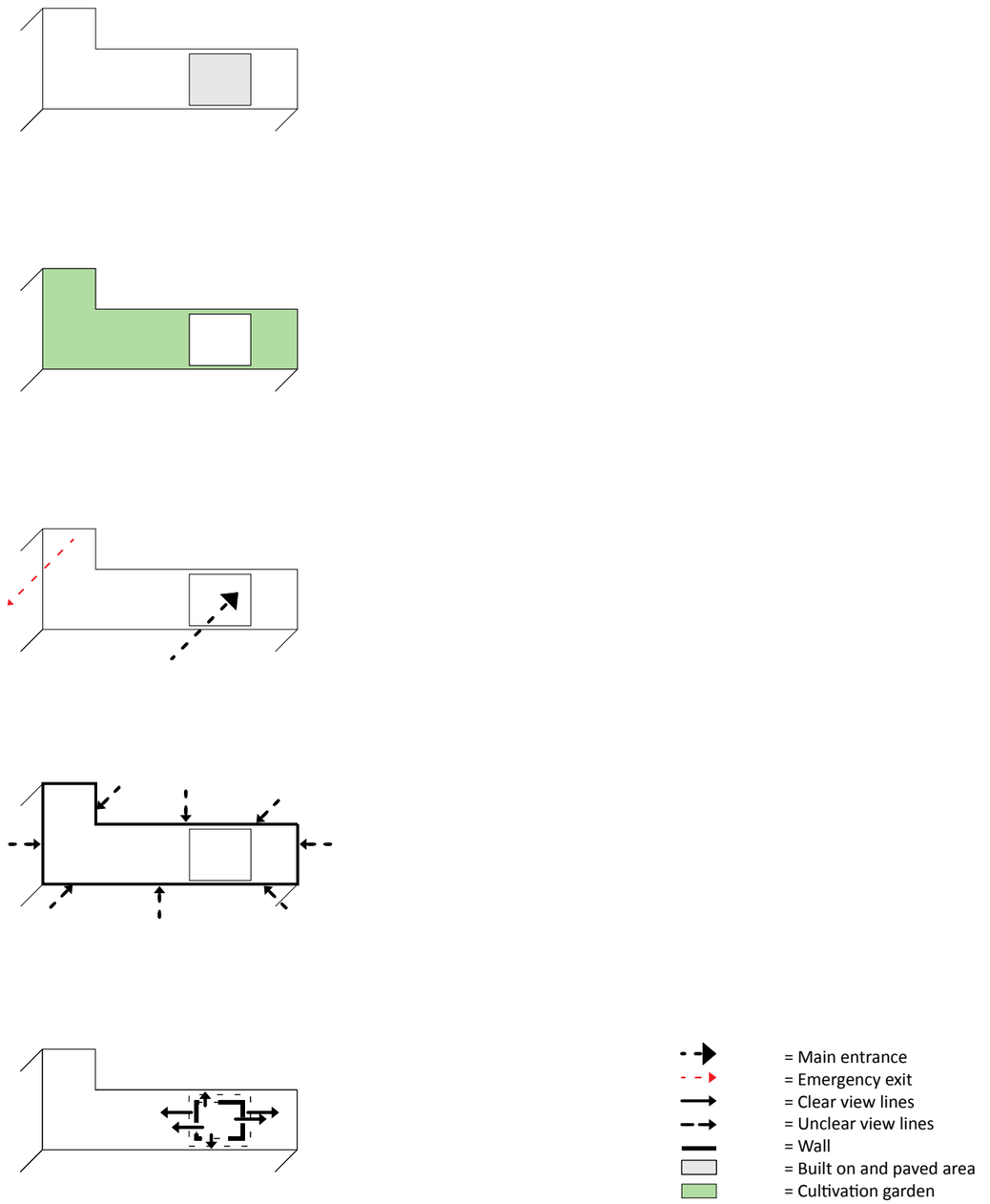

Fig. 65 *Schematic visualization of spatial aspects Dakakker [from: Nienoord, 2013]*

Fig. 66 *Impression of location [from: Nienoord, 2013 – derived from schieblock.com]*

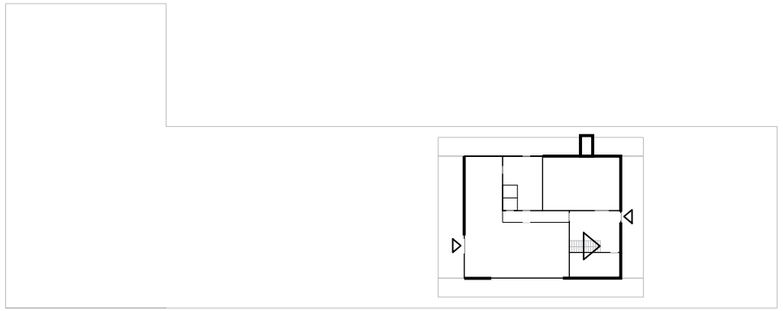

Fig. 67 *Plan, 1:500 [from: Nienoord, 2013]*

= Connected functions
= Bordering to cultivation ground
= Borders of building or courtyard/terrace

= Entrance

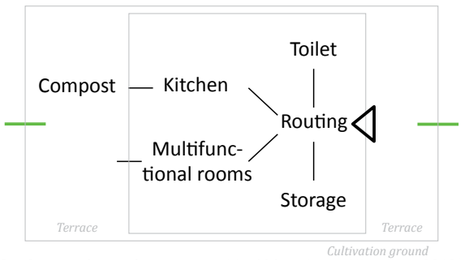

Fig. 68 *Schematic relation scheme of facilities [from: Nienoord, 2013]*

A lot of time is needed for the guidance of the volunteers, the communication with the media for instance, the organisation of guiding tours, the participation in research and having interviews by students, contacting businesses and catering to sell products (Bauman, 2013).

The Dakakker project receives national and international media attention. Another success is that local catering and tenants of the Schieblock buy all products on the local scale, as intended initially.

For the future, the realisation of more green roofs á la Dakakker consortium is preferable. .

4.3.2 Spatial organization

The Dakakker is functional organized by straight plots in combination with pathways. Both use the same material only the thicknesses differ. To minimize the weight on the roof, cultivation is done in ground beds. The crops are planted in groups, practical for seeding and harvesting.

The Dakpaviljoen (roofpavilion) divides the roof surface in two parts. It is a build extension in line with the entrance including the buildings vertical transport. The roof is accessible by this vertical transportation ways, by elevator or stairs. On the other side, another stair ensures a safety escape at the end of the longest cultivation garden.

For other safety reasons, special flowerboxes are placed on the border of the roof. The back wall of these flowerboxes meets the minimum height requirements as fall off barrier. The weight of the soil in the flowerboxes ensures that they will not fall of the building.
From the ground floor, it is visible that something is happening on the roof of the Schieblock. If you one is known with the projects it will recognize the plants, but people who don't know the project maybe will not look up at all. Inversely, people have profit of a nice view on the cultivation garden from taller buildings that are situated in the area.

Several functions are located in the pavilion. By entering the top floor, it is possible to go directly outside or into the pavilion, or have a look in the storage. From a small hallway one can enter the multifunctional room on one side or a small kitchen on the other side, which are both connected. A toilet is also situated in the hallway. Around the pavilion is a wooden pathway. Terraces are created at the sides facing the cultivation gardens where the pathway has gotten more depth. From the terraces, there is a nice view on the garden and a broader overview on the city itself. The terraces can be reached when entering the top floor or through the multifunctional room. From the kitchen it is also possible to enter the pathway, to get rid of the compost on the stack situated over there.

4.3.3 Sustainability

Environmental aspects

The implementation of the cultivation garden does add new greenery in the city and it contributes to the biodiversity of the area. The green roof can remediate rainwater. Rainwater is not collected for the watering of plants. The organic matter produced in the garden is collected and composted with the use of earthworms. With the use of more roofs the environmental impact will be bigger.

Economic aspects

The Dakakker does not create new jobs. One worker from Rotterdams Milieu Centrum is designated to manage all

Fig. 69 *Flower boxes [from: Nienoord, 2013]*

Fig. 70 *Hided composting place [from: Nienoord, 2013]*

activities at the garden. The new utility space does create economic qualities especially for the high-rise buildings that have a view on the garden.

The utility space is available for rent, to gain yields. The load of media attentions raises publicity and therefore products can be selling easier. The sale of more products generates a relative higher turnover.

Social aspects

The social quality of the project is small. The roof can be used as a meeting place for different tenants of the Schieblock. In addition, the Dakakker is a meeting place for volunteers once a week. During the volunteering work hour's people can visit the roof to buy products or take something to drink. The volunteers do not serve the drinks so visitors need to serve themselves. Therefore there is only little interaction between the volunteers and the visitors. Visitors need to know of the existence of the Dakakker and necessarily need to choose to it as a distance is created from ground surface and the roof. The recreational quality will increase during additional activities, as a wider public makes use of the roof. The Dakakker also provides education.

The products sold are relative high priced and thus exclude particular target groups. People who cannot pay those products will hardly go to the Dakakker.

4.3.4 Relation with existing urban areas

In the dense central district of Rotterdam the Dakakker project is implemented to make use of unutilized roof surface and to create green cultivation space. The maintenance is done with the use of low-tech equipment. The implementation provides a new utility space surrounded by cultivation ground in the dense area. The cultivation ground is functional arranged in groups of the same crop. Next to its cultivation ground and terrace there are facilities for activities to rent, such as a multifunctional room and kitchen. This internal site offers shelter during bad weather days. The shape, size and location of the site are based on an already existing structure, namely the house of a previous building caretaker. The functions were easily addible because of the existing building structure of the previous caretakers home. No fixed space is determinate for the function of a shop, where people can buy the crops. Pesented in wooden crates or on a small table, the sale of products takes place in or outside depending on the weather.

The roof is accessible by vertical transportation. In the Schieblock there are stairs and elevator. The accessibility is uncomplicated but creates a distance between people at the ground floor and people going up the roof. Thereby, the roof is not publicly accessible most of the time. Apart from the accessibility aspect, a second point for vertical transportation is needed in case of fire. For security reasons the visibility of the green garden from street level is low. Taller buildings profit from a nice view on the roof.

Rooftops provide space for new uses, such as a cultivation ground. The use of it is limited by the surface of the roof, security measures and the weight of additional constructions and people.

Fig. 71 *Location [from: Nienoord, 2013]*

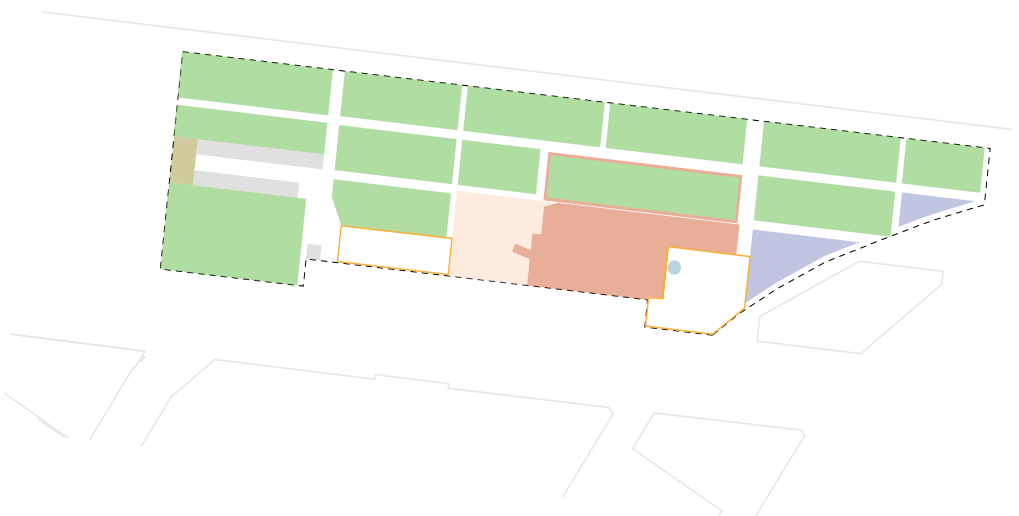

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Fig. 72 *Situation [from: Nienoord, 2013]*

4.4 MARCONISTRIP

4.4.1 General information

The Marconistrip is initiated by 'Uit je eigen stad' (Out your own city) as a commercial urban farm located on the border of a harbour area in Rotterdam. The main goal is to produce food in relation with the city. Next to the relation with the city, they also involve the countryside to fulfil the concept. All served products originate from own production or from surrounding farmers within a radius of 30 km (Vré, 2012).

The project is located on an old marshalling yard in the harbour of Rotterdam. In line with the place making approach, the transformation of vacant land and building into a public function, will have a positive influence in a area with a lot of industrial activities. The buildings do have an industrial character and the transformation of the vacant buildings is done with a time span of 10 years in mind.

Its location is in the middle of a harbour area of Rotterdam and raises a lot of question about the air quality and contaminated soil. To resolve this matter, a new layer of soil is added with a cloth underneath, so the crops will not get in contact with the contaminated soil. To comply to the Dutch food legislation, the products are tested if they have not assimilated to much pollution from the air.

At the Marconistrip a diverse range of production methods is used. Crops are cultivated in soil beds in open air or in plastic greenhouses. Provisions are made inside to cultivate mushrooms and for chicken breed. The chickens also have another space inside and a chicken run, so they can walk freely. An aquaponic system is planned for the nearby future.

Because of the projects commercial character there are only paid workers. It concerns around 7 -8 workers, including apprenticeships to lower the labour cost.

The project could be realized, because of the support of different parties that keep the costs low. The investment costs are 900.000 euro, financed by Havensteder, Rabobank, Stichting DOEN and by crowd funding. Subsidy from the municipality is obtained for the aquaponic system. Now, the aquaponic system is not installed yet.
For the purpose of urban farming, Havensteder is able to rent the location from the municipality for a symbolic amount of money for at least 10 years.

The entrepreneurs have trouble to obtain permits from the municipality. For example, they are not allowed to use biodegradable waste from households as animal food (for safety reasons). This restriction limits the project in making use of waste sources from the city. Another difficulty is the profitability of the project. Only the last few months the business process is getting profitable. Therefore, it takes a while before the project is profitable.

The glasshouse is the only new built construction. Its location is not optimal location: built in between two buildings on the north and on south side it does not get enough light. Also there is paid too little attention to the aesthetics of the plants in the spatial garden design. Flowers are still flowering in the back of the area instead of in the front, close to the terraces.

De Leede, one of the entrepreneurs, is glad that the project worked out as professional as intended and that it is getting profitable. It is a sign that the implementation of the concept succeeded and works out well. Besides, the project is getting a lot of media attention.

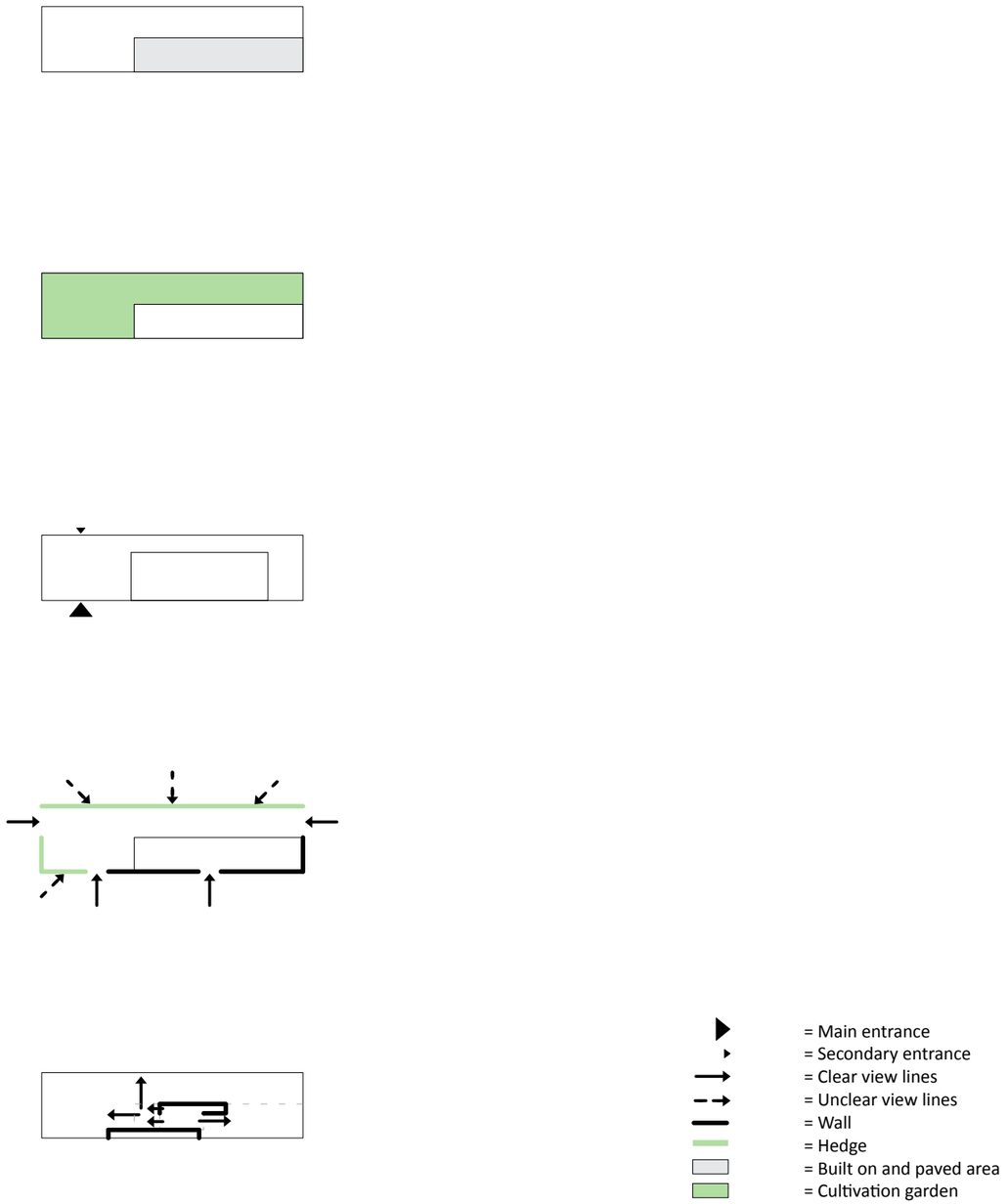


Fig. 73 *Schematic visualization of spatial aspects Marconistrip [from: Nienoord, 2013]*

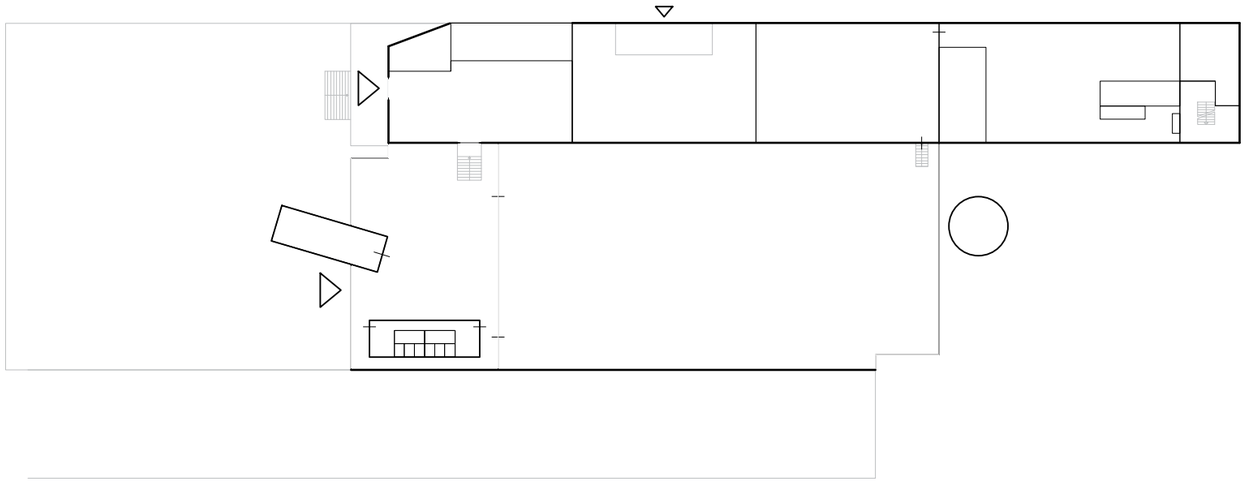


Fig. 74 *Plan, 1:500 [from: Nienoord, 2013]*

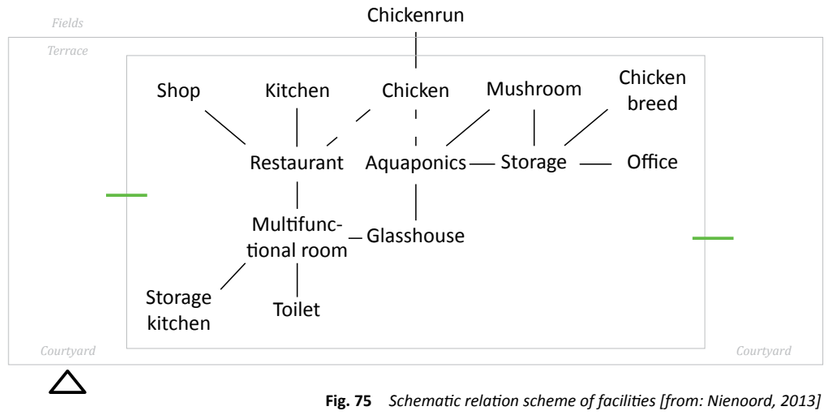


Fig. 75 *Schematic relation scheme of facilities [from: Nienoord, 2013]*

= Connected functions
= Bordering to cultivation ground
= Borders of building or courtyard/terrace

= Entrance

The entrepreneurs are having contacts already with parties in other cities. Their idea is to multiply the concept in more cities.

4.4.2 Spatial organization

Cultivation is done in straight plots in open air and within plastic greenhouses. The chickens also have an outside space, connected to the inside space in the building. There are three areas available, surrounding the building. Most plots are located along its north and west sides. On the fourth side of the building, an elongated building is located that isn't included in the project.

On the south side, next to the elongated building, the main entrance of the Marconistrip is located. The entrance is facing towards the harbour. Passing the plastic greenhouses, a wide paved road leads one to the parking plot on one side or the courtyard on the other side. Another small entrance is situated on the opposite of the main entrance. This entrance might probably be used as a short cut to the site from the public transport.

The elongated building totally blocks off the view to the Marconistrip. The site is totally fenced off by a steel frame so that it can be locked off. Hedges and trees mostly interrupt a few possible glimpses on the site.

Next to the elongated building a width courtyard leads one to the building of the Marconistrip, existing out of a glasshouse and a transformed industrial building next to each other. Both of the two buildings can be entered, but one will often walk straight though to the glasshouse. The glasshouse is separated into two parts, the front part I will name the 'multifunctional room' and the last part the 'glasshouse'. At the other side of the glasshouse, there is also a courtyard for employees and storage. This courtyard reaches to the border of the site with a view on a surrounding building.

Two containers are placed into the multifunctional room, one functioning as toilet and the other as storage for the kitchen. The last mentioned container thrust out of the multifunctional room. A small stairs reaches up from multifunctional room to the restaurant. The restaurant has an open kitchen and gives a view on the shop. Glass walls close off the shop. From the restaurant a door is leading to the outside terrace, laying down the stairs. In the multifunctional room one can enter the glasshouse. From the glasshouse one has access by a stairs to get where the aquaponic system will be previewed. From this room one can walk along the mushroom cultivation room into the storage area that contains an industrial refrigerator and a freezer. Passing by an employee cloakroom and the chicken breed space one will reach the stairs going up to the office.

The chicken breed and mushroom cultivation (and aquaponic system in the nearby future) are out of sight for visitors. Only with a group tour it is possible to see these methods.

From the buildings it is hard to get a nice overview over the cultivation grounds. From the restaurant the best view is trough the terrace doors. Windows that are present are located above eye level. A view from the glasshouse to the cultivation ground is also hard, as build in between two buildings and faced in both directions to the courtyards.

4.4.3 Sustainability

Environmental aspects

Thanks to the location of the project, its environmental quality is relative high. In a harbour area with almost non-green surfaces, the addition of an urban farm makes a real difference. The use of a vacant building and land also contributes to the environmental aspects, as limited material is needed to set up the project. The

Fig. 76 *View to cultivation garden [from: Nienoord, 2013]*

Fig. 77 *View from cultivation garden [from: Nienoord, 2013]*

Fig. 78 *Impression of restaurant with shop [from: Nienoord, 2013]*

Fig. 79 *Area surrounded by a fence [from: Nienoord, 2013]*

transformation of the building is limited with the time span of 10 years in mind.

The contribution to the environmental aspect can be found in the amount and diversity of greenery. In addition organic matter is composted and future use of earthworms will make it possible to use the biodegradable waste of the crops as fertilizer again.

The implementation of the aquasystem will ensure an almost closed food cycle.

Economic aspects

The project generates around 8 jobs that are of economic quality. A few high-rise buildings are benefitting the nice few of the location. The media attentions raises publicity and therefore more people are coming to the site and probably buying some products. The sale of more products generates a relative higher turnover. The project is since a few months profitable.

Crowd funding is used for the realization of the project. People are attracted to the project on forehand and create already a small consumer group.

Social aspects

The Marconistrip is a recreation place for people and to make them probably more aware of food production and healthy products. The project location in the harbour makes it quite isolated for costumers. On one side the project is facing a neighbourhood but a wide road with tram is separating the two. Additionally, it can be questioned if people living in that neighbourhood are willing to pay the relative high prices. The products sold are relative high priced and therefore attracts particular target groups. It is not necessarily a meeting place for its close surroundings.

The business concept includes apprenticeships. It gives students the opportunity to learn and experience how the cultivation of crops works in practice. However, the intention of the apprenticeships for the project is to lower the labour cost.

4.4.4 Relation with existing urban areas

The entrepreneurs of the Marconistrip selected a vacant land plot and building for the implementation of their concept. They produce many different products and use production methods. These methods vary from low-tech equipment for the crop cultivation to more high tech as the aquaponic system.

Not all production methods are visible for visitors as they are cultivated behind walls. Products can be bought in the small shop located near the restaurant and kitchen. The added glasshouse is placed in between two buildings and therefore not suitable for crop cultivation. From the glasshouse, the other functions are accessible by a stairs. These functions are not easy to reach by disabled people. It is also quite remarkable that views on the garden are scarcely offered from the inside of the building.

Surrounded by the industrial harbour activities the project is quite isolated and mostly accessible for city customers well known with it. The site is so embedded between a building elongated building and a row of trees that there is hardly any view provided from the outside to the cultivation garden.

Fig. 80 *Location [from: Nienoord, 2013]*

Fig. 81 *Situation [from: Nienoord, 2013]*

4.5 VILLA AUGUSTUS

4.5.1 General information

Villa Augustus is a commercial project created by entrepreneurs who were asked by the municipality to do so. The cultivation garden is a central element in the concept, used to strengthen its marketing function. The entrepreneurs also wanted to create a beautiful garden for themselves and to be used by the restaurant chefs (Muynck, 2011). The project is constructed as first as part of a larger transformation project in Dordrecht. For the sake of the development of this transformation project, the municipality wanted to use the site of Villa Augustus for “place making”. The attractiveness of the project should have a positive influence on the whole area and speed up the transformation (BRON). The invited entrepreneurs had already some experience with developing another ‘place making’ project in Rotterdam in 1993 (transformation of Hotel New York, Rotterdam).

The Villa Augustus project contains an area of 1.8 ha of land in property of the municipality. Two old buildings and appropriate land is given in leasehold for at least 50 years. The municipality pays Villa Augustus yearly an amount of money for the purpose of management and maintaining the site. Villa Augustus opened its doors in 2007.

Villa Augustus exists of different outside spaces that includes gardens, cultivation garden and a tiny forest. The cultivation garden also has an orchard. Despite the area is walled, the gardens are public accessible during opening hours through multiple entrances. All gardens may function as an escape from busy city life, although Villa Augustus located in a villa district.

The old buildings transformed are an old water tower and a pump building, both of historical quality. The design of the interior and all marketing purposes do have the same artistic style. In the buildings a range of functions are located, namely a restaurant, a market-café, a hotel and multifunctional rooms that can be used for meetings or parties. The market-café sells also presents and gizmo’s, besides products from their own garden, bakery and kitchen. Throughout the year, Villa Augustus offers cultural activities. Villa Augustus is open every day of the week until 24 h or 1 o’clock. This in combination with the diversity in functions ensures that people come and visit spread over the day. Yearly, Villa Augustus attracts 300.000 visitors.

The total amount of investment costs is 8.800.000 euro. The maintenance of the garden needs 130.000 euro every year, including the yearly gift of the municipality of 32.000 euro. Villa Augustus enlarges its commercial quality thanks to its unique character by giving paid tours and selling a film to learn about the development of Villa Augustus.

At the start of the project, fertile soil replaced 1.2 meter of the original (less fertile) soil layer. This replacement increases the harvest yields on the longer term. Half of the production out of the cultivation garden is processed in the kitchen and half of it is used to sell. In summer time, the use of home made products prepared in the restaurant covers only 5 to 10% of the total production.

In the gardens of Villa Augustus 3 paid employees and 5 volunteers are working. To run the whole business process, 150 employees fill in 90 jobs. So a lot of employees work part-time (Muynck, 2011).

Villa Augustus is an expansive project in which the municipality invested at least 7 million euro. The municipality still invest a yearly amount of money for garden maintenance. The replacement of the soil to a more fertile one contributed to higher investment costs. The municipality preferred Villa Augustus to have contracts or connections to other institutions in the city, to give more parties a change to have profit from municipal investments.

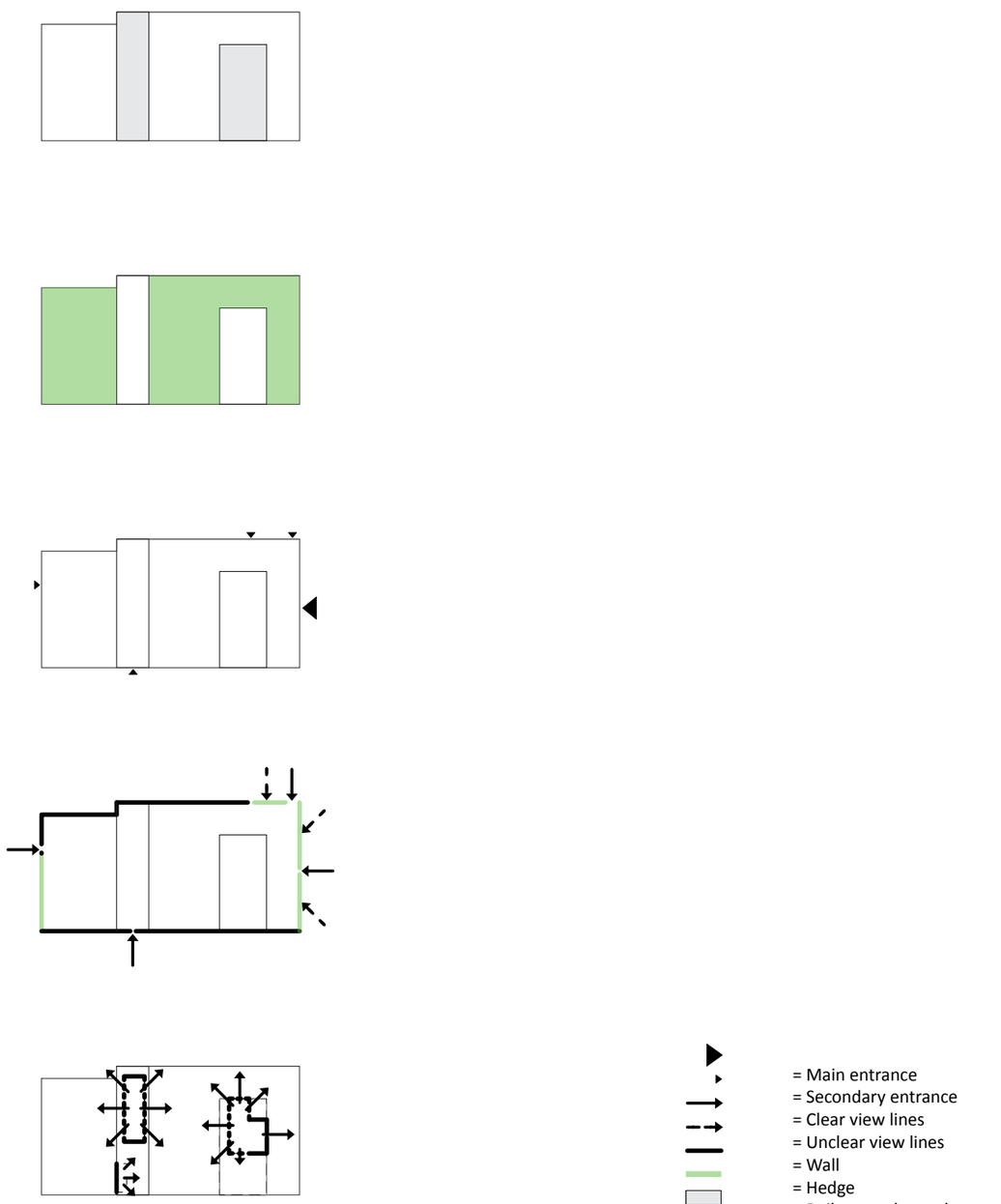


Fig. 82 *Schematic visualization of spatial aspects Villa Augustus [from: Nienoord, 2013]*

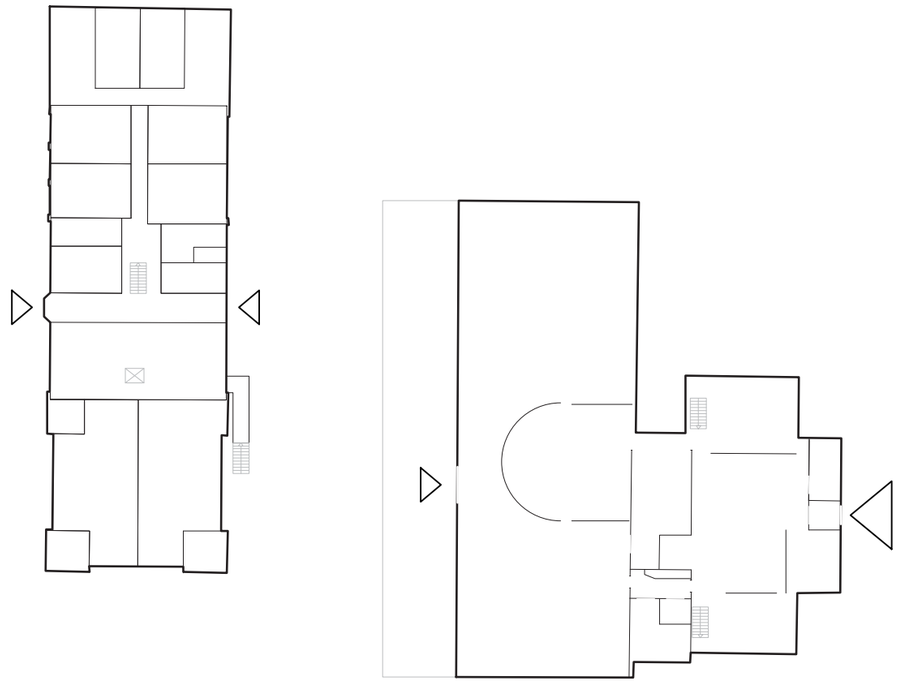


Fig. 83 *Plan, 1:500 [from: Nienoord, 2013]*

= Connected functions
= Bordering to cultivation ground
= Borders of building or courtyard/terrace
= Entrance

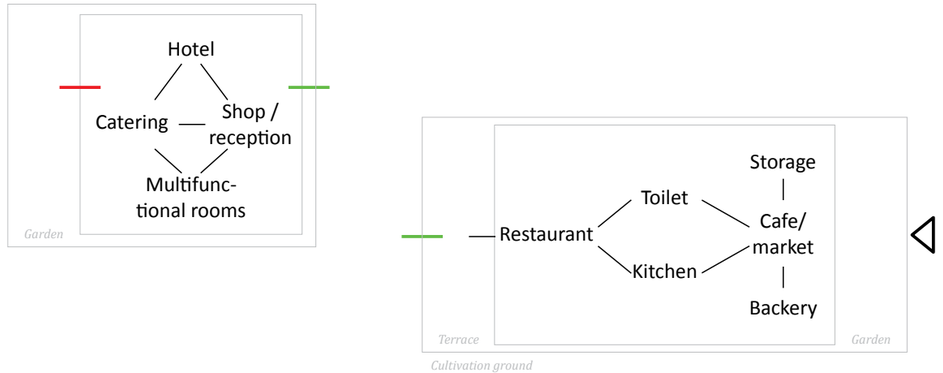


Fig. 84 *Schematic relation scheme of plan [from: Nienoord, 2013]*

As the garden is intended to be public accessible, it is not experienced as public. Surely, the gardens suffer from some vandalism.

Most visitors combine the visit of the garden with one of the other facilities. Villa Augustus attracts people from all over the Netherlands. This improves the image of the area. In 2010, the design of the garden has won the price 'Garden of the Year' by the British magazine Garden Illustrated together with the Garden Museum in London. The design includes the reuse of 100 years old glasshouses.

In this research it is unknown if Villa Augustus is composting and if they do it is surely visible for visitors. Almost no attention is paid to the closure of cycles.

4.5.2 Spatial organization

All gardens at Villa Augustus are carefully designed. For example, constantly from direction twisting plots interrupted by crossing diagonal pathways. The two buildings are both surrounded by outside spaces. Most cultivation ground is placed in between the two buildings.
A low bush is dividing the area from the street, so the front garden and building are well visible. All other sides are block off with walls or tall hedges. Only the tower can be clearly seen from the outside. Opposite the main entrance, a second entrance is facing the water with a boat pier. A third entrance is situated next to glasshouses and third multiple room. One can reach the hotel directly from the two last mentioned entrances. Otherwise, one should first pass the restaurant building. Through these two gates one can have a glimpse to the site.

The main entrance will lead one into the first building, namely the old pump building. In the front of the building a market –café is situated in the middle. On both sides of it, employees are working in the preparation kitchen or in a bakery. At the same sides a stairs is going down, one to the storage and one to the ladies toilet.

From the market-café two hallways lead to the restaurant. One hallway includes the toilets for man and disabled people. The other hallway is accessible for employees only and is an extension of the preparation kitchen, which leads to the kitchen. The restaurant is placed in total length of the building. The kitchen and bar are situated in the middle. A door in the middle of the restaurant gives access to the terrace.

The hotel and two multifunctional rooms are situated in the second building. In the front of the old water tower one will find the entrance on the first floor. The glass hallway divides the building. One side leads to the reception of the hotel, an elevator for hotel guests, the multifunctional rooms and the small catering bar. The other side is reserved for hotel guests and services. The back door of the hallway reaches to the garden with a pathway to the waterfront.

The transformed buildings contain a repetition of tall windows. A clear view outside is possible, but the artistic interior distracts ones attention to look outside.

4.5.3 Sustainability

Environmental aspects

The environmental quality of Villa Augustus is mostly notable in the increased amount of greenery, biodiversity and water retention in comparison with the old situation. The old site was mostly paved surface.

The project makes use of the transformation of two old unused buildings (water tower and pump building) and two restored 100-year-old glasshouses. Questioned is, if the intentional use of these two old glasshouses is

Fig. 85 *Main entrance with non-functional greenery [from: Nienoord, 2013]*

Fig. 86 *Fenced off public garden [from: Nienoord, 2013]*

Fig. 88 *Impression café and shop [from: Nienoord, 2013]*

Fig. 87 *Impression garden [from: Nienoord, 2013]*

Fig. 89 *Impression market and café [from: Nienoord, 2013]*

because of environmental reason or to strengthen the business concept.

The project does not contribute to the closure of cycles, as it does not collect rainwater or compost all organic matter used in the business concept.

Economic aspects

The project creates many jobs for its surroundings. These jobs related to the additional activities of business concept, like the hotel and restaurant among others. The cultivation garden only provides a few jobs but in close relation with the additional activities. Creates popularity for neighbourhood

Social aspects

Villa Augustus is as a place for recreation. As the garden is a public garden, its use is mostly in combination with one of the other activities. When visiting, people can create an awareness of the ability of fresh food production. The wall around the garden gives the project an introvert character. The place is not necessary a meeting place for the surroundings as it attracts people from all over the Netherlands.

4.5.4 Relation with existing urban areas

Villa Augustus makes use of characteristic industrial buildings that are unthinkable in the total concept. The buildings were empty before reusing and the interiors endured a radical transformation. The combination of multiple functions makes it a valuable project. The preparation of food for the restaurant, but also the food that can be bought in the shop is available to visitors. The commercial mix of functions makes it a diverse project on its location surrounded by houses and a new to develop area. Many functions already exist in the city. The addition of new function in the city should not compete to snatch all visitors of other already existing functions.

The cultivation garden serves as marketing concept. From the square meter relation between cultivation gardens and other gardens (fig. 92) can be concluded that the comprehensive garden is not optimized for food production. The aesthetically garden design visualises different spheres. The outline of the surrounding pathways serves to experience them all.

The water tower at Villa Augustus attracts a lot of attention from its surroundings.

The multipurpose visit and the fenced site show that the project is one on its own.

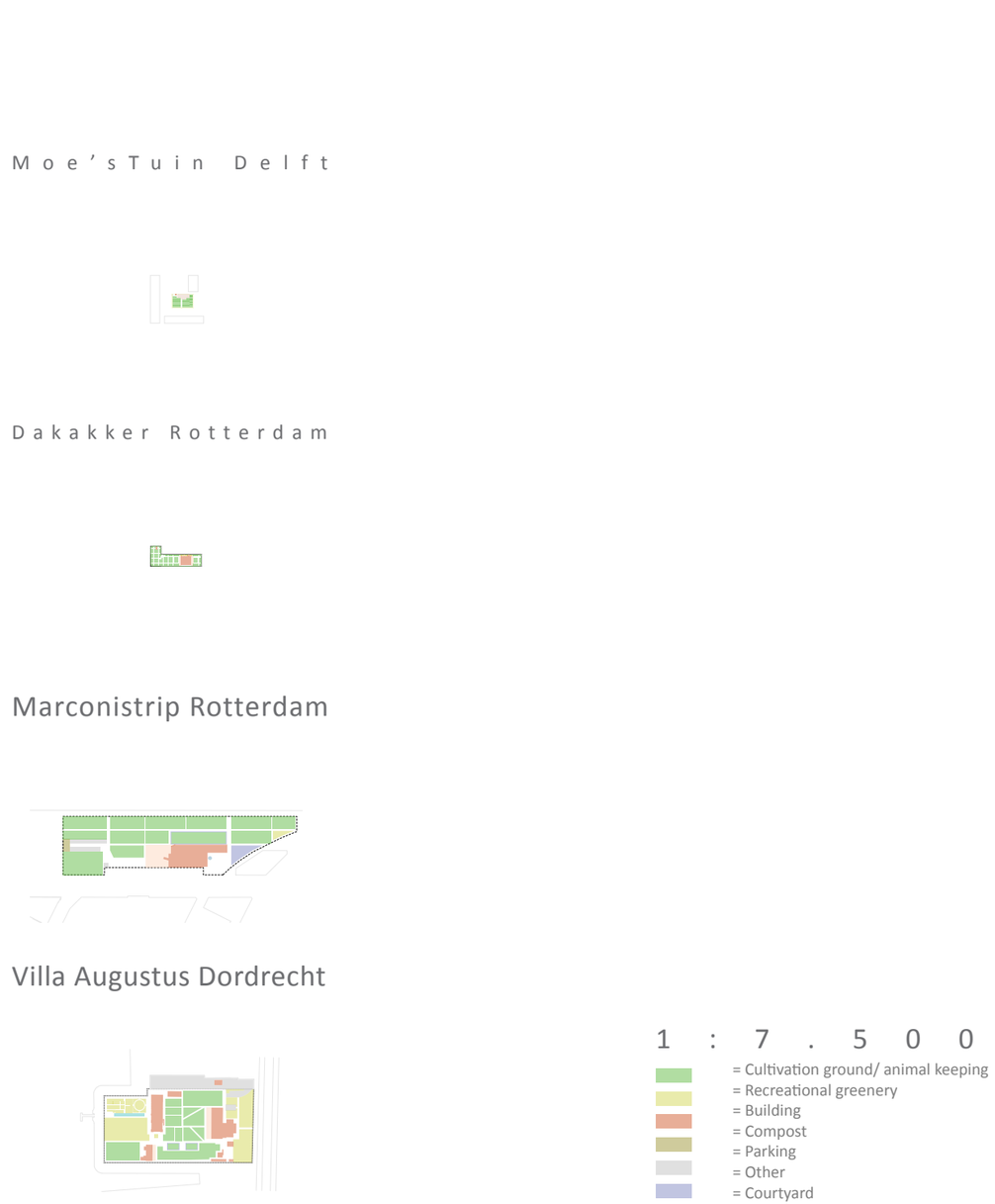
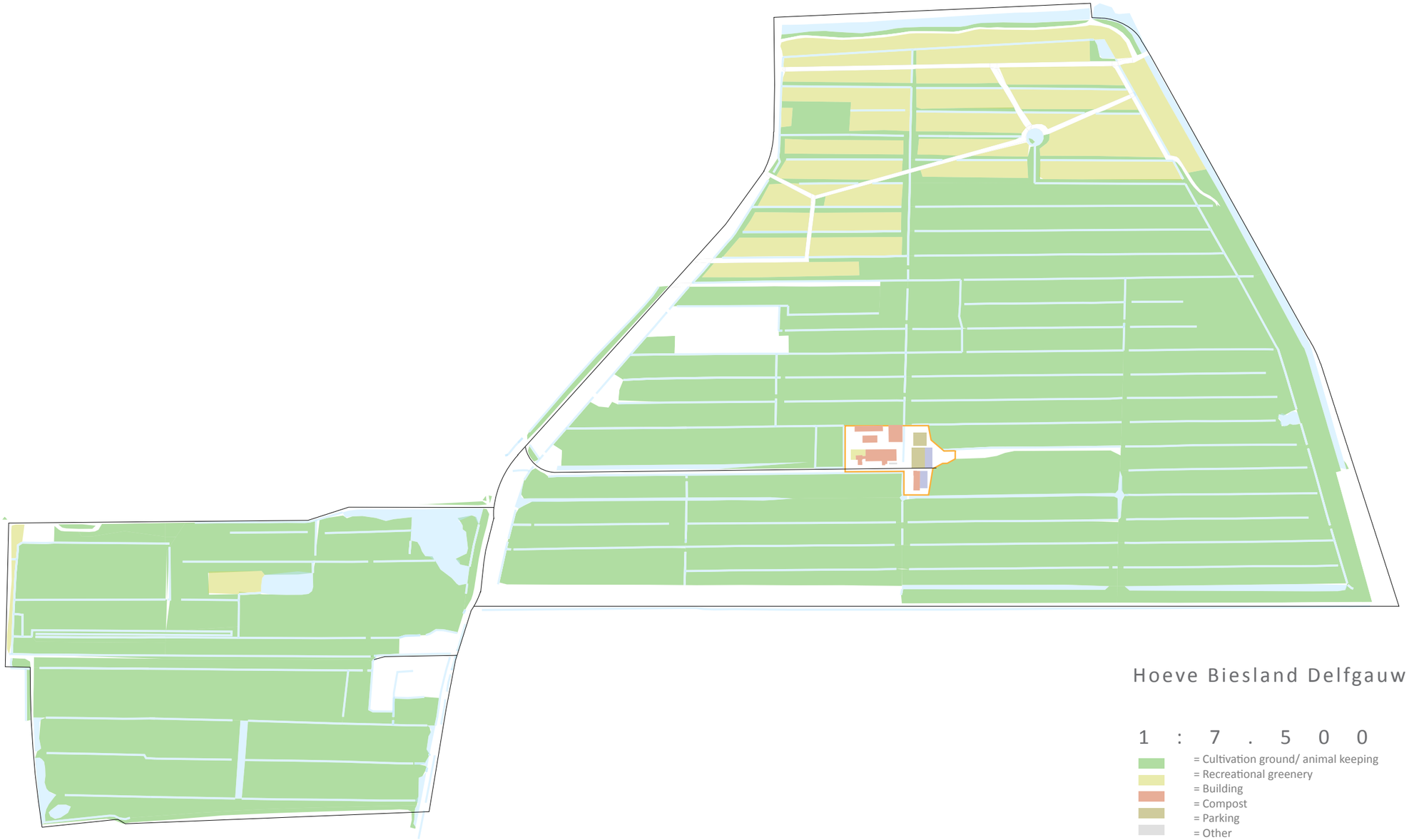


Fig. 90 *Size comparison of case studies [from: Nienoord, 2013]*



Hoeve Biesland Delfgauw

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= Cultivation ground/ animal keeping
= Recreational greenery
= Building
= Compost
= Parking
= Other
= Courtyard

5. ANALYSIS CASE STUDIES

This chapter contains the analysis of the five case studies described in the former chapter. The case studies are compared for general information, spatial organization and sustainability. The analysis provides insight in the most important differences (see comparison charts). Finally, the spatial considerations will be abstracted from the description of the case studies.

5.1 GENERAL INFORMATION

All case studies have their location in the Randstad in the Netherlands in common. Hoeve Biesland is the only project situated on the border of the city. The other four cases are an added quality in the city or as Villa Augustus has been a part of a larger transformation project.

The projects contain a diverse size range, from 210 m2 to around 1.500.000 m2. Moe'sTuin is the smallest project. The scale of Hoeve Biesland is much bigger than the other projects. Outside the city, there is more space available in general. Moe'sTuin its location and primary goal results in a small-scale project. Enlargement of the project is possible thanks to waiting list for participants. The roof surface of the Dakakker limits the cultivation and cannot increase above 1.400 m2. Creating a consortium of more than one Dakakker projects, realizing multiple cultivation roofs, is a plan of the organization. Marconistrip and Villa Augustus are both established on vacant land and are almost the same size, consecutively 1,7 ha and 1,8 ha).

From all cases, Hoeve Biesland is the only one already existing project for several generations. Its business processes has changed gradually from 1997 onwards. It was necessary to increase the amount of land to maximal use of natural processes. All other cases are recently established, between 2005 and 2012, and experienced only small changes since its realization, after running the project a few years. For example, Moe'sTuin added children gardens and the Dakakker changed the terrace design and the location of the aquaponic system at the Marconistrip was alternated.

The Marconistrip and Villa Augustus do have a time-limited character as private parties initiated them. The project locations are on loan from the municipality for a specific period. The loan period of the Marconistrip is the shortest and the building transformation is limited. Among other things, the continuation of the project will be determined according to the future-developing plan of the area. Hoeve Biesland is a family owned farm, a next generation or party will take over the business. In time, Moe'sTuin and Dakakker project have a more permanent character. The Moe'sTuin project has a social character by stimulating communication between neighbours from different cultures. Its continuation is depending on the willingness of (future) inhabitants of the neighbourhood to socialize by cultivating crops. Dakakker is an environmental type of project as its goals is to be an inspiring example for greening the inner city. With the project, it wants to emphasize all positive aspects of greenery.

The commercial characterized projects have a different goal. Hoeve Biesland is trying to find a balance between animals, people and nature, the Marconistrip aims to create relation between professional food production and the city and Villa Augustus is using the cultivation garden to strengthen its business concept. Last mentioned are comparable in size, but cause of the different goals the land is used in another way. Marconistrip uses as much land as possible for the cultivation, as the cultivation garden is just a part of an overall garden at Villa Augustus.
Hoeve Biesland is putting a lot of effort in functioning as an urban farm. Its business process is done in relation with citizens, by optimizing the experience of citizens and use servant farmers. Other sub goals are aiming to close cycles within the business process and integrate all triple-P aspects.

Fig. 91 *Comparison chart, general information [from: Nienoord, 2013]*

CASE STUDIES

GENERAL INFORMATION

	HOEVE BIESLAND	*MOE'STUIN*	*DAKAKKER*	*MARCONISTRIP*	*VILLA AUGUSTUS*
City	Delftgauw	Delft	Rotterdam	Rotterdam	Dordrecht
Location	Border of the city	Addition in the city	Addition in the city	Addition in the city	Part transformation project, as first constructed
Size (in m2)	ca. 1.000.000 (out of 1.780.000)	470	1.400	170.000	180.000
Start	1997 (change concept)	2005	2012	2010	2007
Project type	Economic	Social	Environmental	Economic	Economic
Period	Permanent	Permanent	Permanent	Minimal 10 years	Minimal 50 years
Initiator	Private iniative	Some inhabitants	ZUS Architects	Private iniative (Uit je eigen stad)	Private iniatieve
	Supportive government	Support Woonbron Delft,	Binden projectgroup		Supportive government
		Municipality,	RMC		
		Wide Wealth Delft (Breed Welzijn Delft)			
Goal	Balance: animal - people - nature	Communication between different cultures	Inspiring example for greening the innercity	Proffessional food production vs the city	Garden strengthens catering concept
Sub goals	Experience	Meeting place	Insulation	Relation countryside - city	Create a special garden (personal)
	Care for care needed people (2007)	Connection and participation	Water retention	Place making	Placemaking (municipality)
	Business process with city inhabitants	Education	Additional space	Use vacant land and buildings	
	Balance: 3P's		Reducing heat island effect	Apprenticeships	
	closing cycles		Filters the air	Awareness	

To stimulate the communication between neighbours of different cultures Moe'sTuin contains a meeting place. Participation of crop cultivation establishes the connections between neighbours and invites them to connect with each other.

Dakakker is an inspiring example that contributes to sustainability by aspects of building insulation, water retention, reducing the heat island effect, filtering the air and creating an additional space.

By cooperating with farmers within a radius of 30 km Marconistrip establish a relation with the countryside. This relation contributes by creating awareness about the food cycle. The project uses apprenticeships to minimize the labour cost and realizes a professional business concept. Both Marconistrip and Villa Augustus used the idea of "place making". For latter, this was intended by the municipality. The creation of a special garden is a sub goal of Villa August as overall garden expresses different atmospheres. A clear separation between cultivating gardens and non-cultivating gardens is visible. Thing to notice is that the realization of the different gardens spheres implies not only cultivation gardens. Optimization of crop cultivation is thus not a main goal. Both projects are also use vacant buildings. The Marconistrip chose the location intentionally. The municipality asked the entrepreneurs of Villa Augustus to develop the specific location. The use of a monumental building for Villa Augustus corresponds to the previous project of the developpers, Hotel New York, and is a remarkable landmark in their concept. The buildings used for the Marconistrip have an industrial character.

A person with an agricultural background manages the projects Hoeve Biesland, Dakakker and Marconistrip, or is at least included in the management team. A board of volunteering inhabitants is organizing Moe'sTuin with the help of a social worker. The entrepreneurs of Villa Augustus have an entrepreneurship or artistically background.

Hoeve Biesland makes use of private owned land and land on loan from the municipality. A housing corporation owns the land of Moe'sTuin. Marconistrip and Villa Augustus are on loan from the municipality. LSI project investment and OntwikkelingsBedrijf Rotterdam (OBR) are owners of the Schieblock building that is the core for the Dakakker project.

The investment costs of Moe'sTuin, Dakakker, Marconistrip and Villa Augustus are increasing consequently. The first mentioned and smallest scale project needed a maximum investment of 10.000,- euro, which has been financed by the housing corporation, municipality and Fonds 1818. Around 450.000,- euro was needed for the Dakakker. The construction of the garden design with its roof covering is one of the biggest expenses. The 'Stadsinitiatief 2012' in Rotterdam and the Rabobank Rotterdams Fonds financed the project. Twice as much is spent, around 900.000,- euro, on the Marconistrip. Havensteder, Rabobank, Stichting DOEN financed the project in combination with money collected crowd funding. The aquaponic system is subsidised with only the financial help by the government. Costs could be lower because parties offer services rather cheap. Almost ten times as high as Marconistrip and thus 20 times as high as the Dakakker, are the investment costs for Villa Augustus. In this case the municipality of Dordrecht has been extremely generous. The financial aspects of Hoeve Biesland are unknown. The business change is probably private financed with the support of the municipality and institutions.

From all projects, only Moe'sTuin does not generate direct income. It provides fresh products, so participants do not have to buy them in the supermarket. The other projects generate yields by selling products and catering. Hoeve

Biesland, Marconistrip and Villa Augustus do give tours as well. The last two mentioned and Dakakker rent facilities for income. At Villa Augustus it is also possible to buy books about the project and to rent water taxi's. As Moe'sTuin provides education to school kids, as all cases, except Villa Augustus do. It is unknown if they receive money in return. The other projects provide this service for compensation. Hoeve Biesland is the only project offering business excursions.

The most remarkable functions are family living at Hoeve Biesland; worm composting at the Dakakker; mushroom cultivating, aquaponic system, inside chicken breeding and also worm composting at Marconistrip and the hotel catering at Villa Augustus. Hoeve Biesland also keeps chickens outside the buildings. All projects include a storage room. As Hoeve Biesland provides many additional functions, it does not have a space to host visitors. Villa Augustus broadened its catering function by adding, a preparing kitchen and a bakery. The organization of additional activities, such as Bieslanddagen, sowing- and harvesting festivals attract people to the locations.

As cultivation method Hoeve Biesland, Moe'sTuin, Marconistrip and Villa Augustus use soil. Marconistrip will also use an aquaponic system with water as medium in the nearby future. All projects make use of composting. This is not known for Villa Augustus but can be presumed because their use of compost to fertilize the cultivation soil.

Originally is Moe'sTuin is accessible for everyone, the garden is not locked but only participants are allowed to enter. Villa Augustus is open all days during the week until from 7h – 8h to 24h – 1h. Marconistrip is only closed at Monday and Tuesday's but opens and closes at 22h at the latest (16h at Sundays). Opened only one day a week to sell products, work activities continue through the week at Hoeve Biesland. At the Dakakker, volunteers are working one day a week. The latter is accessible for building tenants during office hours. Hoeve Biesland, Dakakker and Marconistrip are accessible at appointment. Vandalism affects the public accessible garden of Villa Augustus.

All projects are cultivating vegetables, fruits and spices. To this Hoeve Biesland adds cows, sheep's and chickens. Dakakker, Villa Augustus and Marconistrip add flowers and bees, as the latter also cultivates mushrooms and keeps chickens. The future aquaponic system will also supply fish. These fish are not for sale. This method will optimize the cultivation process. The system is a close system except the addition of fish food. Also interesting is that the projects do contain flowers, even if not for sale, as flowers are important for the pollination of crops. This pleads for bees as well.

Probably because urban farming is an upcoming phenomenon, all projects do get many media attention. Some project even international instances. For the Dakakker this also generates a problem, as media asks for a lot of time in combination with the guidance by volunteers, interviews and to contact businesses and local catering for selling of products. The agenda of Hoeve Biesland's farmer is also overloaded and without structure.

The design of Villa Augustus' cultivation garden focussed on aesthetics. Mr. De Leede points out that they paid too little attention to the aesthetics of the plants within the spatial design of the Marconistrip. They also paid too little attention to the placement of the glasshouse, which it is not receiving enough sunlight to use it for crop cultivation in wintertime. The Marconistrip wanted to integrate sources from the city into their business concept, like the use of biodegradable waste from households. The government restricted the idea to use city waste into its business cycles

Additions to the original plan, as sowing- and harvesting festivals and children- and elderly gardens, show the success of Moe'sTuin. Even if the participants are not happy with the introduced membership fee, there is still a waiting

list for participants to join the garden. The Dakakker also has a waiting list for volunteers to join the team. Another success of the Dakakker is their product are bought by local catering and tenants of the Schieblock building.
The Marconistrip's main success is the fact that they are getting profitable for the last few months. The project is succeeded in being a professional business. The project organization of Moe'sTuin also tried to make Moe'sTuin a more professional project as it was intended for the inhabitants of the neighbourhood.

5.2 SPATIAL ORGANIZATION

The orientation of the buildings or meeting places in relation with farmland or cultivation plots differ for each farm. The farmland encloses the farm of Hoeve Biesland. A road is leading to the courtyard and goes through the farmland. The terrace at Moe'sTuin and the buildings of the Marconistrip are at the border of the cultivation plots located. These sides also contain the main entrances. The functions of the Dakakker are located in between the two cultivation gardens, as at Villa Augustus the cultivation garden is in between the buildings. A staircase or an elevator is reaching to the Dakakker. Villa Augustus main entrance passes trough by one of the non-cultivation gardens. Hoeve Biesland also contains several entrances that will give access to the Bieslandse Bos by foot. This is a natural part of the land intended for recreational walks. Villa Augustus also provides more entrances to enter the public garden and the possibility to go directly to the water tower instead of entering the pump building first. The second entrance at the Marconistrip might function as a short cut to enter the site from the public transport stop. The Dakakker contains a second staircase needed for security reasons. Moe'sTuin only has one entrance.

All case studied contain boundaries made of different materials. They offer a more open view or more closed ones. Twined fences, trees and ditches provide natural land boundaries at Hoeve Biesland. In addition, electric fences need to keep the cows on the farmland. A nice overview of the farmland is still available and a road surrounding it supports this view. A relative small hedge physically fences of Moe'sTuin reduces the view on the garden. It creates a distance to people (neighbours) who are not participating. The use of flowerboxes that fence off the Dakakker roof prevents people from falling. From ground level, it is hard to notice the cultivation garden at height. The Marconistrip is fenced off by an elongated building (not included in the project) and by a steal frame. The steal frame makes it able to lock the location after opening hours. Tall hedges and trees interrupt the view through the steal frame. A wall is mostly surrounding Villa Augustus. Only the side that is facing the street is open and shows a grass field in front of the pump building. This view opportunity does not reveal the more interesting gardens. The secondary entrances offer a glimpse of the gardens.

All projects divided their cultivation grounds in different plots. At Hoeve Biesland, this accounts only for the vegetable garden. The positioning of the plots differentiates from more functional to design that is more aesthetical. Each plot contains one type of crop, except for Moe'sTuin. The privately owned plots (ownership can change each year) make sure one can cultivate multiple crops in one plot. The Dakakker uses volcanic material as growth medium for the crops, because it is much lighter than soil. All other projects use soil as a growth medium or to keep livestock on. The Marconistrip is also going to experiment with aquaponics and uses water as growth medium. This cultivation method is located in a closed room inside and is only accessible under guidance.

One has fragmented views on the farmland from the courtyard of Hoeve Biesland. Although the stables block the view, the enclosed farmland creates exciting views from the courtyard. From the terrace at Moe'sTuin, there is a nice view on the cultivation grounds. The two terraces of the Dakakker provide a nice view on the two parts of the garden and give a beautiful view over the city. Buildings at the Marconistrip are quite close and therefore

The next comparison chart gives insight in the size of the facilities of the case studies. Some remarks concerning the m2 comparison chart in general are:

- Exact figures used are obtained through sources, but most are estimated approximately. These estimations give an indication of the relationship of the different functions included in the case studies. If no source was available, measurements are done based upon scaled drawings derived from maps.tudelft.nl when not maps.google.nl.
- Flowers needed for pollination and eventual sale are included in the cultivation ground as they are spread all-over the cultivation ground.
- The paths measured are the only paved paths or clearly indicated paths for visitors. In between the crops, small paths are present for seeding, maintaining and harvesting.
- Areas that do not function as staying activities but only for cultivation activities are included in the courtyard.
- The floor spaces included all known areas, as not all floor plans have been accessible.

There are also some remarks regarding to the case studies in specific.

1. *Hoeve Biesland*

- Its scale is much larger than the other projects. The percentage of all additional functions is in that way minimal to the cultivation ground.
- Has another proportion between the functions as it keeps mostly animals as only project.
- The cultivation ground includes ditches to collect rainwater to prevent the land from flooding.
- There is no specific parking place but the courtyard contains enough space for cars.
- Bieslandse Bos is a non-cultivation area.
- The sub heading 'other' contains food storage in the open air.

3. *Dakakker*

- The sub heading 'other' contains mostly transportation space to reach the top floor.

4. *Marconistrip*

- The external chicken run is included in the cultivation ground.
- The sub heading 'other' contains one piece of vacant land and one other with a tepee.

5. *Villa Augustus*

- Non-cultivation garden is a separate garden from cultivation garden.
- The sub heading 'other' contains unknown floor surfaces and infrastructure.

The cells, which are marked, indicate the facilities and appropriate of square meters that will be used as starting point for the design.

Fig. 92 *Comparison chart, square meters per facility [from: Nienoord, 2013]*

		CASE STUDIES				
		HOEVE BIESLAND	*MOE'STUIN*	*DAK AKKER*	*MARCONISTRIP*	*VILLA AUGUSTUS*
FARMING FACILITIES	*Build on surface*	3.200	3	130	1.600	2.100
	Floor surface	3.500	3	130	1.600	3.800
	Cultivation ground	1.300.000	210	480	8.180	5.000
	Composting place	1.300	1	2	140	Unknown
	Waterbasin	0	0	0	20	0
	Chicken	100	0	0	1.140	0
	Mushroom	0	0	0	20-30	0
	Aquaponic	0	0	0	150	0
	Cow stable	1.400 - 2.900	0	0	0	0
	Paths	-	120	370	2.910	4.130
	Courtyard	3.800	0	0	1.450	500
ADDITIONAL FACILITIES	*Terrace*	0	90	40	820	320
	Recreational greenery	200.000	0	0	0	4.200
	Shop/ market	0	0	0	20	140
	Restaurant	0	0	0	100	480
	Kitchen	0	0	10	60	300
	Multifunctional room	0	0	60	210	330
	Hotel	0	0	0	0	1.680
	Kantoor	0	0	0	160	Unknown
	House	100 - 200	0	0	0	0
	Backery	0	0	0	0	50
	Butcher	70	0	0	0	0
	Storage	400 - 1.900	3	10	160	200
	Other	700	0	1	520	284
	Bicycle parking	10	0	-	0	90
	Parking	0	0	60	950	1.820

block the view to the cultivation grounds. The terrace is facing a small part of the cultivation garden in the direction of the plastic greenhouses and the parking lot and mostly facing the chicken run. At Villa Augustus, a consumer is distracted to have a look outside to the cultivation garden, because of its artistic interior and the restaurant floor is not at the same level as the garden. A clear view is provided from the terrace to the cultivation garden. All projects examined have a composting place, outside view lines.

Higher buildings are surrounding the Moe'sTuin, Dakakker and Marconistrip. They benefit from the nice view on the gardens.

The functions of Hoeve Biesland are spread out over several buildings, mostly stables (which serve as storage in summer time as the cows can graze outside). A courtyard connects all functions located on the farm. It also offers space for machines to go through, places for food storage tanks and for car parking. Moe'sTuin only contains a small shed for storage and no space for people to meet during bad weather. The shed separates the terrace and the containers from each other. The Dakakker has a pavilion with the multifunctional room as most important space. The Marconistrip contains two buildings connected to each other. One of the buildings already existed and the other is built. The new built building is on the other site embedded by an elongated building that is not included in the project.

5.3 SUSTAINABILITY

5.3.1 Environmental aspects

All projects influence the biodiversity in the area. Different from regular farming practices Hoeve Biesland gives space to flora and fauna to develop. The size of the farmland makes it possible to be more flexible in the business process. As different crops are cultivated at Moe'sTuin, paved pathways replace almost half of the grassland of the old situation. The Dakakker, Marconistrip and Villa Augustus all transformed a non-green area into a cultivation garden. The amount of greenery increased on these locations and so improved the biodiversity and the rainwater remediation in the area. All three projects also make use of vacant or unused spaces and buildings. The transformation of Villa Augustus has a bigger impact on the original building as the Marconistrip. The location on the roof of the Dakakker implies multifunctional use of the building plot.

Hoeve Biesland pays most attention to close cycles. Composted organic matter reused as fertilizer or used as food for the animals. Photovoltaic panels generate solar energy. Projects as Moe'sTuin or Villa Augustus do not compost or collect rainwater. The Dakakker does have a compost place and uses earthworms for composting of the organic matter. The organic matter will be use as fertilizer again. There is no rainwater collection to water the crops. A composting place is also present at the Marconistrip and using earthworms in the future (and even black soldier fly larvae). The Marconistrip will make use of an aquaponic system, an almost closed cultivation cycle, in the future.

5.3.2 Economic aspects

All projects organize additional activities next to the food production. Only Moe'sTuin organizes these activities to strengthen the connections between neighbours. The other projects derive media attention from these activities that will increase their popularity and yields. Products can so be sold more easily and therefore a higher turnover is generated. These higher turnovers generated by (international) media attention for their way of implementing urban farming. Moe'sTuin participant gain economic quality from their cultivated crops. They need to spend less money on

Fig. 93 *Spatial considerations with relative indication [from: Nienoord, 2013]*

SPATIAL DESIGN CONSIDERATIONS	CASE STUDIES				
	HOEVE BIESLAND	*MOE'STUIN*	*DAKAKKER*	*MARCONISTRIP*	*VILLA AUGUSTUS*
Size	+++	+	+	++	++
Accessibility	+	++	+	+	++
Experience	+++	+	-	+	++
Close to market	-	+++	++	+	++
Activities	+	+	+	+	++
Visibility of the location	+++	+	-	++	+
Visibility into the garden	+	+++	++	+	+
Replace paved surfaces	N/A	-	+++	++	++
Meeting place (through seasons)	-	+	+++	+++	+++
Use unutilized space	N/A	+	+++	+++	+++
Design garden	-	+	++	++	+++
Additional facilities	N/A	-	+	++	+++
Flexible	+	+++	++	++	+
Feeling of safety	-	-	+++	++	++
Attracts visitors	++	-	+++	+++	+++
Vacant land or buildings	N/A	-	++	+++	+++
Diverse methods	-	-	+	+++	+
Characteristic building	-	-	-	+	+++
Landmark	-	-	-	-	++
Integration	-	+++	+++	+	+

vegetables from the supermarket. Woonbron and the Municipality gain from it in the way that the neighbourhood is improved and there is more solidarity.
The cultivation of vacant land increases property value on the spot and in tis surroundings.

Both Hoeve Biesland and the Marconistrip are making use of cheap workers next to permanent employees. Hoeve Biesland to be able to extend its business concept and the Marconistrip to make their concept profitable. In addition, Hoeve Biesland makes use of a loan system with private investors to be able to finance photovoltaic-panels on the stable roofs. The finance of the Marconistrip is partly done by crowd funding. The loan system with private investors and crowd funding are two principles connecting the investors to the project.

5.3.3 Social aspects

Hoeve Biesland provides recreational activities for people to experience the natural land parts by cycling around and to be able to walk in the area. These areas are accessible to anyone. Moe'sTuin is a recreational garden in which participants can meet. This meeting place is for participants and thus can exclude other neighbours. The Dakakker is a meeting place mostly for its volunteers and people working at the different companies in the buildings. There is little interaction between the volunteers and people visiting the roof to buy products or take something to drink. The two commercial projects are recreational in the sense that they provide catering. People will go to these projects if they want something to drink or eat. The projects are accessible during opening hours. Despite the public garden of Villa Augustus, the use is often in combination with one of the other activities.

Working together on food cultivation raises awareness about food. The projects including food processing also help to make people more aware of value of healthy food.

Hoeve Biesland and the Marconistrip are making use of workers that need to develop skills. Moe'sTuin involves children by giving them their own garden. The children will be educated about the food cultivation.

All cases studied incorporated additional activities around their urban farm. Activities as markets, sowing and harvesting festivals are popular. Villa Augustus also organizes cultural programs with shows for different ages.

Hoeve Biesland does attract many target groups, but immigrants do not visit the farms so far. Little communication between the neighbours of different cultures is exactly the reason for the project initiation of Moe'sTuin. Working on the cultivation of crops brings immigrants from different countries together. Moe'sTuin is the only project that does not sell the cultivated crops. The cultivation gardens are on loan by its participants (the participants might change yearly). The other four cases cultivate crops intended for sales. These crops have relatively high prices and thus are not affordable for all people. Particular target groups will be attracted to these farms.

5.4 DESIGN CONSIDERATIONS

The spatial considerations derived from the case studies are described in the next scheme (first column). In the cells the performance of the case studies on the spatial consideration are relatively indicated by -, +, ++,++ or N/A. The cells, which are marked, have been chosen as starting point for the design. They indicate the best performance on the item mentioned.

Fig. 94 *Sustainability triangle, concept according to Nienoord [from: Nienoord, 2013]*

6. A FRAMEWORK FOR DESIGN

Urban farming can contribute to many urban issues that might result in a more sustainable living environment. Achieving a sustainable living environment needs a balance between the social, environmental and economical qualities with the implementation of urban farming. This chapter gives a framework of the spatial implementation of urban farming within existing urban areas in the Netherlands. To create a sustainable living environment an ideal representation of the implementation is shown in the design. The spatial requirements depend on location and space, farming specifications, spatial organization, usage and buildings. Those requirements lead to urban farming typologies per building type.

The first paragraph sets a framework how to sustain a living environment in the context of this research. The second paragraph discusses the key considerations for choosing a farming location within existing urban areas. The next paragraphs give a specification of urban farming, the spatial organization and the building requirements.

6.1 SUSTAINABLE LIVING ENVIRONMENT FRAMEWORK

A sustainable city provides a high quality of living environment for the people living in it. In this research, several sustainability goals are set as prerequisites to indicate if the living environment in existing urban areas is sustainable or not. These prerequisites are derived from the sustainable definition in this thesis: *Sustainability is about high quality and is to be found in a valuable balance of social-, environmental- and economical qualities. It becomes a manifest in spatial environment.*

A sustainable living environment refers to a living environment in which a valuable balance of social-, environmental- and economical qualities is found. The social quality is about the *cohesion* between inhabitants within existing urban areas. Environmental quality is about the *green*ery in all its forms. The implementation of greenery meets multiple environmental purposes as well. The economic quality is defined by *food*, to make greenery more functional. Cohesion, greenery and food are the central goals I am focussing on.

The concept of sustainability is illustrated in figure 94. From those qualities and related goals, different aspects are derived that will be included in the design of urban farming, a mandatory part of the graduation. After describing each qualities, related goal and aspects, attention will be paid to the way the qualities are interrelated.

6.1.1 Environmental quality

Adding greenery to the living environment can increase the environmental quality. Greenery serves the multiple purposes, especially by creating more biodiversity. Different kinds of flora and fauna can develop if there are more (differentiated) places. Secondly, greenery will improve the micro climate as it creates shadows or evaporates water. The improved micro climate influences peoples well being, health and labour productivity. It also affects energy usage, as less energy is needed to cool down buildings for example. The ability of greenery to evaporate water is one possibility that addresses the issue of water management in areas with (too) many paved surfaces.

6.1.2 Economic quality

Traditionally the economic quality is focussing on money making. In an economic driven society, it is necessary to find ways to cope with preferred functions that do not directly make a lot of money. Implementing urban farming creates functional greenery with higher yields and costs for maintaining greeneries can be lowered. Yields are obtained by selling the products and qualitative greenery creates higher property value of the (surrounding) estate.

Lower cost can be reached by the use of servant farmers. Local employment is created by the need for maintenance of the gardens to keep it to a high quality. Production of food close to its costumers excludes a number of business processes within the food supply chain. Food miles will be drastically lower.

6.1.3 Social quality

The social quality is depending on the way inhabitants within existing urban areas interact: if there is any cohesion or not. Cohesion is indicated by health, connecting and meeting. A living environment that invites people to go out will have a positive influence on the people's health. Exercise that is more physical will be the result. The possibility of meeting other people is higher if one is spending more time outdoors. In general, it is easier to connect with people if you meet them more often. Creating relationships between inhabitants will open up individualization. This will result in people willing to take care of their own living environment.

6.1.4 Interrelated qualities

Social quality and environmental quality are linked by the perception of people by greenery in the living environment. It is related to the *feeling* of people. In general, information about the opportunities of greenery might have a positive impact on their involvement with their environment. The liveability of an environment can be improved if more qualitative greenery is situated close to ones home. People can become aware of the meaning of greenery if the green is *visible* and *accessible*. Knowing how to cope with this aspect of urban farming stimulates the process towards more social cohesion. Social cohesion might have a positive impact on the environmental goals of urban farming.

The link between social quality and economic quality can be found in the opportunity of participating in social groups, in this case at urban farms. Different aims can contribute to participation. The relationship between participants is depending on their aim. Different aims are working, volunteering, caring, educating, recreating and knowledge creating. All aims are correlated to the accessibility of the location. People can become aware of the meaning of food if they get the opportunity to know more about the way food is produced in an urban farm and know how to integrate this economic quality in their way of living. Participation in food production might have a positive impact on the economical goals of urban farming.

The link between environmental quality and economic quality is fragile. The environmental quality is related to the visibility of (business) processes. In general, cycles should be closed. This means to deal carefully with the in- and output streams in the living environment.

The effect of food production in the living environment will be visible on the roads because less traffic is needed. Scarce space within the living environment asks for efficient use of it. Multifunctional use and the utilization of unused spaces can deal with the situation. Last, functional greenery can have high quality when maintained well. The economical quality is asking for efficiency.

Since every city has its own city development, the unique qualities of each city should be taking into account while adapting sustainable innovation processes. In the end, all cities should adopt the above-mentioned aspects of sustainable living.

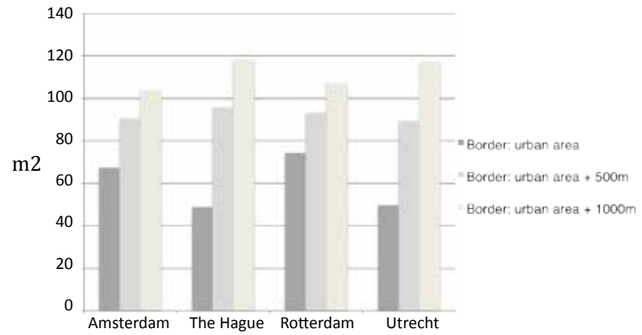


Fig. 95 *Amount m2 per dwelling in the Netherlands [from: Nienoord, 2013 – derived from Bezemer & Visschedijk, 2003]*

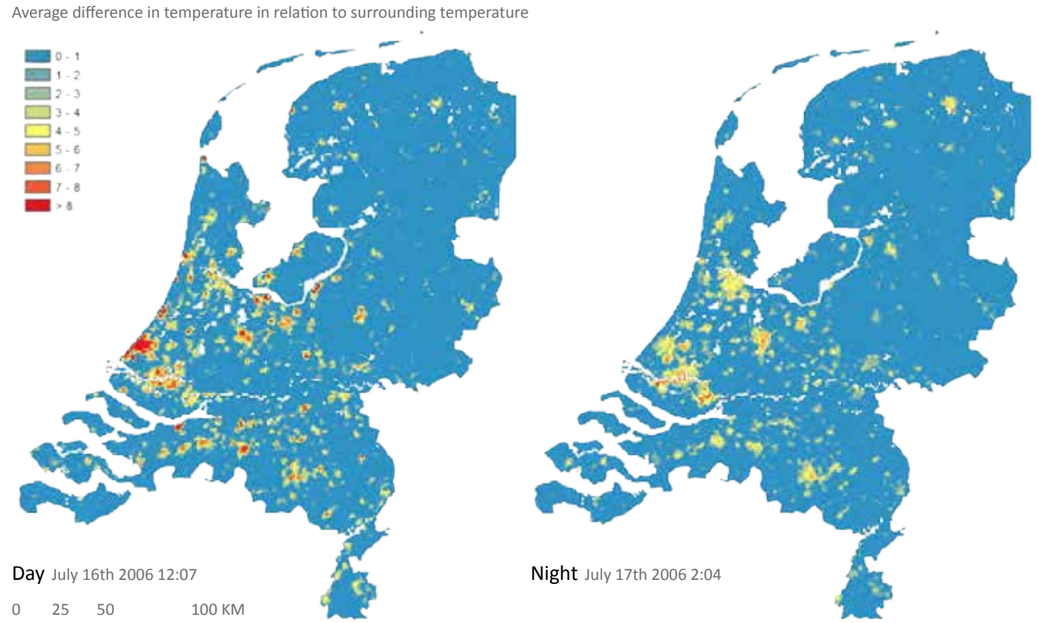


Fig. 96 *Map with urban heat island effect in the Netherlands, derived from NOAA-AVHRR surface temperatures [from: Klok et al, 2012]*

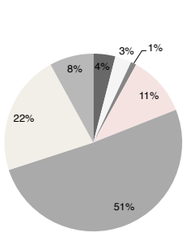
= Cemetery
= Forest
= Day recreation area
= ‘Dry’ natural area
= ‘Wet’ natural area
= Other agrarian use
= Parks
= Sport fields
= Victory Gardens

= Greenery
= Buildings
= 1000m range
= Boundary urban area

2000 0 2000 4000 Meters

Rotterdam	41
Amsterdam	33
Utrecht	33
The Hague	30

Fig. 97 *M2 greenery per citizen in the Netherlands [from: Nienoord, 2013 – derived from Stadsvisie Rotterdam 2008]*



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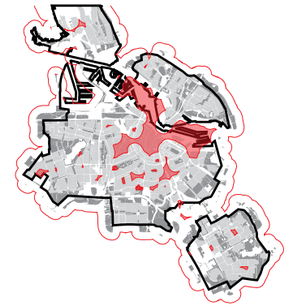
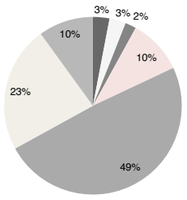
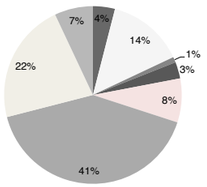




R o t t e r d a m



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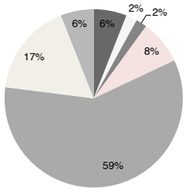

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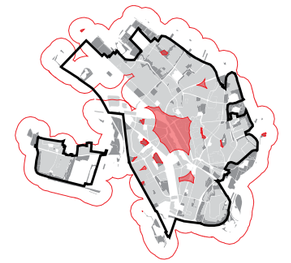


Fig. 98 *Division different Green types within the urban area [from: Nienoord, 2013 – derived from Bezemer & Visschedijk, 2003]*

Fig. 99 *Green analysis, relation between buildings and green [from: Nienoord, 2013 – derived from Bezemer & Visschedijk, 2003]*

Fig. 100 *Green analysis, accessibility of green within 1000m per dwelling [from: Nienoord, 2013 – derived from Bezemer & Visschedijk, 2003]*

6.2 EXISTING URBAN AREAS

6.2.1 Context of Dutch cities

The design should fit in the Dutch context. The choose location, the context of Dutch cities will be described next.

The Netherlands is a relatively small wealthy country. Compared to most cities in the world, inhabitants of Dutch cities can reach a green area for recreation or natural landscape relatively quick. Every dwelling should have 75 m2 of greenery and within a range of 500 meter, as mentioned in a report about greenery in the Netherlands (Bezemer & Visschedijk, 2003). In the thirty biggest Dutch cities, the G30, there is not enough m2 greenery for every dwelling. In addition, dwellings can not reach greenery within 500 meters in almost all of these cities. Of course, the cities of Amsterdam, Den Hague, Rotterdam and Utrecht, the G4, are included. The research does not say anything about the quality of the greenery, but it gives an indication of the amount of greenery and its position.

A research from 2005, Groen in de stad: ontwikkeling 1993-2000, concluded that a little growth is shown of the parklands (including parks) in the city itself, while the areas of 'semi-public' parklands (including sport grounds and allotments) and especially 'agricultural land' has decreased. (Agricultural method most used in the Netherlands is SPIN farming in the ground soil). In the periphery of the city, an increase of 'public and semi-public parkland' is shown, while there is a significant decrease of 'agricultural spaces'. In comparison, the overall growth of public parklands is less than the growth of the population. It represents a drop in the growth per individual (Niet, 2005). Besides the rivalry of more economic feasible projects, the maintenance costs for greenery are relatively high. Although the Netherlands does not contain mega cities, still almost all cities are dealing with Urban Heat Island effect as shown in a research of TNO on mapped infrared images of surface temperatures in the Netherlands (E. J. Klok, Schaminée, Duyzer, & Steeneveld, 2012). The measurements are taken during a heat wave in 2006. The type of soil is of influence of the temperature as sandy soils ensure a high SHI (Surface Urban Heat Island) during the day (absorb heat) and clay or peaty soil a high SHI at night. During the day, the sandy area of The Hague shows the largest area with an average highest temperature (figure 9). In the night time, the area with the most SHI is situated in clay and peaty area of Rotterdam. The river the Rijn that retains heat during the night is also influencing the SHI of Rotterdam.

Most of these cities are located in the Randstad. As it is hard to define the boundaries of the Randstad it incorporates cities containing more than 300.000 inhabitants. Furthermore, it is characterised by a large number of urban municipalities on the border of or in between big cities. It also includes cities with less than 100.000 inhabitants that have been historical important, Delft for example. Around 7 million people live in the Randstad out of 16,8 million in NL (CBS, 2013).

6.2.2 Choice of location

The focus of this research is to create a sustainable living environment within existing urban areas by implementing urban farming. Previous goal will function as guideline for the implementation of urban farming into the design. Considering the following aspects will result in a suitable location.

One of the choices of an urban farm location is given by the Urban Heat Island effect. Urban farming can have a significant influence on the Urban Heat Island Effect as it can decrease the higher temperatures (see chapter 2.2.1).

The implementation of urban farming in areas that experience these higher temperatures can have a larger impact on the local climate.

A second factor for choosing a urban farming location is improving the rainwater absorption. Rainwater absorption will have influence on the local climate is the addition of greenery on locations that are currently paved. Transforming paved areas into green areas will positively affect water infiltration by soil and surface. The local climate within industrial areas can be improved as well, but in these areas, relatively less people live. As the research is focussing on the improvement of the living environment, these areas will not be selected for design implementation.

Although a norm of 75 m2 of greenery per dwelling is standard in the Netherlands, thirty of the biggest cities do not reach it. Another objective that is not applicable is that inhabitants should reach greenery within 500 meter. The quality of greenery in these measurements is not even considered. Areas in the inner cities of the Dutch four biggest cities do not meet these norms. The ecological aspects of greenery as described in chapter 2.4.3 are depended on the m2 of leaf surface instead of the m2 greenery per person or dwelling. To meet the norms urban farming should be introduced in these locations.

Within existing urban areas it is hardly possible to implement large urban farms as done outside cities. The creation of a sustainable living environment in this research implicates an increase of qualitative and quantitative greenery. To create a large positive impact on the living environment, the implementation of urban farming should be on a larger scale than just an addition of a single community garden. Cities contain vacant and unused plots and buildings and therefore it is possible to create different green areas in all sorts over those different locations. The amount of unused space on roofs is underestimated. Especially relatively large roofs offer a potential for the development of a sustainable city.

In an ideal situation, a connection should be created between urban farming locations in the city. In this way, participants can share knowledge and exchange experiences at a single or multiple locations. The connection can facilitates the meeting of people that participate in different urban farming activities. The city broad network for public transport can be used to reach specific urban farming locations.

6.3 URBAN FARMING SPECIFICATION

The way of implementing urban farming is depended on the functions it will achieve. The choice of it depends on the location an farming possibilities.

6.3.1 Farming possibilities

Urban farming needs several supply inputs and generate several outputs. Most important supply inputs are light, water and nutrients, as outputs are products and biodegradable waste. The sun and rain provide sunlight and water that are natural supplies. Both are weather depended. Natural supplies prevent unnecessary use of sources. Water needed for plants can be provided by the rainwater that can not infiltrate in the current situation. *Collecting rainwater* can help to overcome longer periods without rain or prolonged hot days. Using drinking water for irrigation is a waste when rainwater is present and can be collected. Efficient use of natural supplies and the (re) use of output as input is sustainable. Every farming technique does have different specifications. Investigation of forehand can turn out in how to make use of surrounding sources or waste in the process.

Digested biodegradable waste should function as fertilizer for the plants, after *composting*. The nutrients in this organic fertilizer decrease the need for external fertilizers. External fertilizers should also be organic to limit the

Fig. 101 *Comparison chart, goals [from: Nienoord, 2013]*

GOALS

ASPECTS	*FOOD PRODUCTION*	*BIODIVERSITY*	*CARE*	*EDUCATION*	*MEET*	*PARTICIPATION*	*INCUBATOR*
Social area	Economical	Environmental	Social	Social	Social	Social	Economical
Accessibility	Private	Public	Semi-public	Semi-public	Public	Semi-public	Private
Requisite	Knowledge	Guidance	Guidance	Knowledge	Guidance	Guidance	Knowledge
How	SPIN farming Hydro culture Aquaponics	Forest gardening SPIN farming	Forest gardening SPIN farming	Forest gardening SPIN farming Hydro culture Aquaponics	Forest gardening SPIN farming	Forest gardening SPIN farming Hydro culture Aquaponics	Forest gardening SPIN farming Hydro culture Aquaponics
Where	Inside the building Around the building Facade Rooftop	Parks Plazas Waterfront Streets Around the building Facade Rooftop Balconies	Parks Plazas Waterfront Streets Around the building Facade Rooftop	Parks Plazas Waterfront Streets Inside the building Around the building Facade Rooftop Balconies	Parks Plazas Waterfront Streets Around the building Rooftop	Parks Plazas Waterfront Streets Inside the building Around the building Facade Rooftop	Inside the building Around the building Facade Rooftop
When	9 - 18 h	N/A	9 - 18 h	9 - 18 h	9 - 18 h , 18 - 2 h	9 - 22 h	9 - 18 h
Spatial organization	Efficient Functional Maximalization	Aesthetic Non-functional	Aesthetic Non-functional	Efficient Functional	Aesthetic Non-functional	Aesthetic Non-functional	Efficient Functional
Additional facilities	Supportive functions Shop Market Office Composting place Parking Storage Toilet Terrace	Beehive Birdhouse Insect hotel Rainwater collector Composting place	Supportive functions Kitchen Workspace Parking Storage Toilet Terrace	Workshop room Kitchen Lecture room Childcare Composting place Parking Storage Toilet Terrace	Shop Restaurant Bar/cafe Catering Community spaces Public garden Storage Terrace	Community spaces Kitchen Parking Storage Toilet Terrace	Supportive functions Workspace Glasshouse Composting place Parking Storage Toilet

environmental impact. Enlargement of the system with other waste streams can be seen as a future perspective. This transfer retains the system of being a “flushing system” (see chapter 2.4.1).

Current regulations in the Netherlands do not allow biodegradable waste from households as fertilizer on urban farms. In the meantime, another developed technique makes it possible to use the residual products of human sewage sludge to retrieve valuable nutrients.

All input supplies for crop cultivation can be artificial controlled. A more advanced farming system is required that need higher investment cost on forehand. Optimized crop conditions will result in higher yields. The implementation of urban farming should not increase the need for energy. Now, not all new resource inputs can be restricted to zero yet. The emphasize, if a high tech urban farming system is selected, should be on alternative supplies from output of the surroundings. Climate-controlled rooms can use the extra heat produced by buildings for example. It is environmental responsible to create interaction with (close) urban conditions. If one urban farm will be totally reliable on those ‘conditions’ for its input and its use of the farms output, it can be a difficult situation if the ‘surrounding’ will change its processes. Small cycle dependencies increase the flexibility of a system.

Implementing different types of urban farming emphasizes reason to existent. The diversity of a city reflects the diversity in needs. One type of urban farming does not apply to all those needs. Every location does have different conditions that will influence the specific farming type. A central urban farm can function as a *demonstration garden* where all different kind of farming types can be experienced. Property ownership will also influence the type of urban farm.

The implementation of different urban farms with different functions all over the city can create certain chaos. Central meeting spaces and corridors will become important to create any order in this “chaos”.

Buildings can have a positive or negative influence on crop cultivation. The built environment creates shadows that limit the amount of sunlight on possible farming locations. A positive aspect is the use of vacant buildings for the use of (climate controlled) cultivation with artificial lightning.

Visibility and *accessibility* are important aspect to make the experience of greenery successful. Visibility and accessibility determine the utility of the farms. Some types of urban farming are not (clearly) visible, as it is possible to cultivate crops in glasshouses and climate-controlled rooms. This does not exclude high-tech solutions as previous mentioned. It might result in a combination between different farming methods and techniques. The improvement of the living environment in cities is related with the experience of its inhabitants.

6.3.2 Mix of goals

Urban farming can achieve different goals. To broaden the market, it is more likely to select multiple goals for a single urban farm to increase its reason for existence. The extent of privacy and commercial character also creates diversity in urban farms. For this research, these goals are divided in 7 categories, based on the defined goals for the urban farm Caetshage in Culemborg. The description given by each goal is part of the research. The defined goals are:

- Food production: a commercial business focussing on food production, with as main goal earning economical yields.
- Increasing biodiversity: adding diverse greenery
- Care: integrates servant farmers in the business process. These farmers need support from others to function well. This might include people that need to re-integrate in society, are (temporary) unemployed or

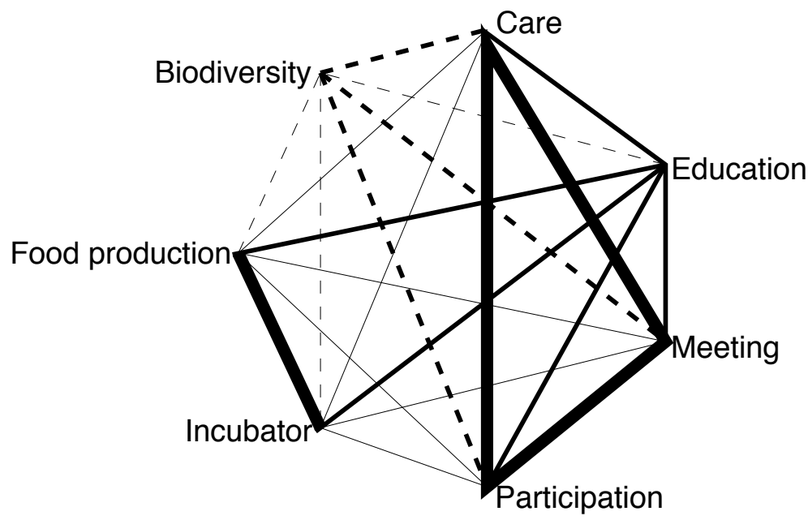
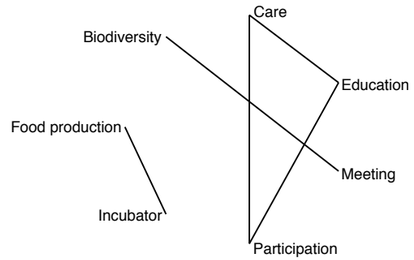
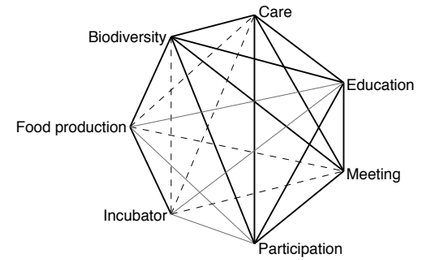


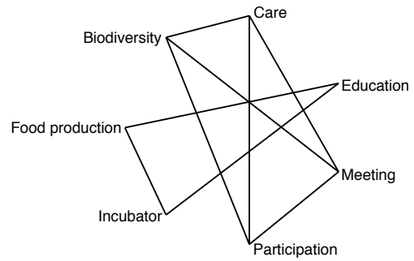
Fig. 102 *Ideal typical model of goals [from: Nienoord, 2013]*



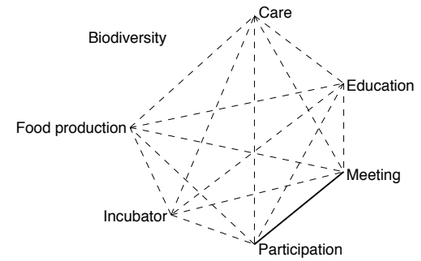
2. Accessibility



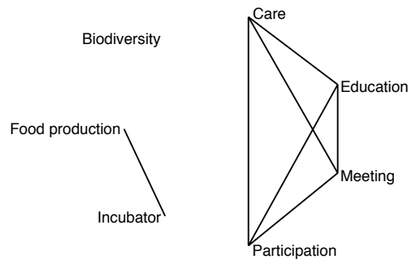
5. Where - location



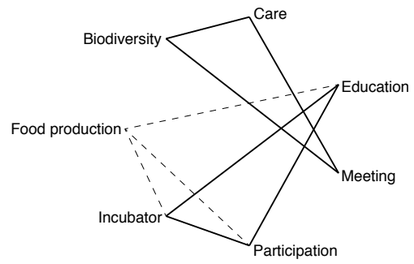
3. Requisite



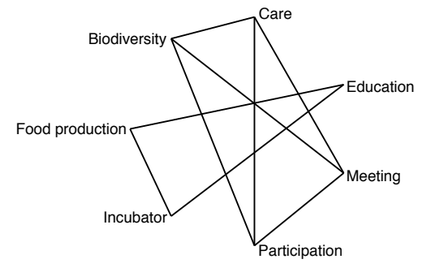
6. When - time



1. Social area



4. How - Farming method



7. Spatial

Fig. 103 *Ideal typical models of goals per aspect [from: Nienoord, 2013]*

have a handicap.
- Education: gives possibilities for people to extent their knowledge on the food cycle and sustainability.
- Meeting: facilitate spaces so people are able to meet each other
- Participating: facilitate activities so people can join.
- Incubator: creates a place to experiment with new farming techniques.

Figure 101 shows a guidance model to map application possibilities. This model is not exhaustive and based on the best possible combinations. Practice proves, after implementation, if the model will hold water. Based on this model (and visualized in figure 103.1 - 103.7), figure 102 shows ideal typical model of goals that go hand in hand with each other. This can be starting point of the design. As mentioned before, all goals need to be valuable for the inhabitants of the city in question. Otherwise, urban farming does not have the right to exist.

Each goal focuses on the following sustainable aspects: social, environmental or economical. The social area of food production and incubator are economic qualities. Both food production and incubator are characterised by a private profile and aim for more yields. In the first case, yields will be money, as the last case will mostly provide services and knowledge. Creating biodiversity is mostly characterised by the environmental aspect. Goals characterized by a social profile are caring, educating, meeting and participating. Biodiversity and meeting will have a public profile. A semi-private profile is best suitable for caring, educating, and participating.

For food production, education and incubator is knowledge needed to optimize the outcomes. Biodiversity, care, meeting and participation need guidance for continuation of practice.

All farming methods are applicable for education, participation and the incubator. As food production focuses on generating yields, this goal excludes the method forest gardening. Forest gardening and SPIN farming emphasize especially the goals of biodiversity, care and meeting.

The visualization of figure 101 in figure 103.5, shows similar implementation possibilities in the built environment for the goals biodiversity, care, education, meeting and participation. Only one of two options differs. The best locations for food production and incubator again overlap. The locations also overlap partly with the other possible goals. Within figure 103.5, of the ideal typical models, the thin dashed lines show this overlap. The thin lines without a dash represent the overlap in which one of the goals' locations are totally included in the other goal.

Concerning the time span, all functions are possible during working hours. Except for biodiversity, that does not have time span at all. The use of meeting and participation is also possible outside working hours.

The spatial organization of knowledge-needed goals will be efficient, functional. The design for food production focuses on maximization. The guidance-needed goals will tend to be more diverse and non-functional organized. These goals are more focussing on experience of the garden on the people working in it.
Different goals lead to the implementation of different mixes of function, and each function has its own spatial requirements. Overall, there is some overlap or not. The additional functions of biodiversity do not overlap with one of the other functions. Biodiversity does not focus on people and therefore includes functions to support animals of natural processes only, like insect hotels, a bird nests, rainwater collectors or a compost place. The other goals can combine many functions. Therefore, the functions are listed instead of translated in an ideal typical model.

Figure 102 presents an ideal typical model. It shows the best possible combination of goals that can be achieved. The diagram shows a relative strong connection between food production and an incubator, also between care, meeting and participation. Education is related to all other goals, as education can concerns many different

Fig. 104 *Desired ratios for spatial organization of urban farms [from: Nienoord, 2013]*

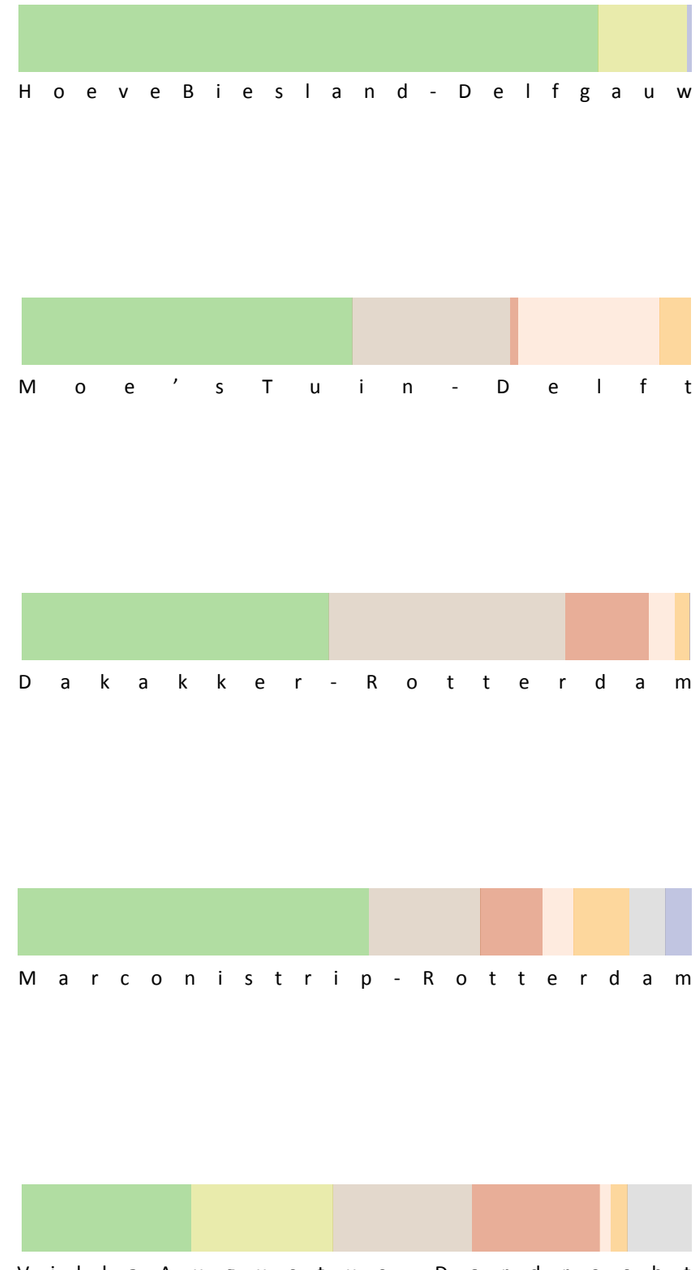


Fig. 105 *Spatial organization ratios per case study [from: Nienoord, 2013]*

subjects. Therefore, education is a function that is easily to combine with one of the other functions. Biodiversity has connections with multiple goals, because of the similar characteristics. A different characteristic is that it does not involve people as the other goals do. Therefore, the lines with biodiversity are dashed lines in this figure 102. Biodiversity is an important goal regarding to creating a sustainable living environment.

6.4 SPATIAL ORGANIZATION

A mix of goals (and facilities) results in a spatial organization of urban farms. These ratios for an urban farm in existing urban areas are derived from literature and the case studies. The desired ratios includes the following notions:

- As much cultivation ground as possible.
  - A bit less than Hoeve Biesland (see chapter 5.2), as its cultivation ground does not include paths.
- Limited pathways for visitors
  - Expensive ground so compact design;
  - Combined use of terrace and courtyard;
  - Small paths for seeding, maintaining and harvesting.
- Floor surface
  - Limited because already many unused surfaces in the city;
  - Gives shelter and protection during bad weather;
  - Comparable ratio as terrace.
- Terrace
  - Space for additional activities;
  - Create an open (meeting) space in the city;
  - Combined use with paths and courtyard.
- Courtyard
  - Expansive ground so compact design;
  - Combined use with terrace.
- Limited parking places
  - Assuming visitors to come by foot, bicycle or public transportation;
  - Kiss and ride for people arriving by car.

As commercial urban farming projects have troubles to be profitable today there is a need to experiment opportunities within the total concept of urban farming. To define additional facilities for an urban farming, apart from food production, one should look at facilities, which serve as meeting points. Internal and external spaces to facilitate activities around the cultivation of food are necessary to educate people about and let people celebrate the food cycle. Combining these functions with commercial ones, as a shop with a butcher or bakery, restaurant, kitchen, rooms for rent or a hotel, generate yields. The presence of people in the direct surrounding generates a market for these additional functions. The use of a characteristic site or a characteristic *landmark* might help to *attract* people to the location and to generate more income. A landmark might add extra economic quality of the urban farms for the city. Urban farming should become mainstream, and thus affordable, in a way that all targets groups in the city can benefit from the implementation of urban farming.

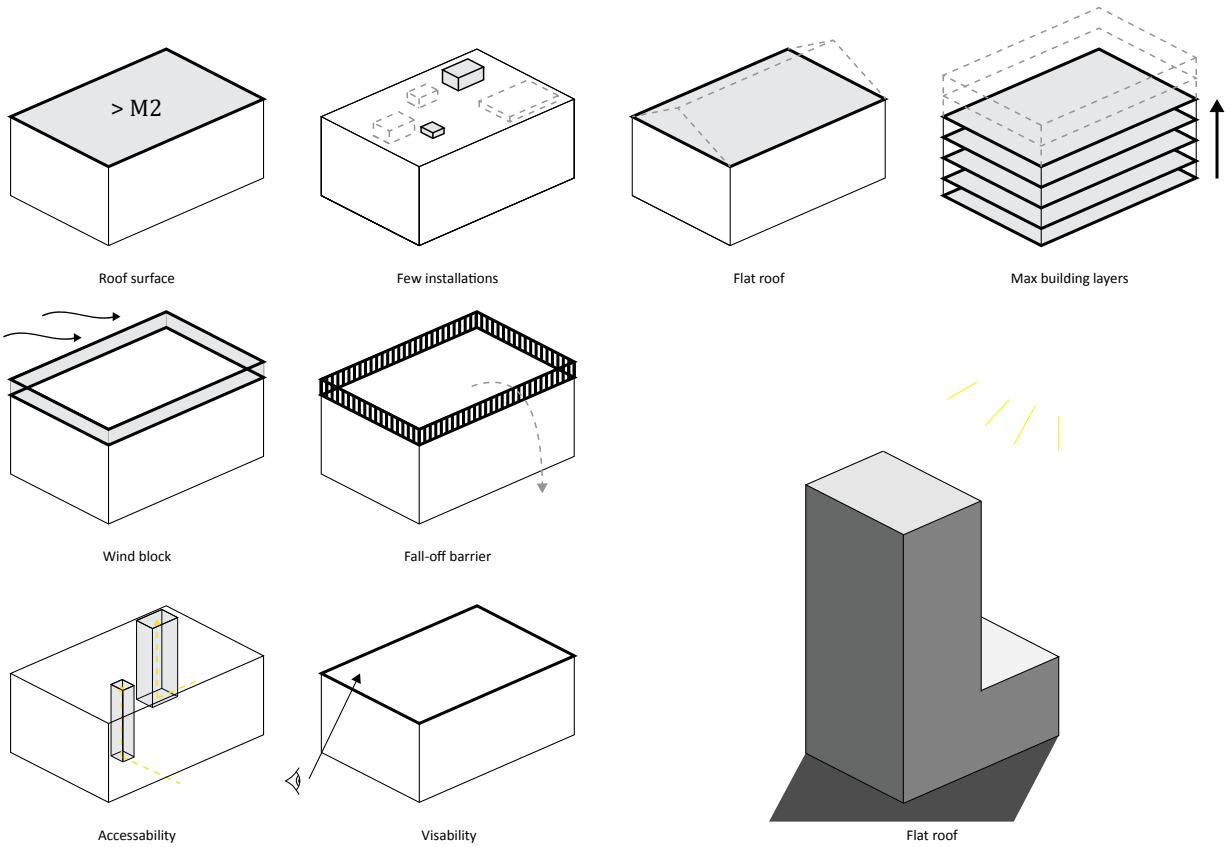


Fig. 106 *Building requirements [from: Nienoord, 2013]*

All facilities have different time spans and occupancies. Some uses will overlap, as others will happen after each other. Gradual use during the day can help to use the facilities sequent. The sequent use of facilities will contribute to make an urban farming project more feasible. It also emphasizes the opportunity to design spaces that can serve for different activities. It broadens the market open for people that will make use of the facilities.

Another element to increase the reason for existence of an urban farm is the *multi use* of the built surface. To afford high ground surface prices, the used of multiple functions is necessary. The use of multiple functions will increase the economic feasibility of a project.

To develop an urban farm that can last for long it is necessary to consider possible future changes. The challenge is to make the design as flexible as possible, to cope with these possible changes during time. This means to adapt additional facilities if needed. The aspects of *flexibility and adaptability* are thus dealing with the future perspective of an urban farm Start point for architecture can even be based on the seasonal changes of crop cultivation.

For urban farms with the goal to serve a community is the location close to its users essential. The integration of the farm within the living environment is essential for the frequency of citizens using the farm. The importance of urban farming will also increase if its citizens can make use of or *experience* it. Urban farms in the direct surrounding of people increase accessibility for everyone. The effort to reach an urban farm is physiological accessibility. Physical accessibility is associated with the ability to lock an urban farming location. Open access to greenery also increases the feeling of safety. During the night, street lightning increases the feeling of safety around the farming locations.

Urban farming done by citizens increases their *involvement* with the city. This make them feel more *responsibility* for their surroundings. This involvement will have a positive effect on the public domain and thus the living environment. Creating exemplary (attractive, tidy and neat) urban farms might inspire people to transform their private unused spaces into urban farms or even give their space on loan for other parties.

Knowledge about cultivation is essential to be able to run an urban farm. The involvement of farmers surrounding the city can prevent the revival between the different businesses.

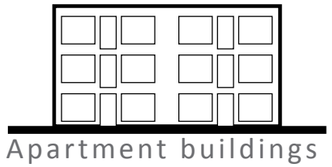
6.5 BUILDING REQUIREMENTS

After goal, location and function selection it is time to find the suited building requirements. This research will focus on the implementation of rooftop farming, as these surfaces are seen as a huge potential in future scenarios.

Roofs have specific points of interest related to safety measures like wind block, a fall off barrier and the accessibility of the roof and building. Large roofs need to multiple vertical transportation points like The Dakakker (see chapter 4.3). Additional considerations need to be taken in mind are the amount of m2 limited per roof surface, present installations, roof shape (flat or in an angle), height, amount of sunlight and visibility of the farm.

Farms at height ensure certain controllability. Larger roof surfaces are mostly separated from others and that create a distance and therefore a separation between the surfaces. Different types of roof farms can be designed in that way so they are accessible for all visitors, only a selection of visitors or no visitors.

The focus of urban farming on the roof does not mean exclusion of urban farming on ground surface. At ground surface, a complex mix of activities happens. Simple implementations of urban farming contribute to the experience of the view. Such as a productive landscape, consisting out of fruit trees draws attention to the need and meaning of food. From ground level the view on the second or third is partial. View lines show the part of an overlaying complex edible roof landscape. Vertical farming contributes to the connection of food production or the observation of it.



Community, servat farmers

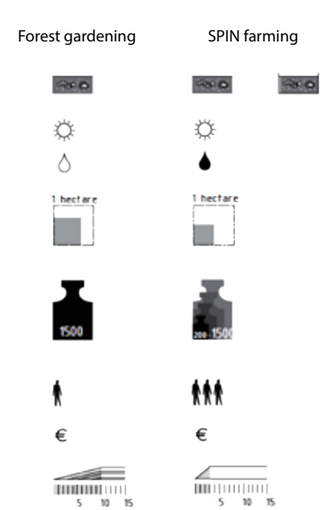
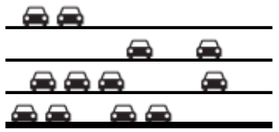
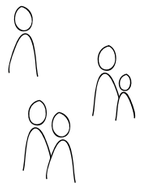


Fig. 107 *Urban farming options for apartment buildings [from: Nienoord, 2013]*



Parking



Citizens

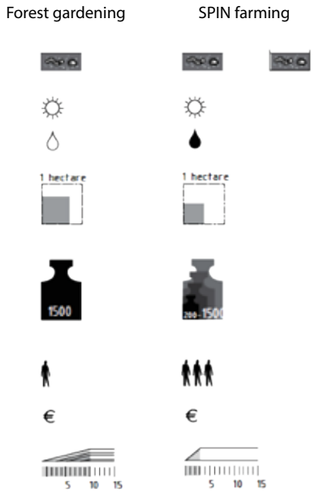
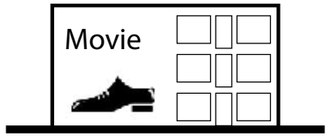
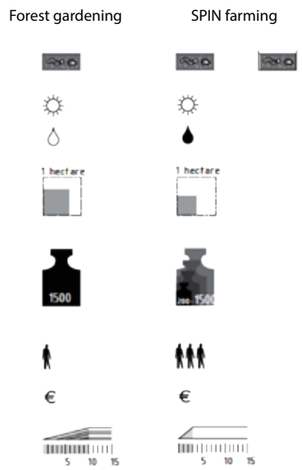


Fig. 108 *Urban farming options for parking [from: Nienoord, 2013]*



Public building

Pupils, students, workers, servant farmers



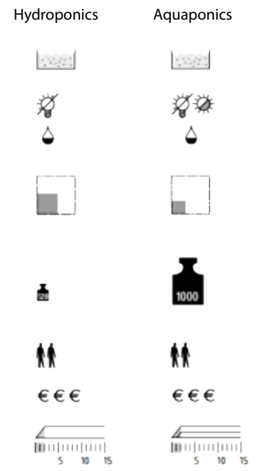


Fig. 109 *Urban farming options for public buildings [from: Nienoord, 2013]*

6.5.1 Urban farm per building typology

This paragraph describes the relation between the type of building and the type of urban farming to be implemented on the roof.

A city consists of different types of buildings and therefore has different types of roofs. As most buildings are built in another way, buildings can be characterized into several types. The following types can be distinguished:

- Apartment buildings;
- Parking buildings;
- Public buildings.

This division is very rough. Single houses and governmental buildings are excluded in the report for instance. The choice of implementing urban farming on the roof of a single house is domain of the owner. The development of multiple roof farms might inspire the owner to transform its own roof to be a part of the overall structure. Government buildings are not suitable for roof farming for privacy reasons.

Apartment buildings (figure 107) are not intended to be public accessible. Therefore the farming type suitable for apartment buildings have to be maintained by people living in the building itself or by people who will work on the building under guidance. The appropriate target group will be community or servant farmers. These target groups will probably use low tech farming methods as forest gardening or SPIN-farming.

Parking buildings (figure 108) are already public accessible. The present vertical accessibility makes them easy to transform the roof into an urban farm open to everyone. These roofs are suitable as public edible park, where all citizens can experience the beauty and taste of food production. Another option is to add an extra building layer on top of the parking, so that the parking does not loose parking spaces and thus revenues. This extra layer is to be designed according to the spatial requirements for the public park. Forest gardening and SPIN-farming are most suitable focussing on the beauty of cultivation gardens.

Public buildings (figure 109) are accessible for everyone. Making the roof farm public accessible might also brings possible negative side effects, noise for example. Suitable target groups to work here would be entrepreneurs, servant farmers and pupils or students. These target groups might use all available cultivation methods.

A green roof, which contributes to a sustainable living environment, increases the image of the specific building owner. Eventually, the building owner might ask compensation for the use of the roof.

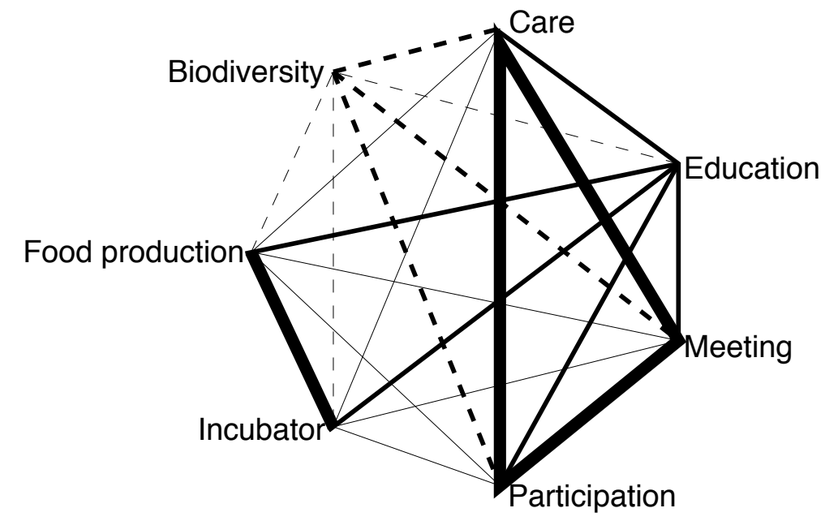


Fig. ii *Ideal typical model of goals [from: Nienoord, 2013]*

Fig. iii *Spatial considerations with relative indication [from: Nienoord, 2013]*

SPATIAL DESIGN CONSIDERATIONS	CASE STUDIES				
	HOEVE BIESLAND	*MOE'STUIN*	*DAKAKKER*	*MARCONISTRIP*	*VILLA AUGUSTUS*
Size	+++	+	+	++	++
Accessibility	+	++	+	+	++
Experience	+++	+	-	+	++
Close to market	-	+++	++	+	++
Activities	+	+	+	+	++
Visibility of the location	+++	+	-	++	+
Visibility into the garden	+	+++	++	+	+
Replace paved surfaces	N/A	-	+++	++	++
Meeting place (through seasons)	-	+	+++	+++	+++
Use unutilized space	N/A	+	+++	+++	+++
Design garden	-	+	++	++	+++
Additional facilities	N/A	-	+	++	+++
Flexible	+	+++	++	++	+
Feeling of safety	-	-	+++	++	++
Attracts visitors	++	-	+++	+++	+++
Vacant land or buildings	N/A	-	++	+++	+++
Diverse methods	-	-	+	+++	+
Characteristic building	-	-	-	+	+++
Landmark	-	-	-	-	++
Integration	-	+++	+++	+	+

7. CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSION

In this thesis, urban farming is discussed as a way to improve and sustain the living environment in existing urban areas. In this chapter conclusions are drawn based on the outcomes of the research.

7.1.1 Urban farming

Urban farming is the production of food in and around cities. Cities offer different site conditions and scales. The available land often is relative small compared to rural farming. The stagnating building sector enables the use of larger (temporary) surfaces in the city. Depending on location, farming method, goal achieved and organization type, many types of urban farming can be developed. These different types of urban farming enable a fit to the each available space within existing urban areas.

The focus of this research is on existing urban areas. The urban farm can be implemented on three levels, namely on the border of the city, in the outer city and in the inner city. On the building level urban farming can be implemented in building surrounding spaces, space inside a building and on façades (hanging gardens). In addition, rooftops and balconies can be used for urban farming. Looking at inner cities, rooftops are often unused surfaces that have potential for the implementation of urban farms.

Urban farming has a positive contribution by improving of the local climates, increasing property value, stimulating physical and mental health, creating awareness and communities. The latter can result making people feel responsible for their living environment.

On the other hand, urban farming does not solve the source of the pollution or raised city temperatures among others. Urban farming needs a lot of maintenance and the increased property value can exclude the availability for certain target groups. Crop cultivation within the city raises questions of more polluted food by its citizens. Farming within the city is also less efficient than rural farming especially because of its relative small farming plots and the limited space for mechanization. Architecture can create facilities to optimize the growth conditions for plants. In the close future, urban farming will not be able to produce enough food to feed all citizens.

Six goals of urban farming can be distinguished: food production, increasing biodiversity, care, education, meeting, participation and creating an incubator. The overlapping goals such as food production - creating an incubator and care - meeting - participation are most likely to be combined, as shown in the ideal typical model described in chapter 6.3.2 (figure ii). Education is a function easily to combine with one of the other goals as it can contain many different educational types and subjects. Education can make a good link with food production and creating an incubator among others. Biodiversity has several overlapping characteristics, but also differs on others characteristics. Although biodiversity does not involve people, it contributes to a sustainable living environment.

Different types of urban farming have different mixes of goals. To make urban farming a success, it is important to keep in mind what goal one wants to achieve while defining the necessary method, functions and spatial considerations. To broaden the market it is necessary to achieve multiple goals. The goals become manifest by the choice of products in combinations with functions. For example, commercial farms might focus on the selling and catering of products as well as non-commercial farms might provide places to meet in order to stimulate social cohesion and the celebration of food. Functions inside and outside will shelter social activities during all weather

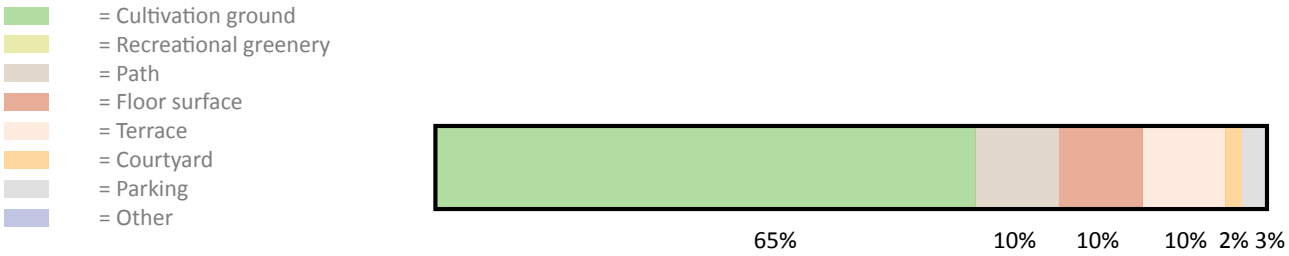


Fig. iv *Desired ratios for spatial organization of urban farms [from: Nienoord, 2013]*

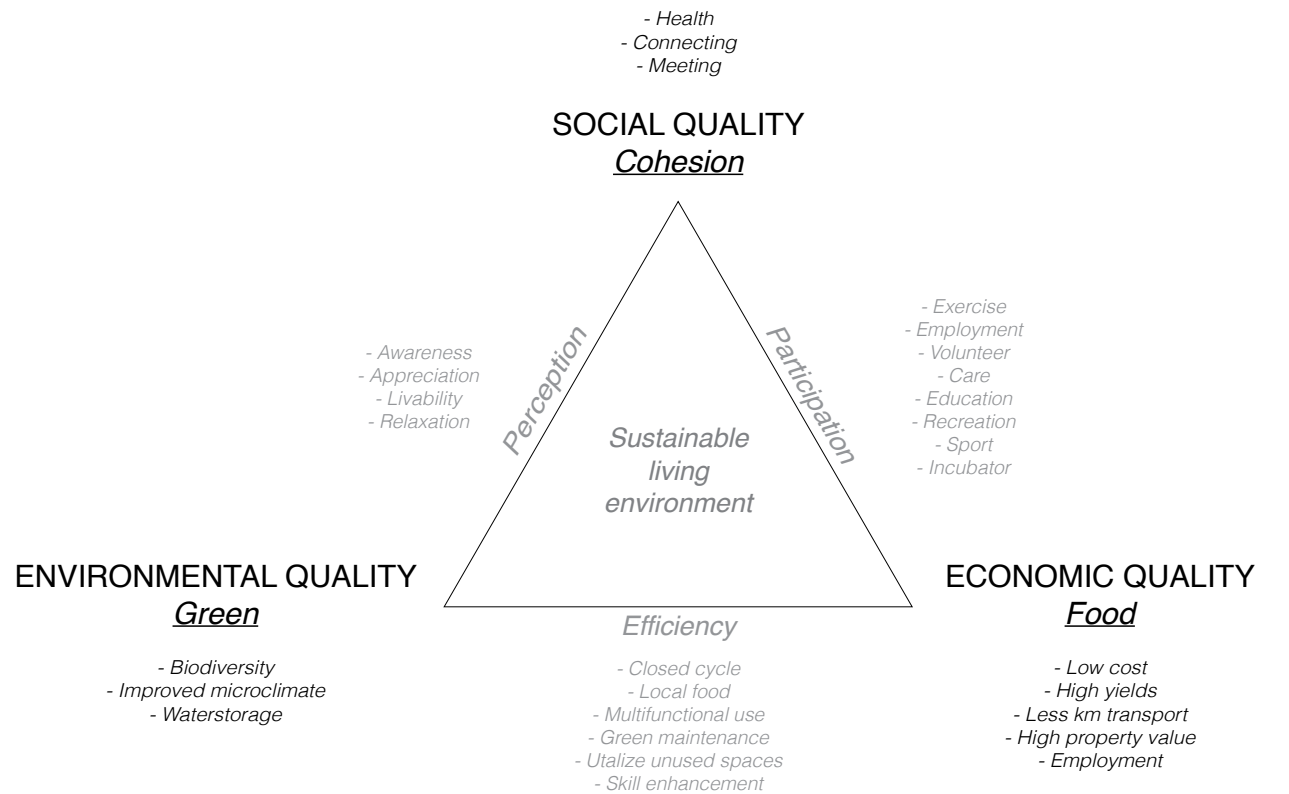


Fig. v *Sustainability triangle, concept according to Nienoord [from: Nienoord, 2013]*

conditions. Biodiversity does not focus on people and therefore includes functions to support animals of natural processes.

The increased attention for urban farming shows a shift in the balance between opportunities and issues. Urban farming is now used on an experimental scale. In the future issues might be overcome by broad implementation of urban farming on the city scale. The opportunities are becoming more important. Crucial for its success is the involvement of citizens.

According to the case studies they have achieved most of their goals. Media attention, some times even international media, confirm this positive outcome. The projects also receive many visitors. In case of Moe'sTuin and the Dakakker, many persons want to be a participant in the urban farm. Hoeve Biesland has paid most attention to the implementation of closed cycles. This might be the benefit of a large scale. Issues derived from the case studies are the restrictions of the legislations and profitability in terms of money.

Based on the literature and case studies a desired ratio of spatial organization is set up. Practice will proves if this ratio is optimal.

7.1.2 Sustainable living environment

A sustainable living environment is an environment consisting of a valuable balanced of *social-, environmental- and economical qualities.* Chapter 5 describes several sustainability goals for the living environment as prerequisites to indicate if the living environment in existing urban areas is sustainable or not. The social quality focuses on cohesion. The environmental quality is about adding greenery and the economical quality is related to food production. These aspects also emphasize the need for implementation of urban farming within existing urban areas.
Most people are living in urban areas. The existing urban areas do not provide the best living environments.

Urban farming can contribute to a sustainable living environment in many ways (environmental, economic and social quality). A passive way to make a sustainable living environment in existing urban areas is the implementation of urban farms all over the city, on permanent basis. The city broad implementation of urban farms adds quality for the different aspects of sustainability in the following way.
The city climate improves instead of the local climate in a small part of the city. This gains environmental quality. The use of functional green at unused spaces is a way to provide more greenery with relative lower maintenance cost and therefore increases economic quality. The selling of cultivated products generates returns. Practice will show if the yields from the food production are enough to keep the business running.
The physical accessibility to urban farms is less. It generates social meeting places in the close environment of citizens. Therefore, it can improve the social cohesion within the living environments as main social quality.

Learning from existing urban farming projects, step by step this implementation can be achieved. In time, this also will shows in what way and to what extend people want to participate on an urban farm.
The description of urban farming and the case studies in each chapter concludes with the spatial design considerations for implementing urban farming in existing urban areas. Some of these considerations are very specific and depend on the chosen location. For the design of an urban farm, the most important spatial design considerations are visibility, accessibility, flexibility, adaptability and making a landmark. Visibility and accessibility determine the utility of the farms. Flexibility and adaptability are dealing with the future perspective of an urban

farm and a landmark adds an extra economic quality of the urban farms for the city. In time, the appeal of farming landscape has diminished thanks to the mono-cultures. Urban farming re-emphasizes the aesthetic appeal of crop cultivation.

During time, greenery had to make place for more feasible economical projects. The implementation of urban farming brings greenery back to the cities. Green areas provide places for people to go out and meet each other, to relax and to retire from the noise and commotion of city life. Urban farming creates a link between food production and citizens so that it might trigger citizens to feel responsible for their surroundings. This might lower maintenance cost for the municipalities. Food production makes them aware of the food cycle and their way of handling it, so they can learn from it. In the future, cities will still be depended on products needed in large quantities such as wheat's and potatoes. Knowledge of food production can be achieved from rural farmers as well. To create a link between urban farms and farmers outside of the city can therefore be important for both parties.

Facilities for urban farming can be created with the help of architectural design and to make people more aware of their use of the living environment and invite them positively to change their behaviour.

7.2 RECOMMENDATIONS

The research does not describe all aspects of urban farming. Further research can be done. For instance more knowledge need to be achieved about possible earning models. For the feasibility of urban farming projects it is important to get an understanding of the financial part of the urban farming project. Also more focus can be paid to political aspects, for example how to implement an urban farm if building codes do not permit urban farming on that specific location?

Because urban farming is still a relative newly discovered phenomenon it is important to do more research about the optimization of food process and the optimal mix of goals.

The developments in the food market will influence the choice of cultivation products. At the moment there are a lot of 'rediscovered' vegetables that are relative popular to cultivate. Whether or not these products will still be popular in the future, the time will tell.

Based on the outcomes of this thesis, a list of DO's and DONT's can be set up for a future initiator of an urban farm. This list of shows that the list of DO's is larger than the DONT's. The DO's of implementing urban farming are:

- Introduce all types of urban farming in the whole city
- Provide connections between them on all levels, ground floor, facades, roofs etc.
- Use unutilized spaces, vacant land or buildings to start with
- Use paved areas as much as possible (cools down city temperature)
- Integrate urban farming in new build projects

- Integrate productive landscapes into the city
- Support the goals of urban farming by promoting them in all sorts of media
- Make urban farms visible so it increases the aesthetic quality of the surrounding
- Involve the citizens living in the neighbourhood to participate in the urban farming projects
- Arrange special events for the celebration of food
- Make urban farms (partial) accessible for all citizens

- Design an urban farm so people can meet during all seasons
- Make sure people can participate at an urban farm in different intensities.
- Implement urban farms in the close surrounding of citizens, step by step

- Give the opportunity for people to learn about the food cycle and how to create an environmental healthy environmental
- Use diversity in crops and flowers to increase diversity in food supply and enhance natural habitat and increase ecological health.
- Try to make the products affordable for all target groups
- Create demonstration gardens to improve urban farming knowledge and experiences

- Make flexible and adaptable urban farms for possible future changes
- Pay attention to the design of cultivation gardens
- Use natural sources as much as possible
- Turn output streams into input streams
- Look how to use surrounding (waste) sources
- Share knowledge and experiences with other (urban) farms
- Test the air and soil before developing an urban farm
- Test products after each /first harvest if they are safe enough to eat
- Process the products without unnecessary addition of ingredients (colour etc.)
- Distribute products by carrier cycles or electrical cars.
- Research impact of small green surfaces as neighbourhood green, street trees, green roofs- and facades and private gardens on the health and well-being.
- Finance urban farms from multiple portfolio's in- and outside municipalities

The DON'TS by implementing urban farming are the following:
- Focus on one aspect of sustainability
- Implement only fenced off urban farms
- Bad maintenance of urban farm
- Use synthetic fertilizers
- Create smell- and noise nuisance
- Focus only on feeding the whole city.
- Large amounts of livestock into the city (diseases)
- Force citizens to work on urban farms
- Exclude other (multiple) uses of the urban farm.

8. LITERATURE

APN. (2013). 'Rund- en paardenvlees gemengd bij bedrijf in Oss'. Retrieved September, 2013, from http://www.nu.nl/binnenland

Bade, T. , Smid, G., & Tonneijck, F. (2011). *Groen Loont! Over maatschappelijke en economische baten van stedelijk groen*: De Groene stad.

Baldwin, C. J. (2009). *Sustainability in the food industry*. Ames, Iowa USA: Wiley Blackwell.

Bezemer, V., & Visschedijk, P.A.M. (2003). Groene meters deel II. Analyse van het stedelijk groen in de G30 steden. Wageningen: Alterra, Research Instituut voor de Groene Ruimte, Alterra-Groene Meters II, Alterra rapport 833.

Brockerhoff, M. P. (2000). An urbanizing world. *Population bulletin, 55* (3).

Brown, K. H. , & Jameton, A. L. (2000). Public health implications of urban agriculture. *Journal of public health policy, 21* (1), 20-39.

Broyles, T. D. (2008). *675: Defining the architectural typology of the urban farm*. Paper presented at the 25th Confenence on Passive and Low Energy Architecture, Dublin.

Brundtland, G. H. (1987). Our common future. Report of the World Commission on Environment and Development. Oslo: United Nations.

CBS. (2013). Bevolkingsteller. Retrieved December, 2013, from http://www.cbs.nl

Cijs, H. (2005). Verslag Moe'stuin 2005.

Deelstra, T., & Girardet, H. (1999). *Urban agriculture and sustainable cities*. Paper presented at the Growing Cities Growing Food - Thematic Paper 2:Urban Agriculture and Sustainable Cities published in Growing Cities, Growing Food: Urban Agriculture on the Policy Agenda (2000), Havana, Cuba.

Diepen, A. van, & Raats, K. (2011). "Stadslandbouw moet mainstream zijn!" interview met Jan Willem van der Schans. *Rooilijn, 44* (5), 4.

Dieu, Tran Thi My (2009). Food processing and food waste. In C. J. Baldwin (Ed.), *Sustainability in the food industry* (23 - 60). Ames, Iowa USA: Wiley Blackwell.

Duijndam, J, & Duijndam, M. (2013). Hoeve Biesland. 2013, from http://www.hoevebiesland.nl

Duijvestein, K. (2008a). Building & environment. "Thinking in systems, designing in variants" *Research and design for sustainable development* (pp. 5 - 18). Delft: Technical University Delft.

Duijvestein, K. (2008b). From triple P to quadruple P; the 4P tetraeder *Research and design for sustainable development* (Vol. Reader AR0080, pp. 73 - 77). Delft: Delft University of Technology.

European Communities. (2002). The World Summit on Sustainable Development. People, planet, prosperity. Luxembourg: Office for Official Publications of the European Communities.

Five Borough farm. (2013). Five Borough farm. Seeding the future of urban agriculture in NYC. Retrieved February, 2013, from http://www.fiveboroughfarm.org

Francis, C., & Wart, J. van. (2009). Agriculture. In C. J. Baldwin (Ed.), *Sustainability in the food industry* (pp. 3 - 22). Ames, Iowa, USA: Wiley Blackwell.

Gehl, J. (2010). *Cities for people*. Washington, DC, USA: Island Press.

Gore, A. A. (Writer) & D. Guggenheim (Director). (2006). An inconvenient truth. New York City.

Graaf, P. de. (2011). *Ruimte voor stadslandbouw in Rotterdam*. Rotterdam: Stimuleringsfonds voor Architectuur.

Hagen, J.B. (1996). Robert Whittaker & the classification of kingdoms. In J. B. Hagen, A. Douglas & F. Singer (Eds.), *Doing Biology* (Vol. 2013). Harper Collins: Glenview, IL, USA.

Holland Barrs Planning Group. (2007). Designing urban agriculture oppotunities: For Southeast False Creek. Vancouver: South False Creek and Olympic Village Project Office.

Jókövi, E.M., & Luttik, J. (2003). Rood en groen. Het combineren van verstedelijking en natuur in de praktijk. *Planbureau-werk in uitvoering*. Wageningen: Alterra, Research Instituut voor de Groene Ruimte.

Klok, E.J., Schaminée, S., Duyzer, J., & Steeneveld, G.J. (2012). De stedelijke hitte-eilanden van Nederland in kaart gebracht met satellietbeelden. Utrecht: TNO publicatie, TNO-060-UT-2012-01117.

Klok, L., Broeke, H. ten, Harmelen, T. van, Verhagen, H., Kok, H., & Zwart, S. (2010). Ruimtelijke verdeling en mogelijke oorzaken van hitte-eiland effect. Utrecht: TNO publicatie, TNO-034-UT-2010-01229_RPT-ML.

KPGM. (2012). Groen, gezond en productief. The Economics of Ecosystems & Biodiversity (TEEB NL): natuur en gezondheid.

Labohm, H. H. J. (2004). Klimaatsceptici. from www.groenerekenkamer.nl

Maas, J. (2008). *Green environments - Healthy environments.* (Doctoral), Utrecht University, Utrecht. Retrieved from http://www.nivel.eu

Muogeot, L. J. A. (2006). *Growing better Cities*. Ottawa: International Development Research Centre.

Muynck, A. (2011). Stadslandbouw en duurzame gebiedsontwikkeling. Rotterdam: Erasmus Universiteit Rotterdam, Stadsontwikkeling Rotterdam, Technische Universiteit Delft.

Nienoord, A. (2013a). [Email contact with T. Moerkerken from Woonbron].

Nienoord, A. (2013b). [Interview by telephone Huibert de Leede].

Nienoord, A. (2013c). [Interview with J. Duijndam].

Nienoord, A. (2013d). [Interview with P. de Graaf].

Nienoord, A. (2013e). [Written interview with L. Meulblock from Woonbron].

Niet, R. de. (2005). Groen in de stad: ontwikkeling 1993-2000, achtergronddocument bij Natuurbalans 2005. Bilthoven: Natuurbalans 2005.

Noordanus, P. (2010). Terugreis uit Utopia, een strategische agenda voor een meer uitvoeringsgerichte praktijk voor gebiedsontwikkeling*, bijlage bij Building Business, december 2010.*

Nuver, M. (2007). Overig Nieuws: Schaapskudde trekt door stad. Retrieved May, 2013, from http:// www.112groningen.nl

Pollan, M. (2009). *In defense of food: an eater's manifesto*. London: Penguin Group.

Pötz, H., & Bleuzé, P. (2012). *Groenblauwe netwerken, voor duurzame en dynamische steden*. Delft: Coop For Life.

Röling, W., & Timmeren, A. van. (2005). *Introducing urban agriculture related concepts in the built environment: the park of the 21st century.* Paper presented at the In proceeding of the 2005 world sustainable building conference, Tokyo.

Schans, J. W. van der. (2011a). Agrarian urbanism the new utopia? Een bedrijfskundige kijk op stadslandbouw. In P. d. Graaf (Ed.), Ruimte voor stadslandbouw in Rotterdam. Rotterdam: Stimuleringsfonds voor Architectuur

Schans, J. W. van der, & Wiskerke, H. (2011b). Stadslandbouw, hype of trend? *Stedenbouw & Architectuur, 4*, 12-15.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science, 225* (April 27), 420-421.

Veenhuizen, van R. (2006). *Cities Farming for the Future. Urban agriculture for green and productive cities*. Philippines: RUAF foundation, IIRR and IDRC.

Volkskrant. (2013). Gevel wolkenkrabber Londen 'doet auto smelten'. *Associated Press.* from volkskrant.nl

Vré, K. de. (2012). Telen, koken en opeten – juist in een volksbuurt. *Trouw, deVerdieping, dinsdag 1 mei 2012* (Duurzaamheid & natuur), 8-9.

Wakefield, S., Yeudall, F., Taron, C., Reynolds, J., & Skinner, A. (2007). Growing urban health: Community gardening in

South-East Toronto. *Health Promotion International, 22* (2), 10.
Westerhoven, M. van. (2013). Bepaling voedselverliezen in huishoudelijk afval in Nederland. Amsterdam: CREM rapport nr. H13.
ZUS. (2011). Project: Dakakker *IABR Test Site Rotterdam*. Rotterdam.

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