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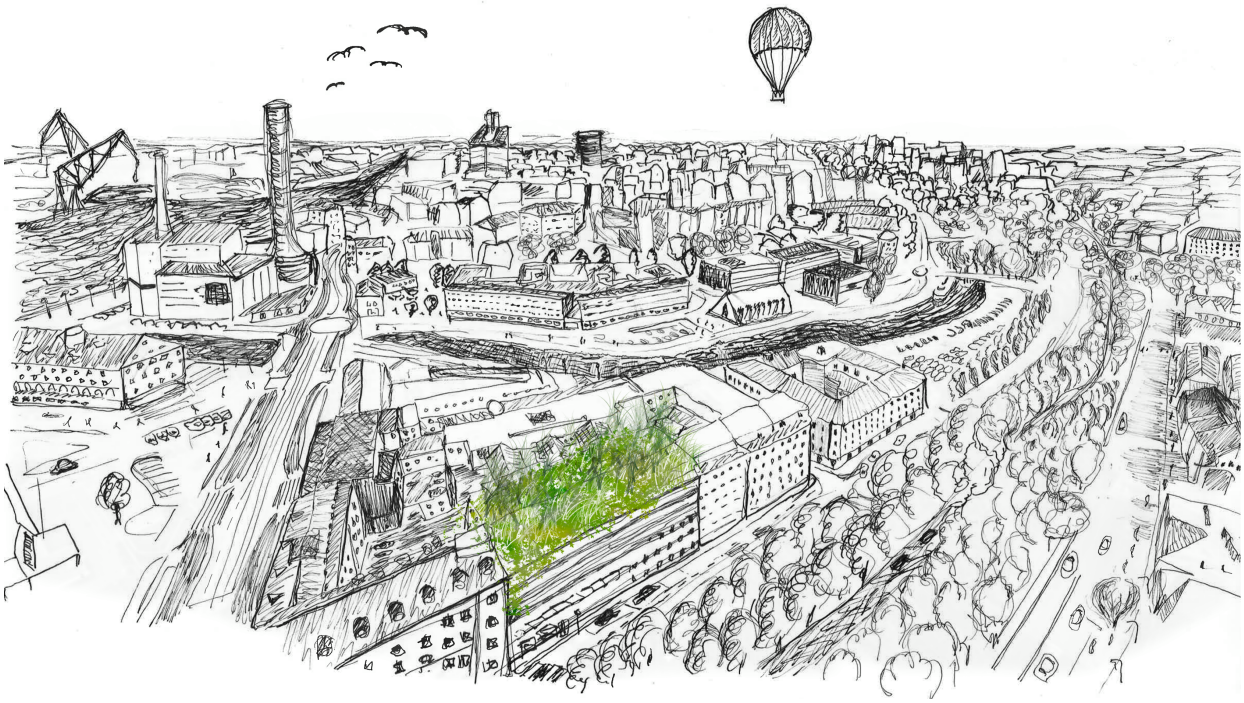

Urban Agriculture for a Sustainable Future

Co-creating Strategies for Scaling up Urban Agriculture in the City of Gothenburg

Master's thesis at the Challenge Lab 2018

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Department of Earth and Space Sciences
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2017

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Cover: Sketch of Gothenburg with a rooftop farm (source: The Authors).

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Abstract

Urban Agriculture (UA) is gaining growing attention from the world's leading global organizations, as it has been identified to play a major role in the world's bid for achieving the UN sustainable development goals. Although the number of UA initiatives in Gothenburg have increased, the practice remains largely deprioritized, and poorly integrated into urban planning. The aim of this thesis is to highlight how UA can contribute to sustainable development, and together with stakeholders co-create recommendations for enhancing UA in Gothenburg. The benefits and drawbacks of UA are explored mainly through literature review, and inspiring examples from around the world are presented. Qualitative interviews are conducted with local triple helix actors, and a force field analysis is performed to identify driving and restraining forces for developing UA in Gothenburg. Finally, a stakeholder workshop is facilitated, in which recommendations for developing UA in Gothenburg are co-created. A case study is included in this thesis, relating to the educational background of one of the authors. The case study explores the symbiotic potential between urban aquaponic farmers and hospitals in Gothenburg. Findings show that UA contributes to several sustainability aspects that are in coherence with Gothenburg's sustainability goals. The strongest restraining forces identified in the force field analysis are related to lack of knowledge/awareness about the benefits and flexibility of UA. Several of the identified restraining forces have been addressed in practices around the world, of which some are highlighted in this thesis. The outcome of the workshop was summarized into four concrete co-created recommendations, with establishment of a local food strategy receiving particular support. All four recommendations need cross-institutional collaboration in order to be successful, which led to the creation of a fifth recommendation; establishment of a cross-institutional working group. The case study shows that skin from tilapia fish has successfully been used as a biological dressing for treating burn injuries abroad. The benefits and drawbacks of a collaboration between local aquaponic farmers and the burn treatment unit of Gothenburg should be further explored. The findings suggest that in order to achieve the regional sustainability goals, the municipality of Gothenburg should create a local food strategy that unravels the full potential of UA. Moreover, to create a local food strategy, a collaboration between several of the city's departments is needed.

Keywords: urban agriculture, backcasting, food security, social inclusion, local economy, burn treatment, urban symbiosis, sustainability transition, multi-stakeholder, force field

Preface

This thesis is written at the Chalmers Challenge Lab, where students take on complex sustainability challenges and act as change-agents. The authors have a background in biotechnology and sustainable energy systems, thus resulting in a cross-disciplinary thesis. The thesis at Challenge Lab consists of two phases. Phase one describes the Challenge Lab procedure for finding the research objectives, using a backcasting methodology. The research questions are then answered in phase two of the thesis. The unconventional thesis set-up reflects the innovative educational approach of Challenge Lab, where students learn not merely how to be problem-solvers, but also how to define the problems we ought to solve in order to reach a desired future.

Acknowledgements

We would like to thank our thesis supervisor Marco Adelfio for constantly being available whenever feedback or further advice was required. The feedback throughout the thesis was always constructive and inspired us to do better. We would also like to thank our co-supervisor Julie Gold for her support and guidance in the case study.
Our grateful thanks expand to our examiner John Holmberg and the rest of the C-Lab staff, Andreas Hanning, Johan Larsson and Gavin McCrory for providing us with helpful tools during Phase I of the thesis project and further guidance and assistance during Phase II.
Furthermore, we would like to express our appreciation to all the stakeholders that in one way or another participated in our research. It has been so inspiring to meet every single one of you and we hope that this was not the last time we worked together. Also, a sincere thanks to Kajodlingen, Leffe and the Foodprint LAB for the amazing job they have done so far in developing urban agriculture in Gothenburg. If it was not for your positive attitude towards our research question we would never have pursued it.
Before we continue, can we take a moment to appreciate the beautiful front cover of this report and thank Josef for helping us draw such a beautiful scenario of Gothenburg. Then we also had a workshop that could be considered as a success and there is no doubt that Louise, Johanna and Amanda played a huge part in that - an extra green and flowery appreciation to you three!
All good things come to an end and we are therefore taking this opportunity to thank the whole group of C-Lab master thesis students of 2018 for making this multi-cultural and interdisciplinary journey an unforgettable experience.
Finally, to my thesis partner, it has been an honour!

Pia Damsten & Kreshnik Rama, Gothenburg, May 2018

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1

Introduction

The city of Gothenburg is currently facing several social and environmental challenges. The city is getting increasingly socioeconomically segregated and the average lifetime expectancy differs up to 9 years between different parts of the city (Jämlikt Göteborg 2017). Gothenburg, as the rest of Sweden, is seeing a worrying development with increasing levels of isolation between citizens as well as mental illness, the latter being twice more common today than 10 years ago. (Folkhälsomyndigheten 2016). Simultaneously, the city is currently undergoing a major development phase, the biggest in its history, and the city center will grow by almost a third the upcoming decades (Göteborgs Stad 2018b). The current densification initiatives of the city challenges the biodiversity, the access to green areas and open meeting places, the air quality and functioning of ecosystems – several essential components for our well-being.

At the same time, food consumption in Sweden is considered the single largest source of carbon dioxide emissions by the household, two thirds of these emissions come from consumption of imported food (Naturvårdsverket 2015). On a global scale, food production is seen as one of the environmentally most devastating practices. It exploits ecosystems by extensive land use, disturbs the natural nitrogen cycle and is responsible for one-third of the greenhouse gas emissions (Gilbert 2012; Bernhard 2010). It is evident, that the current system of production and consumption of food in Sweden is destructive for the planet and that a more sustainable food system is needed in order to feed future generations.

Urban agriculture (UA), also referred to as urban farming or urban gardening, is a flexible practice that can be implemented on unused spaces in the city. UA has the potential to offer a more sustainable food source compared to the current food system and also increase awareness about the food chain and sustainable consumption. Simultaneously UA strengthens cities' resilience to climate change, whilst contributing to a greening of cities and community cohesion (FAO 2018).

Fortunately, there is currently a growing interest among citizens in Sweden about what they eat. Estimates show that Swedes will spend almost 30 billion SEK on organic food during 2017 [1], triple the amount as just three years ago (SvD Näringsliv 2017). The awareness of many expands even further, covering also the origin of the food. This is reflected in the growth of REKO in Sweden (SVT Nyheter Halland

[1] As of May 2018 this data had not yet been finalized

2017), a trading-platform that supports direct interactions between local small-scale producer and consumer.

Complementing traditional agricultural practices with innovative urban farms would be a way to meet the growing demand for locally produced organic food, whilst creating a more sustainable food system. Innovative urban farms could include high-tech farms such as aquaponics, hydroponics, aeroponics and vertical farms. Food production has the potential to occur on rooftops, in cellars, containers, backyards and empty industrial areas while making use of residual heat produced in the city. It is possible to argue that currently there is no strategy in support of integrating UA practices in the urban landscape on either municipal, regional or national level. 'Smart sustainable cities' does not cover food systems (Regeringskansliet 2017) and therefore, a comprehensive strategy for including UA in the long-term city planning does not exist.

1.1 Aim and Research Question

This thesis aims to explore how the municipality can support the continuous growth of UA initiatives in Gothenburg, and thus contribute to a sustainable development on a broad scale. The research question is stated as:

How can urban agriculture be enhanced in Gothenburg and thus contribute towards a sustainable development?

The research question is answered by addressing the specific objectives:

- Explain why an upscale of UA is relevant for the municipality by highlighting the potential benefits of UA from previous literature.
- Map out the current forces acting upon an upscaling of UA in Gothenburg.
- In a multi-stakeholder dialogue co-create recommended actions for further developing UA in Gothenburg.
- Explore a synergic potential between local aquaponic farmers and health care, that could further enhance UAs importance in the city.

1.2 Approach

In our thesis set-up, we are inspired by the backcasting methodology for approaching sustainability challenges (Dreborg 1996). Therefore, we begin by envisioning a sustainable city, which amongst many things has a sustainable food system. We then move on to analyzing the current system. Co-creating both the envisioned future and the strategies, based on input from the stakeholders is an important feature in the thesis. By this co-creation process we hope that a cross-institutional collaboration could be initiated as a by-product of the thesis. As students we have a rare position since we can serve as a neutral arena for facilitating dialogues between

stakeholders.

The thesis is divided into two phases, that corresponds to the two phases of the procedure at the Challenge Lab. The aim of the first phase was to find the research question and objectives mentioned earlier in this chapter. The second phase of the Challenge Lab consists of the research project and addressing of the research objectives.

1.3 Limitations

UA is defined in several ways and in section 6.2 the reader is given a more detailed explanation of how UA is defined in this thesis. In short we began with FAO's definition, which states that "urban and peri-urban agriculture can be defined as the growing of plants and the raising of animals within and around cities". Considering the already ongoing efforts of increasing peri-urban agriculture around Gothenburg, and the time-constraints of the thesis, we decided to limit our report to agriculture on spaces within the city.

Phase I – Arriving at the Research Question

2

Challenge Lab

The Challenge Lab at Chalmers is a student driven transition arena where master students take on the planet's biggest challenges together with industry, government and academia as part of their master thesis. To solve the complex, socio-technical challenges, the students seek critical leverage points, which are transformative and challenge the status quo. In order for these transitions to be successful, there is a need for collaboration between different actors in the system. This includes collaboration both between the three actors in the triple helix: academia, business and society, but also between the three parts of the knowledge triangle; education, innovation, and research (Stewart 1993).

The students possess a unique role as neutral, since they are not regarded as representative of any organisation, which encourages stakeholder involvement and transparent discussions that may ultimately induce transformative change. The Challenge Lab is created to equip the students to become change agents by providing them with methods and tools, including backcasting, dialogue facilitation, self-leadership and more. The Lab works cross-disciplinary with students from different master's programs and with different nationalities. A quote by the founder of Challenge Lab that is a good representation of the mindset in the lab:

"*Think big, start small, act now.*" - John Holmberg

3

Theory

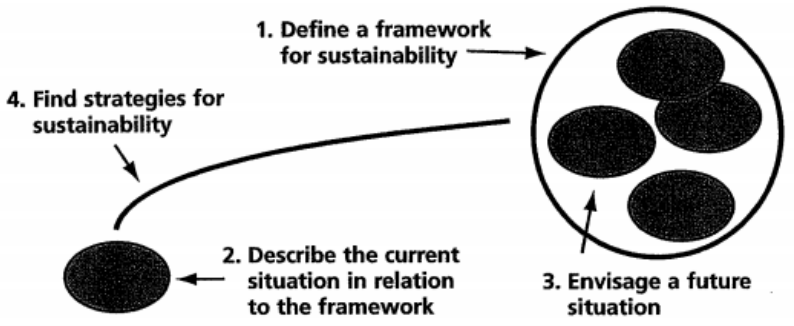
In this chapter the backcasting methodology, as well as theories related to it will be presented.

3.1 Backcasting from Principles

Backcasting is a proposed methodology used for planning or designing. The methodology has been described as particularly useful when solving complex issues, where contemporary trends are part of the problem. The concept of the methodology is to identify a desired future and then take steps in order to attain it (Dreborg 1996). Backcasting is particularly useful when (Dreborg 1996):

- The problem to be studied is complex
- There is a need for major structural change
- Dominant trends are part of the problem
- The problem to a great extent is a matter of externalities
- The scope is wide enough and the time horizon long enough to leave considerable room for deliberate choice

Figure 3.1: The steps in strategic planning for sustainability (Holmberg 1998).



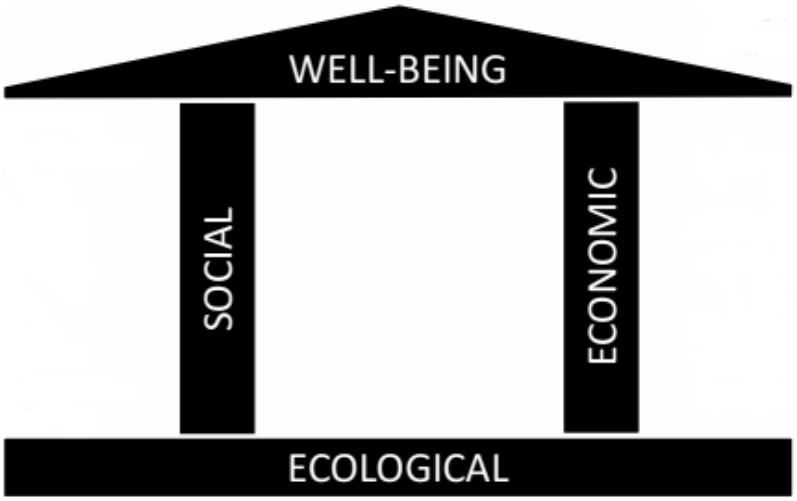
Backcasting is divided into four steps, see figure 3.1. In the first step, principles and values for a sustainable future are defined. According to Stewart (1993) we should *"begin at the end in order to achieve great change"*. The second step of backcasting challenges us to understand the current socio-technical system we exist within. The purpose is gaining a holistic, non-linear view of the current system. Tools that can be used in developing this understanding is the multi-level perspective (Geels 2005)

and multi-stakeholder dialogues. After having gained understanding of the current system, gaps that separate the current system from the envisioned future can be identified. The final purpose of the second step is to find places to intervene in the system, so called leverage points. Addressing, transforming, the leverage points would bring us one step closer to our envisioned sustainable future. In the third step of backcasting, future sustainable solutions/strategies are designed. In the fourth and final step, strategies are identified that can realize the future solutions, linking the present situation with the envisioned future.

3.2 Principles for Sustainability

The sustainability dimensions established at Challenge Lab, defined in step one of backcasting, should be non-overlapping and covering an ecological, economic, social and well-being perspective, see figure 3.2.

Figure 3.2: Four dimensions of sustainable development, used for defining principles for sustainability at Challenge Lab.



The ecological criteria form the bases for sustainability (Holmberg and Robért 2000). According to the ecological sustainability criteria, the extraction and accumulation of raw materials from and on the Earth's crust should be in harmony with the degradation of these. Furthermore, the ecosystems of Earth should not be exploited or deranged. The 'planetary boundaries' defined by Rockström et al. (2009) is another way of describing the ecologically sustainable operating space. Rockström suggests 9 planetary boundaries that the human activity should not trespass in order for our activity to be sustainable. Several of these boundaries have already been exceeded by human activity, see section 6.1 for more details.

The social criteria define how to build sustainable horizontal and vertical relations between people, for us to live together as a society. The economic criteria define how we can use resources to their full potential, distributing them between and within

generations.

The idea with the ecological, economic and social dimension is to serve as a basis for guaranteeing well-being today and in the future. Universal and timeless needs are to be satisfied in order to achieve well-being, however the satisfiers to these needs are variables, changing with the paradigm and culture we live in (Cruz et al. 2009).

3.3 Values and Intrinsic Motivation

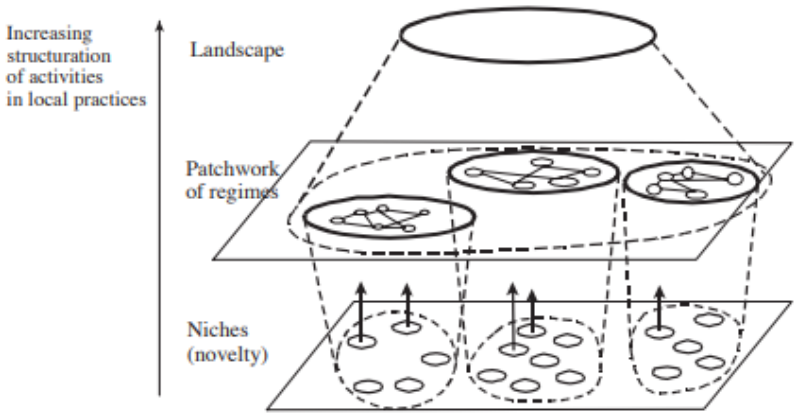
In the "Common cause report" published by WWF (Crompton 2010) it is highlighted that human actions are driven by our inner values. According to the "Common cause report" it is, from a sustainability perspective, particularly interesting to see how personal and cultural values can motivate us to take on so called “bigger-than-self” challenges, as for example global poverty and climate change. The report highlights the importance of trying to awaken these inner values, related to bigger-than-self challenges, by social campaign or communication

Values are not the only type of intrinsic motivator. In self-determination theory (Ryan and Deci 2000), three inner psychological needs, that enhance our self-motivation, have been identified. These are the need to feel relatedness, competence and autonomy. The satisfaction of these psychological needs is essential in order to reach personal growth, social development and well-being. The self-determination theory helps us understand what sort of environment that is needed in order for us to be motivated in our work.

3.4 Multi-level Perspective and Socio-technical Transitions

The multi-level perspective (MLP) is a framework for describing how the socio-technical society functions and how system innovations take place. The MLP describes society at three levels; meso, macro and micro (figure 3.3). The meso level describes the landscape of the society and existing paradigms, these could for example be climate change, urbanization and globalization. The meso level is built of the current socio-technical mainstream structures of society, an example being fossil fuel as a energy source. The micro level constitutes of technological niches, where innovations happen. The landscape challenges put pressure on the societal structures, and open a window of opportunity, where innovations can be seeded into the mainstream society. In this way a socio-technical transition can take place, and a rigid societal structure can be replaced by a new innovation (Geels 2005).

Figure 3.3: Multiple levels as a nested hierarchy (Geels, 2005).



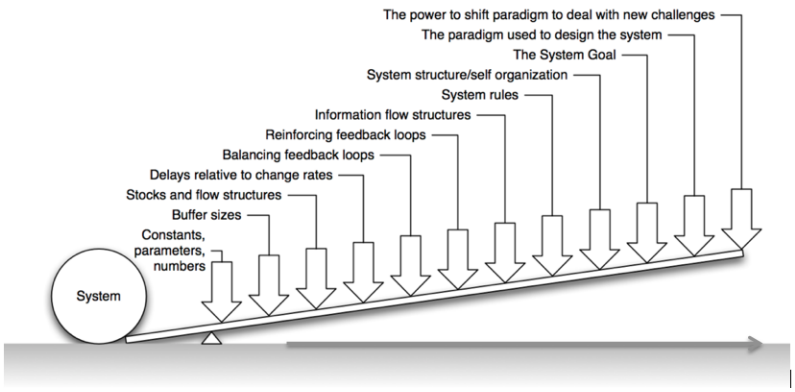
3.5 Dialogues – Allowing for Collective Wisdom to Emerge

The complex challenges in today's society cannot be solved by one individual, neither can they be solved by the same means as they were created. Isaacs (1999) highlights the dialogue as a tool for addressing complex challenges, both within an organization and between disciplines. The traditional approach for addressing the increasingly complex challenges of society has been by breaking them into specialized sub-groups. This has however led to a fragmentation of problem solving and a lack of means to communicate across these silos. Isaacs suggests that dialogue opens up a new horizon of organizational learning and management, it complements the traditional way of solving problems and allows for new collective intelligence to emerge.

3.6 Places to Intervene in a System

In systems analysis so called "leverage points" refer to areas of action within the system, that can have a big impact when being addressed. Meadows (1997) has defined nine levels of leverage points, or places to intervene in a system, as she calls them. The nine levels of leverage points range from more superficial manipulations of the system, as for example changing parameters and stock-flows of the system, to more fundamental changes of the system. The more fundamental changes include changing the goal of the system and the paradigm of which it arises. The highest leverage is however to understand that no specific paradigm is true, and to keep yourself detached from a specific paradigm, Meadows argues (figure 3.4).

Figure 3.4: Places to intervene in a system, ranging from superficial manipulations of numbers, to fundamental paradigm shifting (Meadows 1997).



4
Methods

4.1 Step 1 - Define a Framework and Criteria for Sustainability

During the first week of Phase I focus laid on defining the criteria for sustainable urban development by envisioning a desirable future (outside-in perspective). This was carried out together by all 16 students, utilizing the diverse and broad backgrounds, both academically as well as culturally, and ensuring that everybody felt ownership over the formulated principles. During this phase inspiration was drawn from the UN sustainability goals (UN 2015) and Four principles for a sustainable development (Holmberg and Robért 2000). Initially, all students were divided into four smaller groups, one for each pillar, see figure 3.2, where each group worked with defining key-words and forming principles for their pillar before rotating and doing the same on the next one. Lastly, after having worked with each pillar, all students reunited in one big group to discuss and finalize the principles.

Simultaneously while forming the principles, a workshop was held in self-leadership, with the aim of exploring one's own personal values and our strengths and weaknesses. This was considered as a base for future steps when observing from an inside-out perspective.

4.2 Step 2 - Describe the Current Situation in Relation to Criteria

During the preparatory course, Managing Stakeholders for Sustainable Development, stakeholders were invited to Challenge Lab to participate in a dialogue session facilitated by the students. In the two weeks leading up to the dialogues, students were offered a crash-course in facilitating dialogues. The crash-course included lectures about organizing dialogues with proposed set-up environment and expectation from the students in the roles as facilitators, documenters, and observers.

In total three dialogues were held, one for each of the thematic areas: mobility, circular economy, and urban futures. Representatives from the academia, industry and municipality were present during the dialogues. After each conducted dialogue, students would get together in groups to reflect over and summarize the outcome of the dialogues on paper. This formed the basis for the master thesis students when

describing the current situation in relation to the criteria from step 1.

The findings from the dialogues in the course were complemented in the lab with literature studies and interviews. In our instance, we felt there was little to no representation present for the urban agriculture (UA) movement and thus a final dialogue was held around that area. Present were representatives from the municipality and established farmers in the city, which could confirm there exist challenges that needs innovative solutions and collaboration. The gathered information resulted in a map of challenges for each thematic area, based on the gaps that could be identified between now and the desired future. This gave a good overview of the thematic areas in the region which made up a good basis for definition of leverage points.

4.3 Defining Leverage Points

The definition of leverage points (LPs), was an iterative process, that spanned over the remaining time of phase I. LPs were defined, they were reformulated and lastly, after having identified over 20 of them, they were discarded until there were around 10 LPs left. The remaining LPs were the ones students felt were of high importance or interest and wished to work on further. Finally, pairs were formed based on mutual interest in the topics, and the process of formulating a research question to be answered in phase II begun.

5
Results and Research Question

5.1 Step 1 - Principles for Sustainability

The results from Step 1 was a collection of sustainability principles and keywords that are non-overlapping and covering all four aspects of sustainability: ecological, economic, social and well-being. The complete list of keywords are found in Appendix A.1.

5.1.1 Ecological Sustainability

The ecological sustainability principles were defined with the Earth's need as a starting point. Four principles for ecological sustainability were defined:

- Meeting the needs of the Earth (planet and living beings) today, without compromising its ability to meet the needs of tomorrow
- Alterations made in the crust or biosphere should be reversible
- Serve the environment; preserve, protect and restore/regenerate
- Substances should be produced/extracted so that they can be degraded/reabsorbed within reasonable time

5.1.2 Economic Sustainability

The economic sustainability concern how we economize with resources in a sustainable way. The keywords were divided into five subgroups: man-made capital, human capital, financial capital, natural capital and a general category.

5.1.3 Social Sustainability

The social sustainability criteria were divided into horizontal relations, which define sustainable interaction within and between groups, and vertical relations, which define sustainable interaction with institutions. An overarching category called equity/justice was included, with keywords universal for all social relations.

5.1.4 Well-being

The keywords related to well-being were grouped in eight sub-categories and presented in Appendix A.1. The sub-categories are: general, knowledge, autonomy, self-fulfillment, purposefulness, belonging, subsistence and health.

5.2 Step 2 - Outcome of Multi-stakeholder Dialogues

In this section a short summary of relevant challenges and leverage points identified in the stakeholder dialogues are presented. The focus will be on the dialogue concerning "urban futures", since the chosen leverage point for this thesis was extracted from this dialogue session.

Reoccurring challenges in the "urban futures" dialogue session was segregation and isolation of the inhabitants as well as a lack of communication between actors in the city. We identified that there are a lot of temporarily dead spaces in the city, that are used inefficiently. At the same time there is a huge ongoing densification of the city which creates challenges such as ”how can we build a dense but liveable city” and “what do we do with the areas that are waiting to be constructed on”. An initial leverage point was found to be the creation of neutral, cross-boundary meeting places, that would have both an ecological, economic, social and well-being benefit for the citizens.

After the last dialogue with urban farmers in the city, it was found that creating a strategy for involving UA in the city planning, was a crucial leverage point. An UA strategy was found to have the potential in contributing to all four sustainability aspects, while making use of dead spaces in the city. Since creating such a strategy would require collaboration between several actors in the city, we also found that this leverage point could spark a better communication within the city.

5.3 Arriving at the research question

From the chosen leverage point of interest we began forming research questions. This was a iterative process where we made use of feedback from our Challenge Lab teachers and supervisors. The first draft of research questions were formulated as:

1. *How can urban farming contribute to a sustainable city?*
2. *How does the current system in the city look like today?*
3. *Which challenges and leverage points can be identified?*

These initial research questions were later finalized into one overarching research question, addressed through four specific objectives as defined in section 1.1. From here "Phase II – answering of the research question" begun.

5.4 Reflection

The first four weeks at Challenge Lab was an intense experience when many new skills were acquired in combination with personal growth. Simultaneously the formation of a diverse but cohesive work environment, consisting of students with different cultural and educational backgrounds, took place.

Phase II – Answering the Research Question

6

Background and Theoretical Framework

To define the conceptual and theoretical framework of the thesis, the research question is set against the background of existing literature starting with global sustainability challenges related to food production. Secondly, the concept of urban agriculture (UA) is clarified and the sustainability aspects of the practice are presented. Thirdly, the concepts of local economy, economic multipliers, tactical urbanism and community-supported agriculture are explained.

6.1 Sustainability Challenges with the Food System

The Earth is entering a new epoch due to human manipulation of the biosphere. The Holocene that has ruled for the past 10 000 years, and allowed humanity to establish such vast communities due to its stable and mild climate, has been declared as ended by part of the scientific community. The new era, called the Anthropocene, is defined by climate-change caused by human activity that could have catastrophic consequences (Waters et al. 2016).

Rockström et al. (2009) has defined a set of "planetary boundaries" – a proposed safe operating space for humanity. Human activity has already led to the trespassing of three of the nine boundaries defined by Rockström, these are "the rate of biodiversity loss, climate change and human interference with the nitrogen cycle". The exact consequences for exceeding the planetary boundaries are difficult to predict, but it is understood that the earth cannot continue functioning in a stable way as occurred during the Holocene.

Climate change is largely caused by the accumulation of greenhouse gases (GHGs) in the atmosphere due to the use of fossil fuels. The global food system is estimated to be responsible for up to one-third of the GHG emissions when considering the whole production chain from producing fertilizers, packaging food and transporting it world-wide (Vermeulen et al. 2012). Data indicate that these emissions have doubled over the last 50 years and show no current sign of decreasing (FAO 2014). The nitrogen cycle has been disturbed due to fertilizers used in the industrial food production, and biodiversity loss is mainly caused by changes of land use. An estimate of 10 million m^2 needs to be cleared for agriculture by 2050 if the past trends of food

consumption and production continue (Tilman et al. 2011), an area equal to the size of USA. Simultaneously about one third of the planetary surface is estimated to be left arid if the global warming reaches a 2 °C median increase since pre-industrial temperatures (Park et al. 2018)

Today 50% of the global population lives in urban areas, the number being estimated to increase up to 66% by 2050 (UN 2014). Cities are huge consumers of food, but since only a minimum part of the food production occurs in cities the resilience in case of a crises is low. At the same time the global need for food is estimated to increase by 50-100 % until 2050 (Valin et al. 2014). This will put additional pressure on the global food system. Over one third of currently produced food is wasted, due to long transportation distances, ineffective storage systems and inflexible best-before dating (FAO 2018). Hence it is obvious that without changes, the current food-system will struggle to feed the future populations, and the growing cities, in a sustainable way.

6.2 Urban Agriculture

'Urban agriculture' (UA) is a term that has gained increased interest lately which is reflected on the number of papers published around the topic during the last decade. Nevertheless, to date there is no agreement on a common definition of UA in the academic literature, as the concept is subject to different interpretations made by different authors. One of the most controversial aspect is related to the use of the term "urban". In this report UA is defined as the production of crops and livestock goods within cities and towns (Zezza and Tasciotti 2010). In addition, we consider related activities, such as processing and waste recycling to also be part of UA. UA can include community- and private gardening used for social or commercial production. It can take place on different spaces in the city such as backyards, balconies and parks, but also on roofs, basements and on what otherwise is considered dead spaces in the city. Activities related to UA are diverse and apart from vegetable cultivation it also includes cultivation of medicinal plants, mushrooms, fruits and berries, as well as beekeeping, fish farming, and food composting. UA is increasingly gaining interest as it has emerged as a sustainable alternative to the current food producing system today.

Among many of the unused resources or capacities of cities we find what we today loosely define as dead spaces, i.e. spaces that are not utilized in the current urban planning. Making use of dead spaces is especially of interest in denser cities where green areas and related activities are in a phase of decline and city space generally is quite expensive. Because of the close interaction with the city environment, UA is intrinsically multifunctional and offers more to the urban landscape than food production (Orsini et al. 2017). It plays a role in waste recycling, social cohesiveness in the city, education and health as well as climate resilience (De Zeeuw and Dreschel 2015). Sustainability aspects of UA from previous studies are highlighted in the following sections and categorized according to the four principles for sustainability (see section 3.2). The benefits of UA are dependent on the type of farming and type

of technique being used. The benefits highlighted here are usually direct result of UA, but can in some cases be indirect. The latter case will be clarified or explained if applicable.

6.2.1 Ecological Aspects

Research has shown UA to improve multiple aspects of the urban ecosystem depending on the type of agriculture being implemented, but in general the benefits of vegetation can be summarized as:

- Improvements of air (Yang et al. 2008) and soil quality (Edmondson et al. 2014)
- Increased biodiversity (Oberndorfer et al. 2007 ; Fiorreti et al. 2010)
- Valuable storm water management (Oberndorfer et al. 2007 ; Fiorreti et al. 2010)
- Urban heat island reduction (Ackerman et al. 2014 ; Oberndorfer et al. 2007)

When also taking into account the indirect effects of consuming the products from the edible landscape one can find even bigger potential ecological benefits through shorter distances to our plates, as well as reduced need of packaging (Mohareb et al. 2017).

Empirical findings from previous research show positive outcomes of sustainable UA practices. For instance, according to Yang et al. (2008) a total 1675 kg of air pollutants (NOx, SOx, O3 and PM10) were removed from the Chicago air during a year by having 19.8 ha of green roofs installed. A study by Edmondson et al. (2014) showed that not only is money saved when producing own compost, but the soil structure and nutrients will also improve which leads to reduced need of fertilizers and other additives.

A recent memory of evidential climate change for many Scandinavians is the 2011 cloudburst in Copenhagen that flooded large areas of the city and caused a damage of approximately DKK 6 billion (The City of Copenhagen 2012), thus making storm water management an even more topical issue. Green roofs can be one way to address the issue proactively as significant slower runoff rate and retention (Oberndorfer et al. 2007 ; Fiorreti et al. 2010) has been measured from cases around the world. In addition, rainwater can be captured and used to self-sustain farming projects as in Manhattan (Nelkin and Caplow 2008) and Barcelona, the latter reducing water need by 98% compared to conventional tomato production (Sanyé-Mengua et al. 2015). Green roofs and other gardening/farming practices in the city have been proven to support improvements of the urban biodiversity (Oberndorfer et al. 2007 ; Fiorreti et al. 2010), and for cities experiencing higher temperature in the city centre compared to the peri-urban landscape there are studies supporting the theory that vegetation can help reduce urban heat island effects (Ackerman et al. 2014 ; Oberndorfer et al. 2007).

The highlighted benefits so far have been related to general vegetation in a urban landscape, but if studying the impact of the produce, the food, we learn it too has effects that are beneficial from an ecological perspective. Until recently, most agricultural paradigms have focused on improving production, often to the detriment of the environment, causing biodiversity loss, water pollution and desertification (Foley et al. 2013). With the increasing population and thus also increased demand on food we need to become more efficient. In addition, according to FAO (2018) one third of the food produced gets lost or wasted. These challenges call for immediate response and there is a big potential for UA to address this. Industrial forms of UA can slow down land use change, increase crops yield and increase resource efficiency (Mohareb et al. 2017), not to mention the reduced emissions from transport (Hara et al. 2013) and packaging savings (Sanyé-Mengua et al. 2015).

Lastly, it is worth mentioning that some of the techniques used for food production in UA are heavily energy demanding, i.e. hydroponics and vertical farming with artificial lightning (Mohareb et al. 2017). These need to become more efficient in order to not only be economically feasible, but also have a net positive ecological impact in comparison to conventional agriculture.

6.2.2 Economic Aspects

What price do you put on a clean and beautiful environment? Although this section focuses on the benefits that can be captured through economic valuation, it is important to emphasize that many of the benefits derived from UA are difficult to put an economic valuation to. According to the book 'Valuing Ecosystem Services: Toward Better Environmental Decision-Making': "*There are many misconceptions about the term 'economic valuation'. For example, many believe that the term refers simply to an assessment of the commercial value of something. In fact, the economic view of value actually includes many components that have no commercial or market basis*" (National Research Council 2005). These benefits include i.e. 'beauty of a natural landscape' and the existence of a species. Hence it is implied that the economic valuation concerns a broad array of sources, though not all of them have been identified.

Nevertheless, there are benefits of UA that are measurable and they include reduced energy demand on buildings with green roofs, tourism attraction, creation of jobs, and in general keeping money in the local economy for a longer period. There is also a big potential for symbiosis with other actors in the urban landscape, and if further explored these could generate new economic benefits, e.g. by making use of residual heat.

Studies show that green roofs reduce the cooling (Omidreza et al. 2013) and heating load of buildings, and they could be particularly useful in cold European climates (Jaffal et al. 2012 ; Castleton et al. 2010). Noteworthy, authors Castleton et al. (2010) propose that older buildings with poor existing insulation are deemed to benefit most from a green roof, which many buildings in Gothenburg city center could possibly qualify for. However, authors Omidreza et al. (2013) points that

savings are subjected to the type of green roof installed. Parameters that varies are depth and composition of the growing medium, plant selection, type of climate, irrigation and insulation specifications.

Through Gothenburg's official visitors guide, goteborg.com, we find Foodprint LAB's activity 'Urban Farming Safari' which is a guided tour to the farms in the city and has become very popular with as many as 30 people turning up for one of their most recent tours [1]. In the most recent report on the effects of UA in Vancouver, the Census Report, the Vancouver Urban Farming Society (2017) highlight the characteristics and impact of urban farms in the city. In the Census report, funded by the city of Vancovuer, highlights include creation of 35 full time jobs and nearly CAD $750,000 in food sales, which when applying a multiplier effect (see section 6.3 to find out more) leads to a total economic benefit of CAD $1.9 million. An calculation example of the economic benefits from UA in Gothenburg are given in figure 10.3. Other business cases that must be given special attention in further studies, in term of successful business models, are Lufa Farms, Monteral, and Gotham Greens, New York & Chicago. A calculation example of the economic benefit when utilizing dead space in the city will be presented later in this report, see section 10.3.

6.2.3 Social and Well-being Aspects

Some of the most frequently studied benefits of UA are those related to social and well-being aspects of the practice. UA has the potential to create cross-boundary meeting places, increase the safety and trust experienced in neighbourhoods as well as contribute to integration and create a sense of belonging (Kamvasinou 2017; Olivier et al. 2017; M. Horst et al. 2017). An example of this is the UA initiative "Skip Garden" in London, that brought together school children of different ages with employees working in nearby businesses. This collaboration resulted in an empowerment of children, by creating a relationship with local businesses they would not have had otherwise. Through the program everyone involved had the opportunity to acquire new personal skills and obtain knowledge about themselves and sustainability (Kamvasinou 2017). The pedagogical value of UA, both as a mean to create environmental awareness, but also as a tool for teaching other subjects has recently been emphasized. Today we see an increasing number of UA initiatives focusing on integrating the practice with educational systems (Deelstra and Girardet 2000). UA can bring the rural and urban areas closer to each other and preserve important agricultural skills that otherwise might go lost with future generations born in the city.

Numerous physical and psychological health benefits can be linked to UA practices. The physical benefits are those connected to an improved diet, both due to availability of fresh vegetables as well as caused by an increased interest and awareness of food (Brown and Jameton 2000). Other physical health benefits are the ones that come with an increased outdoor recreation (Wakefield et al. 2007). Remarkable is the impact of green areas on both stress levels, and physiological healing of the

[1] According to the organizer the Foodprint LAB

body. It has been found that hospitalized patients, placed in departments with a green view from their bed, need 50% less pain medication and have a 10% shorter recovery time (Ulrich 1984).

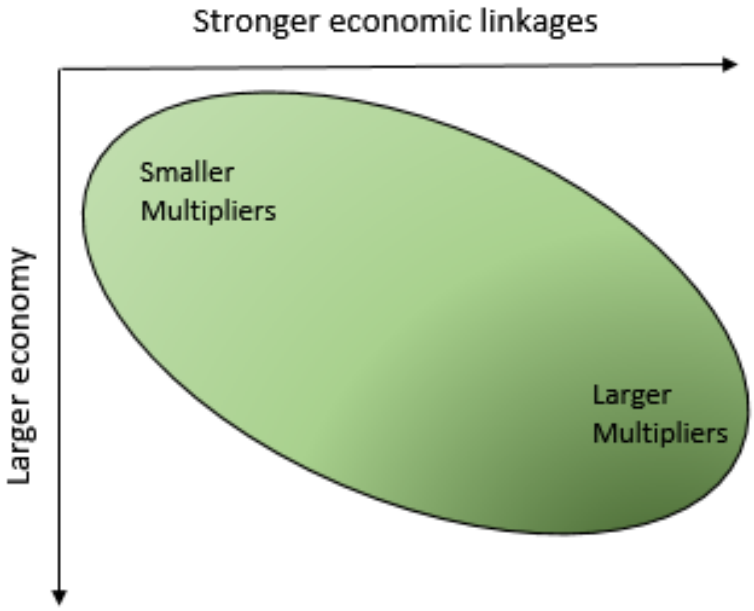
As opposed to several other cultures, Swedish people tend to seek consolation from the nature, rather than from a religious context. Up to 67% of the Swedish inhabitants reported, that in case of a personal crises, they would primarily turn to nature as a coping-method (Ahmadi 2006). According to Boukharaeva and Marloie (2015) humans have an inner drive to get close to nature. For populations living in the city, UA can offer an opportunity to reconnect with the nature on a small scale. Alcock et al. (2014) found that when inhabitants move to greener areas their mental health would improves. This supports the importance of access to green areas, as urban farms or community farms, in order to increase the life quality of citizens.

It should be noted that UA alone cannot overcome the larger structural drivers, such as poverty or racism. It is therefore important to consider food justice when planning UA in the urban landscape, and not make it a class issue by benefiting already privileged communities and contributing to the marginalization and even displacement of disadvantaged groups (M. Horst et al. 2017). Knowledge should be made available for everyone and the prices of the products must be affordable for all citizens.

6.3 Local Economy and Economic Multipliers

The local economy is defined here as an economic system and related activities in a local area that serves a local population. In March 2016 the US department of agriculture released a toolkit; 'The Economics of Local Food Systems'(USDA 2016), to help local organizations make more deliberate and credible measurements of local and regional economic activity relating to agriculture, which can be used in dialogues with policy makers and city planners. This toolbox was developed to address the difficulties when quantifying the potential value of food production for a local economy, which can occur because of the complexity of linkages that exist in a community. USDA offers a method to measure the extent of the complex intra-regional linkages using Input-Output analysis to generate economic multipliers. An economic multiplier is a single number that captures the economy-wide circulation of activity from initial to financial transaction. Economic multipliers makes it possible to put a value on the total economic benefit of locally produced and sold fruits, vegetables and other UA-related products or services. Researchers typically use multipliers between 1.0 to 2.0 with bigger urban areas closer to 1.9 (USDA 2016), see figure 6.1. However, they do mention the possibility of unique situations involving local economies that are capable of larger multipliers.

Figure 6.1: Illustration of Factors that Drive the Size of an Economic Multiplier (USDA 2016).



6.4 Tactical Urbanism

Tactical urbanism theory can offer a significant contribution to UA. It can be explained as an 'approach' to neighbourhood building and activation using short-term, low-cost, and scalable interventions and policies (Lydon and A. Garcia 2015). The practice can be used by a range of actors, including city planners, citizen groups and individuals. For citizens this is a way of reclamation or redesign of public space. Tactical urbanism can be seen in different ways all around the world from transformation of an unused Tempelhof airport, Berlin into a big urban farming society (The Guardian 2015) to green pop-up parks on the long shopping street Avenyn, in Gothenburg, as can be seen in figure 6.2 (The Foodprint LAB 2017).

Projects can be put in a spectrum of unsanctioned vs sanctioned tactics, but well-considered projects that begin as unsanctioned often become sanctioned over time (Lydon and A. Garcia 2015). One project that became permanent over time was the 'Skip Garden' in London which is mentioned in this report as a better practice and can be read more about in section 9. To conclude the section, in this report tactical urbanism is viewed as an effective tool for utilization of spaces in the city for gardening/farming.

6.5 Community-supported Agriculture

Community-supported agriculture (CSA) is a commonly mentioned business model in the literature and is based on direct partnership between the farmer and con-

Figure 6.2: The Popup Park @Avenyn. Image credit: the Foodprint LAB

sumer, where both share the economic risks and products of the farm (O'Hara and Stagl 2001). In other words, the consumer becomes a shareholder in the farm. CSA promotes interactions between farmers and consumers and is originally an old business model that has been rediscovered as it creates and builds communities, while supporting environmentally sound agricultural practices and land use (DeLind and Ferguson 1999).

The set-up of CSA may vary between farms and countries, but in general each 'shareholder' purchases a 'share' of the harvest for a set price, prior to the growing season. The consumers then receive the products throughout the season, usually on a weekly-basis, or according to agreement with the farmer. Municipalities in Sweden have begun studying CSA as a way around EU's legal framework on public procurement, which forces them to have open competition on all their contracts and not restrict procurement to locally produced food. Tingsryd municipality is an example of a municipality that is currently shareholder in a CSA. By being a major shareholder it is also possible for the consumer to affect what is grown (Hinrichs 2000).

7

Local Context

The city of Gothenburg, populated by half a million inhabitants, is the second largest city of Sweden. Gothenburg is located on the west-coast and has an humid continental climate according to Köppen climate classification with around 235 frost-free days (SCB 2014). The city is currently undergoing a major development phase, the biggest one in its history, and will grow by almost a third (Göteborgs Stad 2018b). In the following sections a selection of local sustainability goals and programs will be presented along with current UA initatives, both public and private.

7.1 Sustainability Goals and Programs

The city of Gothenburg has adapted 12 local environment goals starting in 2008, the local goals were derived from the 16 national environment goals of Sweden (Göteborgs Stad 2018a). To concertize these goals a local environment program has been established, containing an action-plan with 212 strategies to be taken in order to reach the goals (see figure 7.1). Strategies nr. 10-15 relate to sustainable food production of the city, and the responsible boards are the Miljö- och klimatnämnden (Environment and Climate Board), Fastighetsnämnden (the Property Management Board) and park- och naturförsvaltning (the Park- and Nature Board) (Göteborgs Stad 2013).

A specific program called the "climate-strategic program" has been created in order to help to reach the municipal environmental goal nr. 1, "limited environmental impact" (Göteborgs stad 2014). The program was adapted by the municipality in 2014, and aims to provide concrete strategies for reducing the climate impact of the city. One of the goals of the climate-strategic program is to reduce the climate impact of food consumed by the public sector of the city by 40%, compared to the levels consumed 2010 (Göteborgs stad 2014). It is also mentioned that the food waste produced by each citizen should be reduced in the future. One of the strategies to reach the goals is by educating and actively inspiring all citizens through actions and dialogues.

The 'Miljö- och klimatnämnden' includes, among its objectives, the creation of a local food strategy for Gothenburg. The local food strategy will serve as a complement to the existing national and regional ones, and support the municipality's efforts towards achieving the goal of reduced climate impact of the food chain. Prestudies of the food strategy are currently ongoing. The intention is to apply a

Figure 7.1: Illustration of Gothenburg's climate goals and programs (Västra Götalandsregionen 2016). The 12 local environmental goals led to the formation of an environmental program, containing concrete strategies. A separate program, the climate strategic program, was later established to focus on creating strategies for achieving the climate goal nr. 1 – limited environmental impact.

cross-institutional collaboration, while including local private actors in the creation of the food strategy. The EU-financed platform "Stadslandet" will serve as a base for the dialogues. The goal is to enhance the sustainable production of food, provide jobs and increase the economic growth of Gothenburg (Västra Götalandsregionen 2016).

7.2 Local Initiatives and Support

In this section a number of identified local UA initiatives will be presented. The local initiatives are divided into public initiatives, run by the municipality, and private ones, operated by local enthusiasts. It ought to be mentioned that all local UA practices are not covered here, but merely a handful of prominent ones.

7.2.0.1 Public

Fastighetsnämnden of Gothenburg city aims to promote urban and peri-urban agriculture in Gothenburg and thus implement the strategy nr. 13 from the local en-

vironmental program. This task is performed by the department of **Stadsnära Odling** (Cityclose Farming), formed in 2012. Stadsnära Odling provides support to both recreational farming in community gardens, as well as commercial farming in and around the city. The municipality of Gothenburg has a unique position for enabling urban and peri-urban farming, since it is the biggest landowner in Gothenburg. Stadsnära Odling provides farmland for urban farmers and helps with soil preparation. They also offer workshops and educational support on occasions (Stadsnära Odling n.d.).

Another public actor focusing on farming in Gothenburg is **Stadslandet**, a EU-financed project that focuses on developing sustainable businesses especially in the north-eastern parts of Gothenburg. The vision of Stadslandet is built on the environmental goals of Gothenburg, combined with the social sustainability goal of improving the equality between districts of the city and thus even out the life time expectancy gap between them. In order to support the Food Strategy of Gothenburg, Stadslandet wants to investigate the possibilities of city close farming as a mean of creating jobs in the vulnerable parts of the city, while producing food (Stadsutveckling Göteborg n.d.).

7.2.0.2 Private

Stadsnära Odling helped to incubate one of the biggest Nordic urban farms, **Kajodlingen**, that operates both on pier decks and rooftops, selling their vegetables to high end restaurants as well as directly to citizens (figure 7.2). The production of Kajodlingen supports two farmers today and in the future they hope to spread their developed business-model. Kajodlingen (n.d.) have a vision of there being one farmer in every neighbourhood.

Another grass-root initiative is the local compost enterprise **Kompostbutiken** in the district of Majorna. Kompostbutiken provides service agreements for property owners, where they collect the food-waste from households and turn it into compost-soil using worms. The soil is then available for inhabitants to use for free for private purpose, one example being backyard farming (Leffe på hörnet n.d.).

Stadsjord is a third local enterprise, experimenting with different types of city-farming. One of the current projects is aquaponic farming in an empty factory building located in Gamlestan, an eastern district of the city. The aquaponic farm produces both vegetables and tropical fish like clarias and tilapia. Stadsjord receives financial support from "Jordbruksverket" and has also been granted money from Vinnova – the Swedish government agency for innovation (Stadsjord n.d.).

The Foodprint LAB is a fourth local actor, matching urban farmers with vacant plots in the city through their app, GrowGBG. In addition they spread information about UA related events and ongoing initiatives in the city, including their urban farming safari. The vision is to establish a local food system in Gothenburg and create a community between city farmers. The Foodprint LAB offers different types of memberships with varying costs, depending on how much access and support you

Figure 7.2: Kajodlingen has rented one of the piers in the old harbour of Gothenburg, and is currently establishing a large scale urban farm. In this picture Kreshnik Rama (one of the thesis authors) is helping with the soil preparation.

choose (Foodprint LAB n.d.).

REKO-ringar (REKO-circles) is a growing nation-wide movement that has given life to many small-scale farms in Sweden once again. REKO is a platform for buying and selling locally produced products without intermediaries. Farmers and consumers communicate through online channels, such as a Facebook group. These circles are formed when producers and consumers in a city or region come together. By the time of this report there are approximately 50 of these circles in Sweden (Hushållningssällskapet n.d.), and 'REKO Göteborg' currently has 4000 members.

8
Methodology

This thesis begun with Phase I of the Challenge Lab, which led to the formulation of a research question and specific objectives to be addressed in Phase II. The second phase started off with a background research and theoretical framing, that was presented in the previous chapters. Outputs from the background research were an understanding of the local context in Gothenburg, a review of sustainability aspects of UA and a clarification of concepts relating to UA. The background research, including literature review, enabled the addressing of the first specific objective: *"Explain why an upscale of UA is relevant for the municipality by highlighting the potential benefits of UA from previous literature."*.

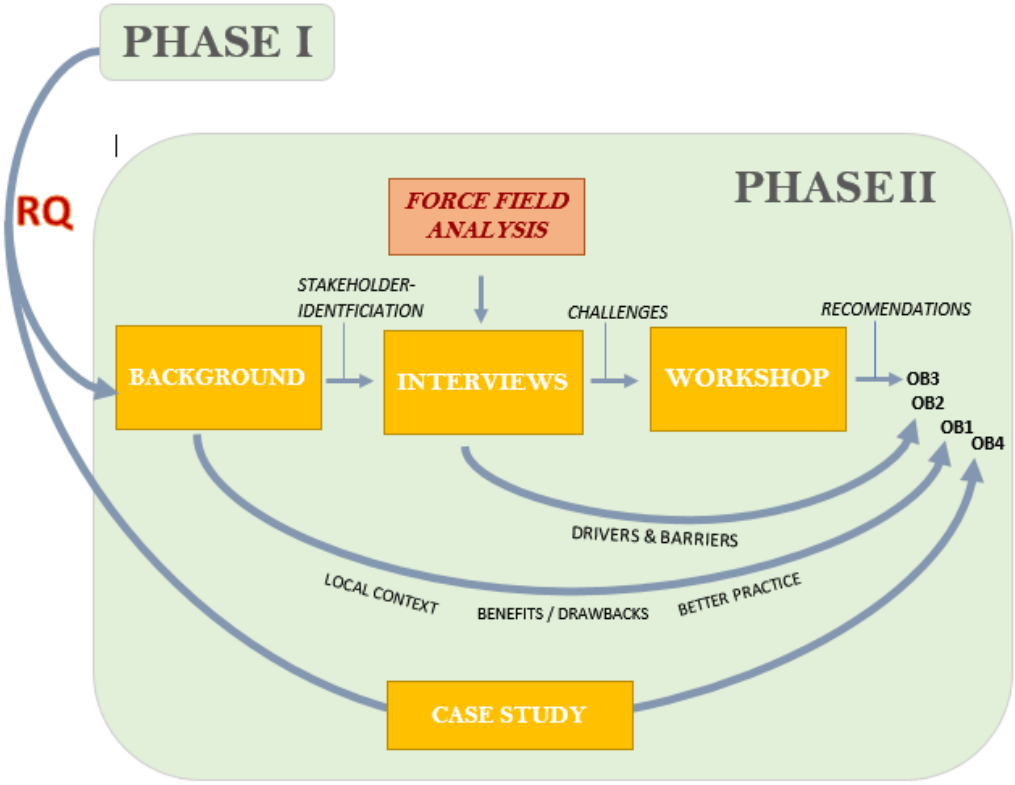
Understanding the local context in Gothenburg enabled the mapping of stakeholders that were interviewed in this thesis. The interviews were analyzed according to the force field analytical framework, which resulted in a mapping of drivers and barriers influencing an enhancement of UA in Gothenburg. This led to the addressing of the second objective: *"Map out the current forces acting upon an upscaling of UA in Gothenburg."*

Finally, a stakeholder workshop was conducted, addressing some of the challenges found in the force field mapping. The workshop resulted in the co-creation of recommendations, and thus addressed the third objective: *"In a multi-stakeholder dialogue co-create recommended actions for further developing UA in Gothenburg."*

In the following sections the research steps chosen to address the second and third objectives, i.e. the interviews, force field analysis and workshop, will be described in detail. The criteria and theory for each step will run in parallel with the methods and design of it. First however, the criteria for selecting a set of "Better Practices" are presented. From the "Better Practices" inspiration can be drawn to further develop UA in Gothenburg.

To address the fourth objective: *"Explore a synergic potential between local aquaponic farmers and health care, that could further enhance UAs importance in the city."*, a case study was conducted in parallel with the rest of the research. The case study is presented in a separate chapter. A clarifying illustration of this thesis structure is offered to the reader, see figure 8.1.

Figure 8.1: Structure of the thesis. Phase I led to the definition of a research question that was answered in Phase II. The research question was answered by addressing four specific objectives. Specific objective nr. 1 was addressed through background research in the previous chapter. Objective nr. 2 and 3 were addressed through interviews and a workshop, for which the methodology is described in this chapter and the empirical findings presented in chapter 10. The last objective was addressed by a case study, presented in chapter 11.



8.1 Finding Better Practices

In order to find the most relevant practice for the Gothenburg context, each practice identified during the literature review (see appendix A.2 for complete list) was subjected for evaluation. The practices were judged upon five categories: location, level of implementation, integration with city planning, duration, and connection to the forces found in the force field analysis. An attempt was made to define a 6th criteria, transferability. However, due to time constraints this was only addressed for the final four practices presented in the "Better Practice" section. The five criterias were:

- *Location* – Is relevant considering the potential differences in climate.
- *Level of implementation* - Either
  - In progress - Currently being run but yet to reach pre-defined goals/targets.
  - 100 % - Currently in operation or finished and having reached its goal.

- *Integration with city planning* - Is this project funded/supported by the city?
  - Yes / No
- *Impact* - To what extent does the project have or have had an impact on society. Three levels of impact;
  - Neighbourhood
  - City
  - National
- *Nr. of connections* - Refers to number of connecting forces from the force field analysis.*

* *This is subjective and varies depends on directness of the connections. Both authors made an attempt to connect forces and the mean value for each project is given here.*

Total score for each practice was counted by summing the sub scores for each category according to the following criteria:

Level of implementation: In progress = 0, 100% = 1
Integration with city planning: no=0, yes=1
Impact: Neighbourhood = 0, City = 1, Nation = 2
Connections to force field map: <5 = 0, 5-10 = 1, >10 = 2

Location was carefully considered, with the aim to match both the socio-economical situation, as well as the climate in Gothenburg.

8.2 Stakeholders

The stakeholder section describes the identification process for finding stakeholders, and finally a detailed list of the identified stakeholders and the extent of their involvement in the thesis.

8.2.1 Identification Process

The stakeholder identification process was split up into two parts:

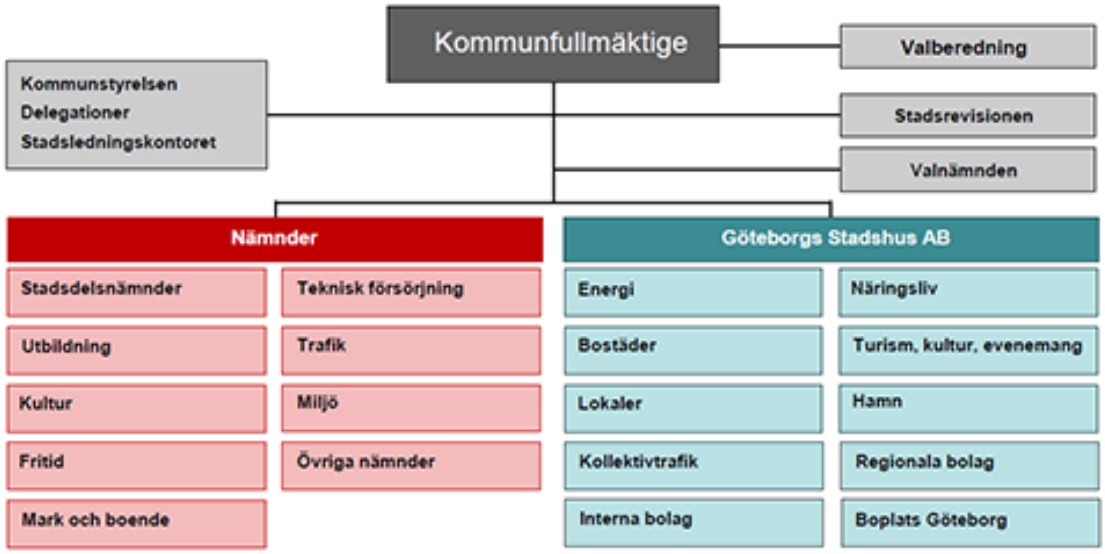
1. Identifying the key sectors and stakeholders relevant to the topic.
2. Analyzing and classifying the stakeholders according to their attributes in a power versus interest matrix, see figure 8.3.

Roloff (2008) suggests that there are two different types of stakeholder management: organization- vs issue-focused stakeholder management. The author demonstrates that the latter dominates in multi-stakeholder networks, because it enables addressing of complex problems and challenges through cooperation with stakeholders. The research question of this thesis can be understood as an issue; the potential of urban agriculture is currently underutilized in Gothenburg and not enough integrated in city planning to contribute towards local sustainable development. Only by exploring the issue together with local stakeholders may such potential be fully understood

and utilized. Therefore, the question asked during the first step of stakeholder identification is; *who can affect/is affected by an upscale of UA in Gothenburg?*

Since current city planning displays an insufficient comprehension of the potential of UA and how it at a larger scale supports increased urban sustainability in Gothenburg, the actors behind the city planning are expected to be the most important stakeholders to the research. These need to be identified and brought to the table for a dialogue. One approach to identify the actors is to familiarize with the municipality's organizational structure in order to know which collaborations are needed to successfully address the issue. Accordingly, time was spent understanding the structure through available information on the municipality's website, i.e. see figure 8.2. Established environmental goals and plans were also reviewed to identify potential key actors within the different boards of the organization, see section 7.1.

Figure 8.2: Illustration of the organizational structure of Gothenburg City (Gothenburg City, 2018). Detailed map with highlighted stakeholders is available in Appendix A.3.

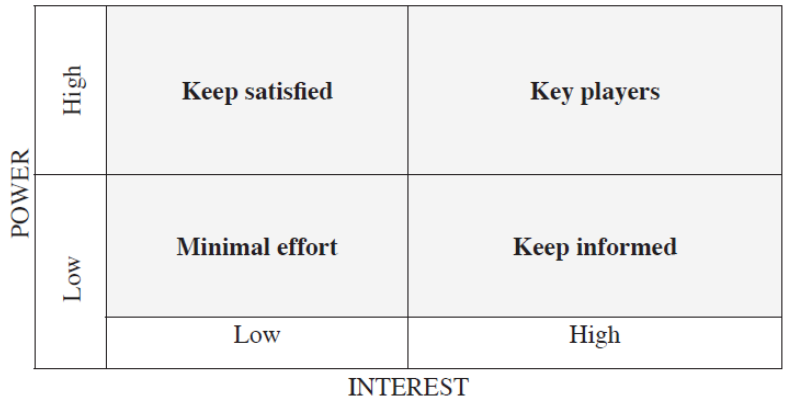


As per the Challenge Lab philosophy, in order to create transitions in a complex socio-technical system, there is need for collaborations within the triple-helix (Etzkowitz and Leydesdorff 1997). In other words, representatives from government (municipality) alone is not enough, thus the final list of stakeholders will also include representatives both from the academy and industry. These representatives were expected to appear while mapping of the ongoing initiatives and benchmarks, especially the ones based in Gothenburg (see section 7.2).

Once the list of stakeholders was created, they were mapped on the basis of the power and interest notions, according to Mendelow (1991) (see figure 8.3), and prioritized in this research accordingly. Stakeholders' power refers to their actual ability to affect the topic, while the interest refers to their desire to influence. It

should however be noted that not all stakeholders were identified through mapping of organizations and initiatives, but some appeared later in the research through recommendations from other stakeholders or when attending workshops.

Figure 8.3: Power versus interest matrix (Mendelow 1991)



8.2.2 Identified Stakeholders

The list of stakeholders grew as the research progressed, with an analysis of the organizational structure of Gothenburg acting as a springboard and subsequently, as interviews were conducted and local initiatives were mapped out this list was further extended. The final list included representatives from government, industry and academy and thus met the requirements of the triple-helix participation. The final list of stakeholders is found in table 8.1.

Stakeholder	Interview	Workshop	Summary
Politician in Fastighetsnämnden	X	X	His department is the owners of the municipality owned land in the city
Official from Fastighetskontoret	X	X	He is the project leader of Stadsnära Odling and has previously conducted studies on sustainable foods in the city.
Politician in Byggnadsnämnden	X	X	Her department is in charge of giving out building permits and designing zoning plan in the city.
Manager at Älvstranden Utveckling	X		Älvstranden Utveckling is the municipality owned company which leads and realizes 'Vision Älvstranden', Gothenburg's biggest project in modern time with 25000 new apartments and 45000 new work-spaces
Official from Miljöförvaltningen	X	X	She is in charge of designing a local food strategy, which potentially could benefit and increase the support for agriculture in the city.
Official from 'Jämlikt Göteborg'	X		Responsible for developing the social sustainability program for the city. Similar to a food strategy, the social sustainability program could directly affect the priority given to agriculture in the city. However, after initial discussions it was concluded that her department only had moderate interest in the topic and was therefore not included in the workshop.
Official from VGR	X		Works with environmental related topics in the region's development plan. Did not find the topic interesting and declined the worksop.
Official from Miljöförvaltningen	X		Responsible for driving the public sector towards a more conscious and sustainable food consumption through the program "Miljömåltider".
Manager at Framtiden AB	X	X	Framtiden is owned by the municipality and owns 72000 apartments in the city and more are currently being built.

Official from Business Region GBG AB	X	X	The non-profit company BRG is owned by the municipality and aims to help citizens establish their business ideas through coaching, networking and more. The company first managed the urban agriculture question before having it transferred to fastighetskontoret.
Kajodling	X		Urban agriculture pioneers in Sweden. Currently working on 950 m^2 in Gothenburg with most of the produce being sold to high-end restaurants.
Founder of "Leffe på Hörnet"	X	X	Pioneer in Sweden for producing compost in the city center, available to citizens interested in UA. Compost can be a crucial part for sustainable farming in the city.
Shareowner from Plantagon	X	X	Sits in the board of Plantagon AB, which aims to be the world's best developer of smart food systems for the city.
Co-founder of The Foodprint LAB		X	Their platform 'GrowGBG' matches citizens without land with private owned land available for cultivation.
Professor at Chalmers	X		She is currently doing research on sustainable food and bio-energy production.
Professor at Gothenburg University	X		She is currently doing research on human impact on urban and peri-urban ecosystem services. Her research topic is investigating the relationship between food production and sustainable development.
Previous researcher at MISTRA Urban Futures and Author of "Odling i Staden".	X		She was part of the study group 'Green production - Grow food and jobs in teh city' at MISTRA Urban Futures together with the official from Fastighetskontoret that would later lead to 'Stadsnära Odling'

Table 8.1: The final list of stakeholders and to which extent they were involved. If nothing else is stated, it is assumed their participation was limited due to schedule conflicts.

8.3 Interviews and Force Field Analysis

A total of 17 semi-structured interviews were conducted and analyzed based on the force field framework. The following sections describe the theory behind, and our process design of, the interviews and force field analysis

8.3.1 Semi-Structured Interviews

There are three interview types usually considered for qualitative research and they can be categorized as *structured, semi-structured* and *unstructured interviews* (Teijlingen 2014). For this thesis semi-structured interviews were chosen. Teijlingen (2014) explains that semi-structured interviews usually include predetermined questions, but that the order can be modified based upon the interviewer's perception of what is most appropriate to the dialogue. In addition, explanations can be given and additional questions can be included. The structure of the interviews conducted in this thesis is a result of Teijlingen (2014) design recommendations, on *planning, doing, analysing,* and *reflecting*, and is presented in section 8.3.3.

8.3.2 Force Field Analysis

The concept of force field analysis has been adapted from physical science, where vectors are used to describe the forces acting upon a system. Lewin developed the tool in the beginning of 1940's to be used within social transformation, and since then has been recognized as a mean to achieve organizational change and transitions (Lewin 1947). The idea is to change a system from a current state to a preferred future state. Lewin described four steps that ought to be taken in order to achieve change. Firstly, the current system needs to be determined, forces driving and resisting the preferred change are to be mapped out. Secondly, the necessary actions in order to change the system are to be identified, these would be related to the driving forces that could be increased or the restraining forces that could be decreased. The last two steps are to apply the changes and stabilize the new system after the transition.

In the 1980's Thomas (1985) has summarized a set of recommendations to be considered when implementing change. Firstly, it is mentioned that force field analysis is most useful and accurate when performed by a group of people. This is due to the reduction of personal biases that might occur when the analysis is performed by a single person. Secondly, the inclusion of several stakeholders spreads an understanding of the system and the change wanted. Another point made by Thomas is that the greater the change implied to be made, the greater the chance of facing opposition by the group affected. This opposition is decreased when the ones driving the change, and the ones affected by the change feel part of the same group. Stakeholder participation can be used as a technique to achieve this inclusion (Dodds and Benson 2013).

8.3.3 Interviews – The Process

Semi-structured interviews were conducted with the identified stakeholders. The main focus of the interviews was to collect information about driving and restraining forces for scaling up UA in Gothenburg. The second purpose of the interviews was to ignite a process of reflection about the topic, and thus prepare the stakeholders for the upcoming workshop – to which each of the stakeholders was invited at the end of the interview. The roles as interviewer and documenter were alternated between us, and the interview was always initiated by a presentation of Chalmers Challenge Lab and the thesis, followed by a presentation of the interviewee about her/his work. The main questions asked during the interviews were:

1. Describe your occupation and organization, is your work related to UA in some way? If not, do you have a personal relation to UA?
2. What do you see as the benefits of scaling up UA in Gothenburg?
3. What would be the driving forces for scaling up UA in Gothenburg?
4. Which conflicts could arise if UA was scaled up?
5. What is hindering UA from being scaled up?
6. Do you have any recommendations on who we should interview in our project?
7. Would you be interested in participating in a work-shop further on?

The interviews lasted from 30 minutes up to 1 hour, and the stakeholders often expressed an interest in being informed of the results further on and/or participating in the workshop. The interviews were either recorded or real time notes were taken, depending on the auditive quality of the setting.

8.4 Workshop

The last part of our interaction with the stakeholders consisted of a workshop where 10 of the previously identified stakeholders participated. The aim of the workshop was to address some of the challenges found in the force field analysis, and in a multi-stakeholder dialogue co-create recommendations of necessary actions for developing UA in Gothenburg.

8.4.1 World Café

World café is a dialogue setting that can be modified in numerous ways, depending on the purpose of the Café. Common to all World Cafés is that they are based on seven design principles that are formulated by the global movement called "World Café" (Café n.d.).
The basic idea is to have attendants gathered in small groups (4-5 per group) around a question or topic. Setting a hospitable context is important, and the aim is to bring out the inner knowledge of each participant. World Cafés usually make use of some kind of rotating scheme – where participants get to move between tables. This is done to ensure the cross-pollination of ideas among the different groups. The set-up ends with summarizing and reflecting upon the ideas and thoughts brought up during the small dialogues.

8.4.2 Multi-Stakeholder Dialogue

A multi-stakeholder dialogue brings together stakeholders around a specific issue or decision-making. As stakeholders count both people that can affect the issue as well as those that are affected by it (Hemmati 2002). The method has been recognized as particularly useful when approaching complex challenges that cannot be solved by a single actor. Multi-stakeholder dialogues has been used by high profile international institutions like the UN Commission of Sustainable Development as well as by private business corporations (Hemmati 2002). The dialogue is preferably facilitated by a professional facilitator that ensures each stakeholder is given the opportunity to raise their opinion on the issue. A multi-stakeholder dialogue aims to create trust between the stakeholders, ensure that knowledge and information is diffused and co create recommendations on how to collectively proceed on the issue (Dodds and Benson 2013).

8.4.3 Workshop – The Design

The stakeholder workshop was conducted at the Challenge Lab, with 10 stakeholders present. In addition to the stakeholders, an external facilitator as well as two documenters had been recruited to assist during the day. The aim of the workshop was to co-create recommendations for addressing some of the challenges identified during the interviews.

Check-in and Presentation

The day started off with a welcome and check-in, followed by a presentation by us students. The presentation served two purposes:

1. To give an introduction of the potential benefits of UA and some inspiring examples from around the world
2. To present results from the force field analysis and allow the stakeholders to vote for a challenge they wanted to address in the second part of the workshop

Action Café

The second part of the workshop consisted of a modified "World Cafe" setup that we named "Action Cafe". The stakeholders were divided into two groups – one for each chosen challenge. The stakeholders were then asked to individually brainstorm about the topic for a few minutes, and write down all their thoughts about three aspects of the challenge: why it should be addressed, who should be involved and how it could be done. It was important that the participants first got to form their own motivations to the question, rather than have it forced upon.
After this, the stakeholders were asked to summarize all their thoughts on a common sheet, under the topics *"why", "who"* and *"how"*.

The Dialogue

The last part of the workshop consisted of a multi-stakeholder dialogue, in which both groups were asked to join together and present their findings from the previous "Action café" with the rest. All participants were asked to write down questions. After the presentations a dialogue was opened up around each of the topics. The dialogue ended with a short summary of what had been discussed during the morning. Recommendations brought up during the dialogue were documented and summarized in the findings.

8.5 Economic Assesment

To highlight the potential economic benefits for the municipality when utilizing dead space in the city for food production, the reader is offered a simple calculation example. The calculation example is presented in section 10.3 and the assumptions that were made for the example are covered here, beginning with cultivation area and expected yield to prices and profits.

Firstly, turning non-farmland into a food production site is not an easy task and can be very capital intensive depending on the approach. The use of raised garden beds is a common and cheap practice when the access to sunlight is good. We assume this is the case in the following example. Other alternatives are hydroponics, aquaponics and vertical farms.From Vancouver's city guide to UA it is recommended that each raised bed should not be wider than 100 cm and that it is surrounded with at least 30 cm wide walk paths on each side (City of Vancouver 2013). This enables the farmer to easily move around and reach the crops. Essentially this means that when using raised beds only about 50-70% of the land can be used for farming depending on how strictly these guidelines are followed. In this case it is assumed that the farmers use 60% of the surface for growing.

Secondly, estimations on the yield and the prices the consumer is willing to pay for the produce is needed. From literature, estimates of yield from UA projects in British Columbia and San Francisco are available, but due to potentially big differences in climate this is not preferred. A more local source is needed. Consequently, after interviewing the local actors they were asked to give an estimation on the yield from tomatoes, kale and spinach per square meter of raised bed. The numbers used in this case are an average of these estimates for each vegetable. Consequently, the suggested prices from the literature were also rejected. Unfortunately, local and other actors based in Sweden were not willing to share the prices of their products. To obtain up-to-date prices that reflected consumers willingness to spend, a market scan was made. In this market scan a Stockholm-based market was identified, which mostly sells organic and locally produced products and had become very popular during the previous year, expanding its franchise with two more stores. These prices were used as a reference. One of the consulted actors was not keen on sharing precise numbers/prices but sells the produce to the aforementioned Stockholm-based market and recommended to calculate from the retail price with a 40 % marginal

(The store adds 40% on the price of the produce). However, Bernstone and Hellqvist (2007) suggest in their research that grocery stores rather only take 20% in marginal for organic food. Due to uncertainties on this subject, we use the actor's recommendation. In this example the prices from the store are calculated with a 40% marginal, and an additional 12% tax. In example: If prices for tomatoes are 100 kr then the farmer gets/sells for $100 \cdot 0,88 \cdot 0,6 = 52,8$ kr.

9
Better Practice

This section is aimed at those who wish to learn about real UA-cases from around the globe and get inspired on how to set up an agricultural project in the urban landscape, individuals as well as organizations or city planners. Going through literature and reading about the cases also supported the authors in identifying key questions for the workshop activity that was described in the methodological section of the thesis. This chapter only includes the practices that have been evaluated to be better than the rest of the practices from the literature review. The full list is found in Appendix A.2 and the process of defining better practices is presented in section 8.1. After having narrowed down the initial list of good practices to four, a deeper analysis of the *better practices* now follows.

9.1 Practice: Skip Garden, London

Skip Garden is highlighted to show that temporary interventions can leave a long-term legacy on a city, even on a small budget. Skip Garden is a successful case of tactical urbanism, turning a construction site into an educational platform owned by the local young people themselves.

King's Cross in central London is currently undergoing one of the biggest regenerations schemes in Europe and by 2020 an area of 27 hectares of industrial wasteland will be transformed into a new diverse part of the city with affordable housing, educational platform, meeting places, jobs, etc (King's Cross Central Limited Partnership 2018). While the construction took shape, the community in the area was still suffering from "insufficient linkages between youth clubs and career paths" (Kamvasinou 2017) which called for social projects to be incorporated into the regeneration plans and put into immediate effect. As a result, Skip Garden was created.

The main focus of Skip Garden is to educate young people regarding the importance of sustainability and connecting them with businesses across King's Cross (Global Generation 2018). Skip Garden received its name from the structure of the gardens, which are planted in skips donated by the construction firm on site. These are easily moved when land is sold and built on. Each skip is a teaching garden and can for example be a herb garden, an orchard garden and you will even find three skips lined up next to each other to teach the young regarding crop rotation. Skip Garden is run by a charity, Global Generation, that focuses on sustainability related education and has received support from local authorities and businesses and the owners of

the regeneration program themselves - King's Cross Central Limited Partnership, KCCLP. KCCLP is the funding organisation, partially through offering no rental costs on three-year renewable leases.

The impact of Skip Garden has been overwhelming and although it was expected to make way for new construction by 2015 latest, it is interesting to hear that Skip Garden is still in operation today in 2018. It has had an lasting impact on young people, showing them that they have a place in the business world (Kamvasinou 2017). Not only young people like to visit this garden, the demand from the public has driven Skip Garden to have it's café open on specific weekdays. Many of the ingredients come directly from the skips, and on the first Saturday of every month they open up the whole garden for everyone. All this whilst working with a little budget and successfully maintaining a healthy relationship with stakeholders throughout the project.

Coincidentally, in the beginning of June 2018, Jernhuset opened 'Jubileumsplatsen', a temporary movable meeting place in the center of Gothenburg, by the central station. The idea behind Jubileumsplatsen comes, according to Jernhuset, from Skip Garden with containers instead of skips that will be moved around as the building site develops.

9.2 Practice: Parisculteurs, Paris

This practice is highlighted because of the top-down approach the city of Paris has chosen to scale up UA, harvesting success since it begun back in 2014. Parisculteurs is becoming an innovative model that many cities, interested in increasing their own amount of green space and food production, already have begun to study (Wong K 2018).

It all began when Anne Hidalog was elected new mayor of Paris with the promise to improve the city's green spaces and by 2016, the Paris government responded to her call and launched Parisculteurs, a project which aims to create 100 ha of new vegetation in the city, mainly by covering unused rooftops and walls. A third of those 100 ha are allocated for production of food. During 2018, season 2 (10 ha) of Parisculteurs is expected to be auctioned out and the results from the first season (15 ha) are already in the books – 500 tons of fruits and vegetables, 100 kg of honey, and 3 ton of fish are expected to be produced per year and has led to 119 new employments, which for 50 of the new employees meant social inclusion for the first time in years[1].

Parisculteurs is set up by the government of Paris and has city officials that solely work with it. Their working tasks include the identification of spaces in the city that could potentially be vegetative, and matching them with projects that can contribute to that. In the beginning of each year there is a call for projects, where

[1]Data obtained from personal phone interview with project leader of Parisculteurs

spaces available are advertised and those interested are offered to visit the location. After project submission deadline, an appointed jury decide which projects to award with a contract. Parisculteurs wants to promote UA and attract people interested in pursuing a career in UA. With this purpose, it offers to handle all the administrative work with the owner of the space. They negotiate and can offer leasing contracts from 3 to 12 years to a relatively low fee, between 0.2 to 1 euro per square meter and month, depending on business model and if the owner is private or public. With 75 projects currently approved and more to be given the green light by the end of May 2018, we learn from this practice what the support of a city towards UA can lead to. This practice is highlighted as an example for city planners in the dialogue to draw inspiration from when aiming at scaling up UA in Gothenburg.

9.3 Practice: What feeds us? Vancouver

This practice is highlighted because of the impact it has had on UA in Vancouver, making the city a world-leader in the field. 'What feeds us: Vancouver Food Strategy' recognizes the unexplored potential of food and how it can be fully utilized through production within the city by putting pressure on city developers to include UA in their plans. Vancouver's local food strategy is a response to the climate-related challenges and disturbing socio-economic trends across the nation, as well as a recognition of food as a catalyzer of environmental services, local economy, and community-building (City of Vancouver 2013). The strategy covers the full spectrum of urban food systems from production to processing, distribution and waste management, and is split up into 5 goals (City of Vancouver 2013 p.41):

Goal #1: Support food-friendly neighbourhoods.
Goal #2: Empower residents to take action.
Goal #3: Improve access to healthy, affordable, culturally diverse food for all residents.
Goal #4: Make food a centrepiece of Vancouver's green economy.
Goal #5: Advocate for a just and sustainable food system with partners and at all levels of government.

Some of the highlighted action plans suggested in the strategy are found in table 9.1. The role of the city according to the strategy is to support with: zoning or bylaw changes, updating land regulation policies, grant programs, public outreach, and partnership with other levels of government and community organizations.

According to the Vancouver Urban Farming Society [2], the strategy has helped them in several ways. Firstly, 'food in the city' got much media attention and brought focus to the topic, which resulted in community engagement. Secondly, the city released funding for projects related to the food strategy that led to several new projects in the city. Lastly, and most importantly, the strategy made it easier for

[2]From Skype-interview with coordinator of VUFS

1.3	Encourage community garden models which promote community development opportunities with local schools, Neighbourhood Houses, and other local organizations as part of their education programming
1.10	Create policy to enable commercial food production (urban farming) as a defined use on zoned lands with appropriate limitations and mitigation strategies.
1.12	Enable alternative food retail and distribution models for urban farming produce such as community food markets, food distribution hubs and pre-approved Community Supported Agriculture (CSA) distribution sites in locations such as community centres, neighbourhood houses and schools.
1.16	Increase the number of urban farms in Vancouver from 17 to 35 by the year 2020, ranging from backyard farms to mid-scale operations.
2.5	Measure the percentage of local and sustainable food procured by the City and make recommendations for an appropriate local and sustainable food target.
3.8	Increase the number of farmers' markets in Vancouver from nine to 22 by 2020.
5.10	Promote education and awareness about growing food in backyards, balconies, podiums, rooftops and other spaces in neighbourhoods

Table 9.1: Extracts of suggested actions in order to support goals from Vancouver Food Strategy.

the society to meet with city planners to discuss policy about UA. According to the local organization PlanH (n.d.), 11 of the action have been impleted, 19 have been started and will be ongoing projects, 26 are in progress, and only 15 are pending. The key take away from this practice is that UA can be supported and integrated into the discourse of city planning through the establishment of a local food strategy.

9.4 Practice: Zoning & Legislation, Cleveland

Cleveland, Ohio has during the last decades thoroughly revisited the city's legislations, in order to provide opportunities for UA. This practice is highlighted due to the deep legislative impact it has had in order to enhance and integrate UA in the city planning for the long run. The first legislative modification, occurring in 2007, was developing an "Urban Garden" zoning category, that would secure the existing community gardens and create a public process to transform this land into something else. According to the Cleveland code of ordinance §336.02, the urban garden district allows for the land to be used for:

(a) community gardens
(b) market gardens - implying cultivation for profit and selling
(c) greenhouses
(d) hoophouses - a round-shaped greenhouse structure
(e) coldframes - used for bringing up seedlings or protecting plants

A second modification was made in 2009 to allow for the keeping of farm animals and bees in the city. Depending of the lot size it allowed for husbandry of either chicken and bees, or for larger lots the husbandry of pigs, sheep, geese and goats. Further recommendations have also been put forward, these include the availability of a community garden on walking distance from every citizen. A program called "Gardening for Greenbacks", that provides agricultural training and access to vacant lots, has been established by the city. It is also possible for participants to apply for UA grants up to USD 5000$ (Canadian Cancer Society 2018).

The city of Cleveland has done an inventory of all available land that could potentially be used for UA. The procedure has been done by using GIS filters and the aim is to be able to preserve strategic farmland in the city and inform when such a land is being acquired (Canadian Cancer Society 2018).

10
Empirical Findings

The empirical findings are derived from the force field analysis applied on the semi-structured interviews, as well as from the recommendations co-created at the multistakeholder workshop.

10.1 Drivers and Barriers in the Current System

From the analysis of the interviews, statements by the interviewees were mapped into driving and restraining forces and the results are shown in figure 10.1. The driving and restraining forces were then grouped into five categories each.

The identified categories for the driving forces were: "Liveable City", "Social Drivers", " Strategic Drivers", "Attitudes and Awareness" and "Well-Being". The categories for the restraining forces were: "Legislative and Political Barriers", "Climate", "Structures in the City", "Attitudes and Awareness" and "Conflict of Interest" (Usefulness). The meaning of each category is explained in detail in the two following sub-sections below.

10.1.1 Drivers

The category **"Liveable City"** included the driving forces connected to the attractiveness and livability of the city. Interviewees expressed the need to create a green and sustainable city with good ecosystem services and meeting places:

"Rooftop farming fills several functions – it is important to understand that urban farming is an ecosystem-service, and that we need to plan for multiple ecosystem-services in the city" – Manager, Älvstranden Utveckling

The potential of UA to serve as a tourist attraction and encourage the so-called 'staycations' where the citizens find the attractions in their own city, was also an often-mentioned driving force:

"UA adds freedom and happiness, these are important aspects in the city. The municipality needs to enable for the citizens to live a good life in the city, you are not supposed to have to travel else to experience this" – Politician, Fastighetsnämnden

"Social Drivers" were the most frequently mentioned driving forces for scaling up UA. Here the need to make the city more socially inclusive through creation of better communities and jobs were the main drivers. It was motivated that there is a lack of cross-boundary meeting places in the city as well as jobs for the more vulnerable groups of the society.

"The mobilizing potential [in UA] is a unutilized force. Instead of going to the supermarket to buy stuff with minimal interaction, you do things together and participate in a network – this has a huge significance and power. It is also necessary to consider the transition work" – Professor at Gothenburg University

"It creates a lot of value the fact that you are outside – it is healthy and you meet different kinds of people, often across the generation boundaries" – Politician, Byggnadsnämnden

"If we had greenhouses in the city managed by the municipality, it could be an excellent way of creating jobs, especially for those that are far away from the job market today... we need a way of introducing these people back to the work life" – Politician, Fastighetsnämnden

"Strategic Drivers" consisted of driving forces that would be useful in the strategic planning of the city – both now and in the future. Forces mentioned in this group were the need to make use of residual heat in the city, and the usefulness of UA in the achievement of sustainability goals:

"We do not know what the world looks like in 30 or 50 years – it is important that we secure sufficient local food-production so that we have access to food also in the future" – Politician Byggnadsnämnden

" We make demands on social sustainability when we plan the future societies – UA is something that can generate this " – Manager, Älvstranden Utveckling

"The huge amount of residual heat [in the city] needs to be better used – if you grow on the countryside you do not have access to this heat... We could have greenhouses in the city heated by residual heat" – Politician, Fastighetsnämnden

The fourth category **"Attitudes and Awareness"** consisted of attitudes and trends driving the development of UA in Gothenburg, and the need to create increased awareness about sustainable food systems among the citizens. The pedagogical potential of UA was often highlighted during the interviews:

"Today we see an increasing interest in UA – both as a hobby, but also the commercial interest in farming that is new since a few years. This interest we need to handle in some way when we plan for the expansion of the city" – Manager, Älvstranden Utveckling

"We need to increase knowledge and understanding in order to create more sustainable food systems. In the grocery stores we don't know the story behind the food. I think cultivating by yourself increases the respect for the whole process, this is very important" – Professor at Chalmers

The last category for driving forces consisted of **"Well-being"** drivers. The inner drive for humans to reconnect with nature, as well as the health contribution that engaging with UA provides, were the most frequently mentioned drivers in this category:

"We have developed as animals in an ecosystem, as biological beings it lies in our nature to reconnect with nature and experience it close up" – Professor at Gothenburg University

"I think it is a genuine genetic interest to engage, as we always have, with nature in some way – otherwise we would not spend so much energy and time on farming and watching it grow – I do not think we feel well without this" – Professor at Chalmers

10.1.2 Barriers

The first category among barriers related to national legislation and politics and was named "Legislation & Politics". These barriers consisted of rules about employment, public procurement and food certification that were perceived to make it more difficult for the city to enhance UA. Even though this legislation could not be changed by the municipality, ways of working around it were mentioned during the interviews. The second category consisted of only one barrier, which was the climate in Gothenburg. The climate of Gothenburg was placed in its own category since it was not directly created or changeable by the city or its citizens.

The third category **"Structures in the City"** was a collection of barriers relating to either physical or organizational structures in Gothenburg. This category included issues related to physical structures such as the lack of a system to identifying UA space, lack of an in-city compost system and lack of logistic system for food produced in urban or peri-urban areas:

"The municipality might be a bit conservative and square when it comes to finding farming-space in the city, there is no active system for finding these – in reality there exists plenty of space in the city" – Politician, Byggnadsnämnden

The biggest barrier found in this category was however the limited space in the city, and the multiple interests competing over this space:

"Today there is a conflict about the space – many might find it very important to farm on a specific space while others would rather see it turned into a parking hall" – Professor at Gothenburg University

The conflicting political interests were also mentioned to affect the lack of prioritization of the matter in the discourse of urban planning:

" It is super controversial politically... everyone does not share the vision of agriculture in the city. Within different political parties the municipality's engagement in UA is valued differently" – Politician, Fastighetsnämnden

" UA has been perceived as a hobby, it is something people engage in but not so important - if a big company reclaims the land, the farming land will be sacrificed" – Politician, Fastighetsnämnden

The category **"Attitudes and Awareness"** consisted of both attitudes about food consumption and production among the citizens as well as attitudes from the building sector. The lack of knowledge about successful UA examples as well as knowledge about the benefits of UA were frequently mentioned:

"In the dense city we need to find multifunctional solutions to many things, this calls for innovative thinking – sadly today the building sector is one of the most conservative ones" – Politician, Fastighetsnämnden

The last category of barriers concerned the **"Conflict of Interests"** (and/or perceived usefulness of UA). The economic viability as well as the potential burden it can cause for the municipality were restraining forces mentioned in this category:

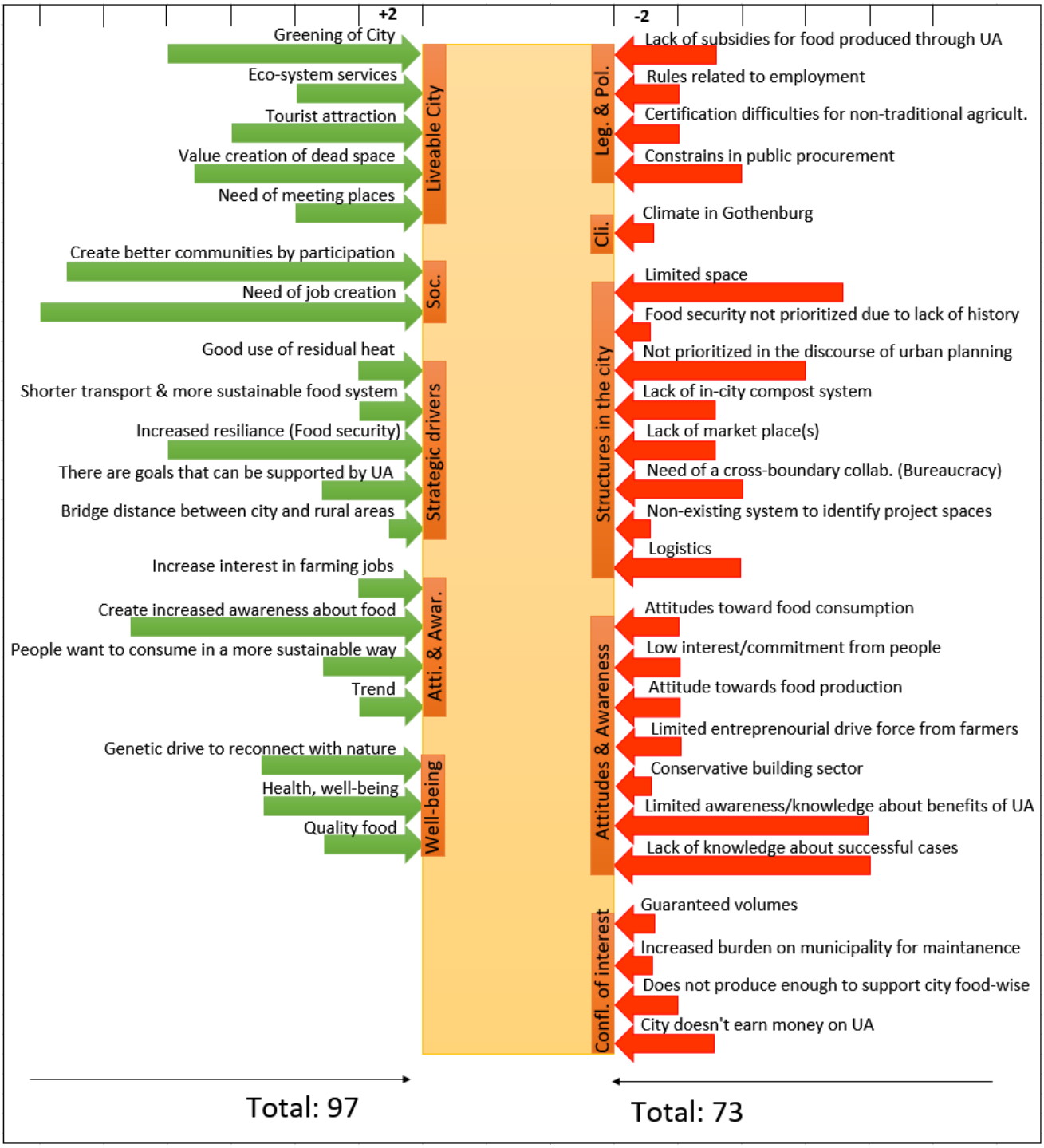
" A space used for UA does not generate as much money for the municipality as if it is sold for building properties, this is definitely a restraining factor" – Politician, Byggnadsnämnden

"Providing for example community-farms takes energy from the municipality – even if there are others doing the "farming" the municipality needs to make sure it works" – Politician Byggnadsnämnden

Within the same last category of barriers, UA was mentioned to be an insufficient source of food for the city, this was found to be a limitation of the practice:

"UA can never provide food for the whole city, although it brings a positive contribution" – Professor at Gothenburg University

Figure 10.1: The results from the force field analysis illustrated, with driving forces on the left, and restraining forces on the right.



10.2 Co-created Recommendations

Two topics were addressed during the workshop. The first topic, "How to create space for UA in the city", was intended to address one of the biggest barriers -

'Limited space' and the other, "UA in the local food strategy", was proposed as a possible solution to the problematic prioritizing in urban planning. The latter was proposed partly because one of the stakeholders, the official from Miljöförvaltningen, was already working on the local food strategy but also because of the better practice in Vancouver, see section 9, that had inspired us. The results from each group's papers in the 'Action Café' are found in Appendix A.4.

The dialogue resulted in 12 recommendations, co-created by the stakeholders themselves. The recommendations are summarized and categorized into 5 concrete actions that are presented in figure 10.2. The dialogue was concluded with a promise from the head of Fastighetsnämnden, who stated that the process for the fifth recommendation would begin before the summer.

Figure 10.2: The recommendations from the workshop were summarized into 5 concrete actions, presented in the figure below.

Recommendation #1

36 month-long projects, that are common length for short projects in the municipality should be eliminated for urban agriculture and instead integrated into longer projects/strategies. One way could be by educating officials about the benefits of UA and how it can be used to achieve the environmental goals in the city.

Recommendation #2

In Sweden there exists 'grönytefaktorn' which is a key number that city planners must work with to guarantee the citizens closeness to nature. Something similar should exist for food production, especially for new neighbourhoods, a task for all city planners to look further into. A pre-study is recommended to set up and estimate how much food can be produced in the city, and the numbers can be used to increase credibility for the resilience program. Miljöförvaltningen was proposed to conduct such a study.

Recommendation #3

Fastighetsnämnden, lokalnämnden, park- och naturnämnden should develop together a program to identify spaces in the city that could be made available for food production or other gardening project. Consequently, a group should be set up to facilitate the spaces to the new urban farmers, much like Parisculteurs, see better practices. Byggnadsnämnden should also make it easier for UA projects to obtain (if not exempt it from) complementary building permits i.e. when wanting to build a greenhouse on the roof.

Recommendation #4

A local food strategy possesses a big potential to support many of the driving forces and counteract on several of the restraining forces from the force field analysis. It is welcomed by fastighetskontoret as it could support their already going initative 'Stadsnära Odling' as well, if formulated in a way that supports increased food resilience in Gothenburg. It should however not be limited to increased food production only but also support social activities such as farmers market and the educational potential of growing in the city.

Recommendation #5

By the end of the workshop it was found that the forces and interest to drive the upscale of UA are present in each relevant stakeholder. However, due to the current way of working in silos this is not effectively taken advantage on. In a response to this, Fastighetsnämnden promised the establishment of a thinktank before the summer. This thinktank will work further with the four previous recommendations but will also act as an important learning platform for the municipality. Hopes are that this thinktank can explore new ways of collaborations for politicians and officials from different institutes, to sit together and discuss city planning with input from industry and academia.

10.3 Economic assessment of potential UA project in Gothenburg

Finally, as numbers of the economic benefits is limited in previous research an attempt was made to estimate the economic contribution when establishing UA projects for commercial use in Gothenburg. The results, presented in figure 10.3, were made available for participating stakeholders after the workshop to start discussions within their departments and political parties. The results will not be evaluated further in this report but is included for same reason - to spark up a discussion.

Figure 10.3: An calculation example of the economic benefit when utilizing dead space in the city. Detailed calculations are given in section 8.5

Small calculation example

Two urban farmers in Gothenburg have been given permit to turn a 1000 m² parking lot into a food producing new space in the city. They will grow tomatoes, kale and spinach on their raised beds. How much do they profit each season and what would the economic contribution of their new service be to Gothenburg according if they sell: A) At the gate, B) To a store? We assume initial investments are already paid.

Detailed explanation of calculations, assumptions etc. is found in methodology.

Produce	Yield [kg/sqm]	Yields/ season	Price [kr/kg] Scenario A	Price [kr/kg] Scenario B	Area [sqm]	Income Scenario A	Income Scenario B
Tomatoes	12	1	52,8	100	200	126720	240000
Kale	5	2	68,64	130	200	137280	260000
Spinach	1	4	131,472	249	200	105177,6	199200
					Total:	369177,6	699200

Depending on the value of the economic multiplier (see section about economic multiplier):

Economic multiplier	Total contribution Scenario A	Total contribution Scenario B
1,5	553766,4	1048800
1,7	627601,92	1188640
1,9	701437,44	1328480

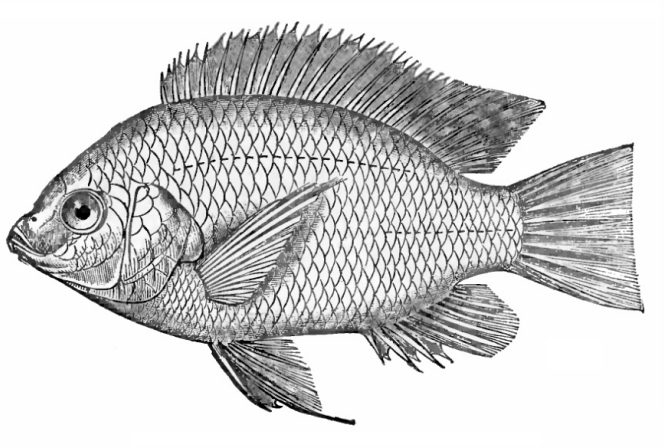
If sold at the gate, the total economic benefit for the city could be a bit over 700.000 SEK, or if sold to store it could be as high as 1,3 million SEK. The two farmers could take out monthly wage of around 12.000 SEK

11

Case Study: Urban Agriculture for Health – Exploring the Potential of Aquaponic Fish as a Biomedical Device

Recent research has shown that skin from the nile tilapia *(Oreochromis niloticus)*, figure 11.1, has a potential medical value as it can be used as a xenograft dressing for treating burn wounds (Lima Junior and Piccolo 2017). The novel method is currently undergoing clinical trials in Brazil. Tilapia skin could potentially be a cheap and sustainable wound dressing alternative for second and third degree burns, but the benefits of using locally produced tilapia skin for treating burn wounds in Gothenburg is currently unknown. Establishing a urban symbiosis, where residual waste from aquaponic farms could be used for medical applications, would further enhance the importance of urban agriculture in the city.

Figure 11.1: The nile tilapia *(Oreochromis niloticus)*, By W H Flower [Public domain], via Wikimedia Commons

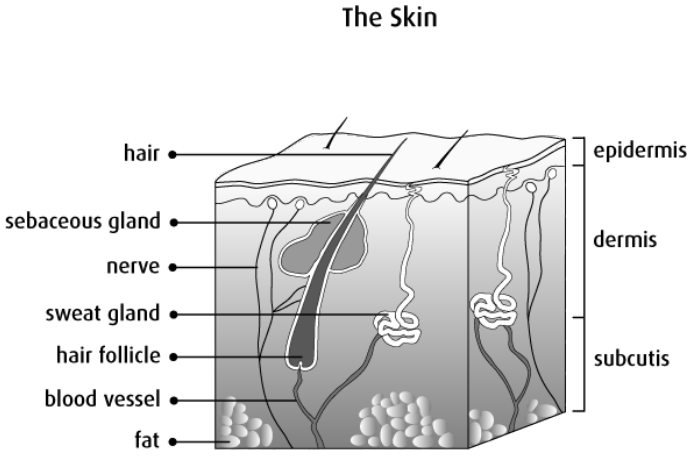


This case study aims to give an overview about existing burn treatment alternatives and review the current literature about tilapia skin as a biomedical devise. Finally, a mapping of stakeholders and clarification of the necessary steps for getting a new medical devise approved will be presented.

11.1 The Skin, Wound Healing and Burn Injuries

The skin is the largest organ of the human body with an area of 1.5-2 m^2 and a thickness of 1.2-1.5 mm. The organ is most often divided into three layers; epidermis, dermis and hypodermis (also called subcutis or subcutaneous tissue), originating from two different embryonic layers (figure 11.2). The epidermis is derived from the ectoderm layer and the dermis and hypodermis is derived from the mesoderm layer. The outermost layer, epidermis, is waterproof and has the function of protecting the body from external pathogens. Epidermis consists mainly of keratinocytes produced in the basal lamina; a layer of adult stem cells separating the epidermis and dermis. The second layer, dermis, contains nerve endings, sweat glands and blood vessels, thus giving the skin its sensory properties and enabling homeostasis of the body. Fibroblasts, producing the extracellular matrix (ECM) rich in collagen type I, are the most prevalent cells found in the dermis. The dermis is much thicker than the epidermis and constitutes 95% of the skin. Under the dermis the so called hypodermis is found. The hypodermis contains adipose tissue and loose connective tissue attaching the skin to underlying structures (Seyhan 2011).

Figure 11.2: Layers of the skin (Canadian Cancer Society 2018)



Wound healing is a complex cascade of events typically divided into four stages: haemostasis, inflammation, proliferation and remodelling. The first phase of wound healing, called haemostasis, occurs immediately after the injury and lasts up to a few hours. The purpose of haemostasis is blocking the blood flow by coagulation and initiating the wound healing cascade. Haemostasis occurs by platelets adhering to the broken blood vessels, releasing epinephrin that causes blood vessel contraction and cytokines that trigger the aggregation of platelets. The enzyme thrombin initiates the formation of a fibrin fibers which form a mesh, stabilizes the platelets and blocks blood flow. The platelets secrete platelet-derived growth factor (PDGF), that causes neutrophils and macrophagues to migrate towards the wound by the mechanism of chemotaxis (Bielefeld, Amini-Nik, and Alman 2013).

The second phase of wound healing is called the inflammatory phase, and aims at

preparing the wound for new tissue formation by the removal of bacteria and dead tissue. Neutrophils first enter the wound removing bacteria and debriding dead tissue, followed by macrophages that further phagocytose bacteria and dead cells, but also secrete growth factor TGF-b, that attracts fibroblasts and epithelial cells to the wound site. The wound is characterized by swelling and redness during the inflammatory phase. The inflammatory phase ends after a few days days and the wound enters the proliferation phase, with the aim to fill the wound with granulation tissue and cover the wound with layers of new epithelial cells. Fibroblasts secrete ECM components as collagen, glycoproteins and proteoglycans, that fill up the wound. Angiogenesis and wound contraction occurs while keratinocytes migrate, proliferate and differentiate in order to close the wound by forming new epidermis. Remodelling is the last phase of wound healing and further strengthens the ECM structures by organizing collagen into bundles. Immature components of ECM are removed and scar formation and wound contraction occurs (Bielefeld, Amini-Nik, and Alman 2013).

Burn injuries are classified into three levels of severity, depending on which skin layers that have been affected. First-degree burn injuries have only affected the epidermis, and treatment is usually simple. Second degree injuries have affected both the epidermis and dermis, and can be divided into superficial second degree injuries or deep second degree injuries, depending on how much of the dermis that has been injured. Third degree burn injuries have destroyed all layers of the skin, reaching the underlying subcutaneous tissue. Deep second degree injuries and third degree injuries typically need some sort of skin transplantation, since the dermis is too injured for regenerating (Sowa 2006).

11.2 Burn Treatment Alternatives

In the following sections a summary of current burn treatment alternatives, including skin grafts and tissue-engineered options are presented.

11.2.1 Skin Grafts: Autografts, Allografts and Xenografts

The "golden standard" for treating second and third degree burn injuries is by performing so called split-thickness skin grafting, where skin containing the epidermis and part of the dermis, is transplanted from a donor site to the injured site (Seyhan 2011).

In the case of autografts, the skin is collected from another part of the same body as it is to be transplanted to. The advantage with autografts is that the transplanted skin adheres and integrates to the transplantation site, since the graft has immunological compatibility, and is therefore not rejected by the immune system. Immunological compatibility is defined by the matching of cell surface proteins; human leukocyte antigens (HLAs) (Rezaei 2017). The disadvantage with autografts is that in case of an extensive burn injury, covering more than 30% of the body surface, there is a lack of healthy donor skin and the procedure might not be possible

to perform (Seyhan 2011). Skin grafts also leave a wound at the donor site, that is often described by the patients to be even more painful than the original injury. By meshing or micro-grafting the donor skin into smaller pieces, an expansion ratio of the transplanted skin can be achieved and thus a smaller donor site is required. Meshing or micro-grafting allows keratinocytes to migrate from the grafts edges and cover the wound with new skin (Seyhan 2011).

Allografts can be used if there is not enough healthy skin on the patient for performing autografts. Allografts implies skin donated from another human or human-cadaver. In many places of the world, donor skin is stored in so called skin banks, where they can be kept viable for up to 2 years by rapid freezing with cryoprotectants, that reduces the cell damage (Traaholt and Eskelang 1980).
The allograft serves as a temporary wound dressing and will usually be rejected by the immune system after a week or two. At this point the allograft needs to be changed, or replaced with an autograft (Seyhan 2011). Skin grafts obtained from another animal, usually porcine, are referred to as xenografts. The xenograft is decellularized before transplantation, thus only the extracellular protein structure remains. The advantage with xenografts is that they are cheaper and easier to obtain. As with allografts, the xenograft serves only as a temporary coverage that needs to be changed before it is immunorejected (Mahdavi-Mazdeh 2013).

The purpose of using allografts or xenografts as temporary biological dressings is that they protect the wound both from external pathogens as well as protein and water loss. Simultaneously allografts and xenografts allows for pain relief of the wound and the formation of granulation tissue on the wound bed, which is needed in order to be able to perform autografts further on. Allografts are generally preferred before xenografts, since they are considered more efficient and may sometimes be used for longer periods of time before being rejected by the immune system. At some occasions allografts can act as a long term cover if the HLA identity is matched between the donor and recipient (Rezaei 2017).

11.2.2 Tissue-engineered and Synthetic Options

A number of tissue-engineered options for covering burn injuries have been emerging during the last decades. Tissue engineered skin substitutes typically contain cultured cells on a biocompatible matrix. A review of a number of tissue-engineered skin options can be found in table 11.1 where a summary of the benefits and drawbacks are displayed. Some of the most commonly mentioned advantages with tissue-engineered options is the possibility to use autologous cultured cells for constructing the skin substitute, which means that the substitute will have immunologic compatibility. An expansion ratio can be obtained by first culturing the cells from a biopsy *in vitro*, and thus a smaller donor site is required.

An often mentioned drawback with tissue-engineered treatment options is their high cost, due to the use of relatively new and complex technologies. Another drawback is the time required for culturing the cells and creating the substitute – it might take

weeks before the substitute is ready to be transplanted to the patient and during this time the wound needs to be covered with a allograft or xenoraft which constitutes a disease transmission and infection risk (Horst et al. 2018) A third limitation is the challenge to replicate the complexity of real skin. Skin substitutes are usually made from one or two cell types, keratinocytes and/or fibroblasts and a avascular matrix, whereas the structure of the human skin is more complex both in the cell, matrix and growth factor composition. The recent development of 3D bioprinting has allowed for creation of more complex skin substitutes, but one of the most critical challenges yet to overcome when creating 3D cellularized skin substitutes is how to vascularize these (Vijayavenkataraman, Lu, and Fuh 2016).

List of Tissue-engineered Treatments		
Treatment Name	Benefits	Drawbacks
Keratinocyte Culture (Horst et al. 2018)	High expansion ratio, can be used for second degree burns	Long culturing time (3 weeks), expensive, replaces only epidermis, poor cell adhesion
Tissue Engineering-Bilayered Substitutes (Atiyeh, Gunn, and Hayek 2005)	Replaces both dermis and epidermis, includes scaffold that makes it easier to handle, better aesthetic result	Expensive, long culturing time
Dermal Substitutes (Yoshimitsu et al. 2001)	Cheaper, promotes wound healing, possible to use allogenic fibroblasts that reduce culturing time	Less elasticity compared to allografts
3D-printing with Bioink (Vijayavenkataraman, Lu, and Fuh 2016)	Possibility to create complex 3D structures of cells and matrix that mimic real skin to a greater extent	Expensive, can not print vascular structures to be used *in vivo* yet
Skin Spray (Horst et al. 2018)	High expansion ratio, shorter culturing time (2 weeks), improved adherence to wound bed, possibility to use non-cultured cell sprays	Replaces only epidermis, can not be used for full-thickness burns, challenges with cell viability

Table 11.1: List of tissue-engineered skin substitutes including benefits and drawbacks

11.3 Tilapia as Biological Wound Dressing

Porcine skin is not the only xenograft that has been used as a biological wound dressing. In fact a number of both mammalian as well as aquatic animal xenografts have been recorded. Both frog and fish skin has for a long time been of interest as xenograft alternatives, the first recorded document of using frog xenografts is from 1890's (Sarto Piccolo 2008). Frequently mentioned advantages with fish and frog skin are their cheapness, availability and ease to use. These alternatives have for decades been used in Brazil as burn-wound coverage on patients (Sarto Piccolo 2008). More recently, decellularized fish-skin from the atlantic cod *(Gadus Morhua)* has been used for treating chronic wounds in Iceland. Cod skin has been found to be rich in Collagen type I, promote angiogenesis and enable cellular growth (Magnusson 2015). The xenograft adheres to the wound through fibrin bindings between the extracellular matrices (Magnusson 2015). Hence it is no news that aquatic non-mammalian skin is of interest as a biological dressing in wound treatment.

The nile tilapia *(Oreochromis Niloticas)*, has for years been of interest for its medical properties. Collagen type I extracted from the tilapia, has in several reports been mentioned as an interesting biomaterial to be used in regenerative medicine (Yamamoto 2014; Zhou 2016; Sugiura et al. 2009). Marine collagen has been of particular interest due to its antibacterial, antioxidant and neuroprotective properties (Hu 2017). In addition, marine collagen has lower infectious disease transmission risk and ethical/religious advantage compared to bovine or porcine collagen (Tang 2015). Collagen derived from the tropical tilapia has showed to have higher denaturation temperatures, compared to fish collagen derived from cold-water fish, an advantage when wanting to use it as a biomaterial for the human body (Yamamoto 2014). This has made tilapia collagen a particularly interesting candidate for replacing bovine collagen as a biomedical material. More recent *in vivo* studies have shown tilapia derived collagen peptides to have enhanced wound healing properties that might be of interest when treating burn injuries. The collagen peptides have shown to positively impact the proliferation of keratinocytes, dedifferentiation of epidermis, and closure of the wound (Zhou 2016). This is believed to be due to aminoacid residues found among the collagen peptides. Since tilapia collagen can be derived from fish waste as bones, scales and skin, it is considered a cost-efficient and environmental friendly option to current chemical alternatives (Yamamoto 2014).

The use of sterilized tilapia skin as a burn wound xenograft dressing, is currently undergoing clinical trials in Brazil (figure 11.3). Tilapia skin as a novel, unconventional, dressing option has gained international media attention where the patients are described to "resemble creatures from a science fiction movie" (Whitaker and P. Garcia 2017). The brazilian researcher, Odorico de Morais at Cera University, reports tilapia skin being 75% cheaper than sulfadiazine cream, currently used to cover burn wounds to prevent infection during the healing process. It has also been found that the novel method shortens hospital stays and reduces the need for pain medication (Whitaker and P. Garcia 2017). Brazil does not have a sufficient skin bank, with the existing one only covering 1% of the country's demand, importing

skin or xenografts is seen as too expensive and locally produced tilapia is therefore seen as a promising option for covering second degree burn injuries until they heal or get an autograft transplantation (Sussman 2017).

Figure 11.3: Child with burn injuries is being covered by tilapia skin at the Dr. Jose Frota Institute in Fortaleza, Brazil [photo source : REUTERS/-Paulo Whitaker]

The clinical trials in Brazil were proceeded by three pre-clinical studies. The first study determined the micro-flora of the tilapia skin and screened for pathogens. It was found that commercially raised tilapia in Ceara, Brazil, had non infectious levels of bacteria in their microflora (Lima 2016). A second study characterized the properties of tilapia skin and compared it with human skin. It was found that the skin had favourable tensiometric properties and similar microscopic collagen fiber structure as the human skin. In addition it was found that tilapia skin contained a higher percentage of collagen type I, which could be a favourable characteristic for a biological wound dressing (Alvez 2015). The third study was an *in vivo* rat study, examining the effect of tilapia skin as a burn-wound dressing in second degree, and full-thickness burns. It was concluded that tilapia skin dressings interfered positively with the healing process without causing significant changes in heamatological values (Lima Junior and Piccolo 2017).

The process for preparing tialapia skin, in order to be used as a biological wound dressing, has previously been studied (Alves et al. 2018). Tilapia skin was removed, descaled and cut into 5x10 cm large pieces. The skin was then submitted to two different sterilization methods, one chemical, consisting of chlorhexidin and glycerol baths, followed by radiosterilization, where the skin was submitted to radiation intensities ranging from 25 to 50 kGy. Tensiometric properties, microbiological and collagen content was evaluated after each sterilization step. It was found that chlorhexidin and glycerol baths in combination with 25-30 kGy radiation caused minimal tensiometric and collagen content changes, while destroying potential microbes.

11.4 Local Context – Prevalence and Cost of Burn Injuries in Sweden

Every year approximately 20 000 people in Sweden obtain a burn injury that requires contact with the health care. About 1500 of the cases are so severe that they require hospitalization, which also constitutes the largest source of societal cost within burn treatment. It is estimated that 11 million SEK is required to treat the hospitalized burn patients each year, compared to 4.9 million SEK for the ones treated in open care (NCO 2008).

Severe burn injuries in Sweden are treated either at the Academic Hospital in Uppsala or the Hospital in Linköping, that have specialized burn units (Socialstyrelsen 2015). Uppsala and Linköping as well as Solna and Lund have today a permit to store skin allografts for tissue transplantation (IVO 2018), and Vävnadsinrättningen (the Tissue Establishment) in Uppsala have a national assignation to establish a skin bank. The aim of the skin bank is that Sweden would be self-sufficient on allografts, as Swedish hospitals previously have relied on imported skin from the Euroskin Bank/Euro Tissue Bank in Holland (Sjukhuset 2013).

The Academic hospital in Uppsala reports that 30-40% of the patients that require specialized treatment are dependent on skin allografts for survival. This means that a total of 130 000 cm^2 of allograft skin is used each year for treating burn injuries only at the Academic Hospital. The cost of imported allograft skin is 12kr/cm2, which would mean that imported allograft skin constitutes a large part of the hospitalized burn treatment expenditures in Sweden. Due to budget restrictions, allografts are currently only used to treat severe burn injuries in Sweden and pig skin is used for less severe injuries (Sjukhuset 2013).

11.5 Steps of Action for Introducing a New Biological Dressing in Sweden

The process leading up to the approval of a new biomedical device is extensive and expensive. Therefor it is crucial to confirm that the new product will solve an existing need. According to Tolkoff and Anders (2013) a product that solves an existing need should fill some of the following criteria:

- Provide decreased mortality rates in a patient group
- Be significantly cheaper than available treatment options for the same patient group
- Improve the outcome compared to an existing treatment or provide decrease sideffects compared to available treatments
- Enable an earlier diagnostic of a treatment that leads to significantly improved outcome

The necessary steps for developing an idea into a finished product are visualized in

the flowchart of figure 11.4. Pre-clinical studies and animal studies are performed prior to clinical studies. In Sweden all animal studies need to be approved by Etikprövningsnämnden (The ethical board) (Kliniska Studier Sverige 2018),

Figure 11.4: Steps of action for developing a medical device. Pre-clinical studies proceed clinical trials, after which a regulatory approval and CE-marking can be obtained.

and clinical trials of new medical devices need to be approved by Läkemedelsverket (Swedish Medical Products Agency). Clinical trials are needed when the necessary data that would confirm the safety of a new medical device can not be obtained through other means, as for example existing literature and previous studies (Läkemedelsverket 2014b). The clinical data is necessary in order to get the new medical devise approved and CE-marked, so that it can be sold on the market. CE-marking is a confirmation of that the new device conforms to EU law and can thus be sold anywhere in EES (Läkemedelsverket 2014a). If tilapia skin would be taken from aquaponic farms and used in the hospital on burn patients, a company that obtains, processes, sterilizes, packages and sells the skin as medical device/skin substitute would need to be established. This company would need to obtain the CE mark first, and do all of the testing and development described.

11.6 Identification of Stakeholders

During the literature studies a number of stakeholders for introducing tilapia derived products as a biological dressing were identified. The stakeholders, and a clarification of their relation to the case study are stated in figure 11.5. A next step in the research would be to proceed with interviewing the identified stakeholders. Due to time limitations, this was not possible to include in the case study. Though initial conversations with Stadsjord, SkinResQU and Sahlgrenska Hospital have been done, confirming that there is a local interest in the topic.

11.7 Discussion and Conclusion

Although studies have shown potential of using tilapia skin as a biological burn wound dressing in Brazil, the amount of research on the topic is still limited. The benefits of using tilapia skin, or tilapia derived collagen, as a biological dressing are the same as have been pointed out with other fish or marine derived biological wound dressings. Compared to mammalian derived dressings, these have a lower

Figure 11.5: Identified stakeholders for introducing tilapia derived products to the market in Gothenburg.

Stakeholder	Relation
Sahlgrenska Hospital	The local hospital of Gothenburg
SkinResQU	Center for skin research in Gothenburg, an interdisciplinary constellation
Läkemedelsverket	The institution granting clinical trials in Sweden
Stadsjord	Local aquaponic farm in Gothenburg, breeding tilapia fish
Sahlgrenska Science Park	Enhances life science development in west Sweden
Burn Camp	Burn Camp is a yearly event organized by Karolinska hospital, would be a possibility to get in contact with burn patients
Veterinary Clinics	Could be of potential interest to use tilapia skin for treating animal injuries in Sweden
Academic Hospital of Uppsala	Has a specialized burn unit and ongoing research
Linköping Hospital	Has a specialized burn unit and ongoing research

risk of disease transmission, an ethical advantage, and presumably a lower cost. The advantage with finding a cheaper wound dressing option in Sweden is not to be underestimated, since it was stated that allograft dressings are not offered for all type of injuries in Sweden due to economic restrictions (see section 11.4). However, there exist ambitions of establishing a self-sufficient national skin bank, that would reduce the costs of using allografts. Several studies have pointed out that allografts are superior to xenaograft alternatives, and if HLA matched, they can even serve as a long term cover. Hence it is far from obvious that there would be a need for a new xenograft dressing in Sweden. Conducting qualitative interviews with the stakeholders identified in section 11.6 would be a next step to consider for taking this work further.

An area that could be further looked into is using tilapia skin as a biological dressing within veterinary care, as has been tried in California where a bear and a cougar got their injuries treated with tilapia skin (Zachos 2018). Since the bandage breaks down biologically, there is not the risk of it blocking the intestines of the animal if ingested, in addition it does not need to be changed as frequently as some other synthetic dressings.

It is to be pointed out, that the control groups used in the *in vivo* study in Brazil were treated with silver sulfadiazine or saltwater, which would not be the standard for treating burn wounds in Sweden. It would be interesting to see how tilapia skin dressings would perform in a comparative study with standard treatment alternatives in Sweden. More research should also be done on the wound healing properties

of tilapia derived collagen peptides. The previously mentioned study concluded that tilapia derived collagen peptides enhanced the rate of wound closure, but the underlying biochemical mechanism had not been identified. Finding a cheap, biocompatible, non-mammalian collagen source would be of interest since collagen is one of the most widely used materials within tissue engineering, but current mammalian collagen sources posses ethical and religious challenges as well as disease transmission risks (Yamada et al. 2014). Marine collagen, and especially tilapia collagen with its high denaturation temperature could be a candidate for replacing mammalian collagen.

The potential benefits of using tilapia skin as a wound dressing is intriguing, though the need for a new wound dressing in Sweden should be further investigated. The potential of using tilapia skin as a wound dressing in parts of the world that lack access to skin-banks might be a more relevant application to consider. Using tilapia waste as a collagen source for wound care or within regenerative medicine might be of higher relevance for the local context in Sweden, than the use of tilapia skin as a wound dressing. More research should be done both on the properties of tilapia derived products, as well as on the need for a new wound dressing or collagen source in Gothenburg, and Sweden.

12
Discussion

The aim of this thesis was to explore how UA could be further developed in Gothenburg and thus contribute to a sustainable development, by addressing the specific objectives:

- Highlight the potential benefits of UA from previous literature and explain why an upscale is relevant for the municipality.
- Map out the current forces acting upon an upscaling of UA in Gothenburg
- In a multi-stakeholder dialogue co-create recommended actions for further developing UA in Gothenburg
- Explore the synergic potential between local aquaponic farmers and health care.

Relevant knowledge for addressing the first objective, "Explain why an upscale of UA is relevant for the municipality by highlighting the potential benefits of UA from previous literature", was obtained through an analysis of the state-of-the-art on the topic and displayed in chapter 6. Previous research has shown that UA practice can contribute to multiple aspects of sustainability. The practice has been studied to see how it can contribute to the four dimensions of sustainable development, see section 3.2 and the practice has been found to have multiple positive impacts on ecosystem services, local economy as well as community development and health in general (see section **??**). Several of the Gothenburg's development goals, both environmental and social, can be linked to the benefits of UA practice (see section 7.1). In addition, UA can be implemented on dead spaces while creating multiple values for the city, and is thus to be considered particularly interesting for city planning.

Specific benefits that ought to be highlighted considering the local context in Gothenburg from the analysis are:

- Contribute to food security and resilience, which is currently very low in Gothenburg and Sweden in general. Sweden counts heavily on food import as a mean to feed its inhabitants, as stated in the introduction (1.1).
- Create ecosystem services in a dense city. Considering the currently ongoing densification ambitions in Gothenburg, it is critical for the city to find a way of providing ecosystem services in order to stick to the environmental goals (Göteborgs Stad 2018a) and still meet the demands on 'grönytefaktor' (Göteborgs Stad 2014).
- Be used in a pedagogical setting, both as an educational tool in teaching multi-

ple subjects, as well as a mean to increase awareness about the environmental impact of the food chain. Considering that the Swedes biggest contribution to GHG emissions and desertification comes through import of food, teaching how food is produced and how the global food system functions could increase awareness and change preferences towards more sustainable alternatives. This is especially relevant, as the city of Gothenburg pursues the goal of decreasing the environmental impact of food consumed in the city (M. Olsson, Vårt Göteborg 2018).

- Creation of cross-boundary meeting places. Gothenburg is struggling to reduce the ongoing social segregation in the city (Stadsutveckling Göteborg n.d.). UA is a practice that can bring together people from different cultural, socio-economical and generational groups, and could thus be used further to create cross-boundary meeting places. A relevant practice to emulate would be the "Skip Garden" in London, see section 9.1.

The second objective, "Map out the current forces acting upon an upscaling of UA in Gothenburg", was addressed by performing semi-structured interviews with identified stakeholders, and analysing the results according to the "force field analysis" described in section 8.3. Most of the forces driving an upscaling of UA in Gothenburg can be related to benefits of UA found in the literature. Examples of these are the need to create jobs, the need to create a higher food-security and increase the awareness about food.

Among the driving forces highlighted by the two interviewed researchers was the "Genetic drive to reconnect with nature". We find this driving force particularly interesting, considering the ongoing urbanization trend where people move away from rural areas with a more obvious connection to nature and farming, and that future generations are expected to live their lives in an urban landscape. This may indicate the importance of considering UA when planning for sustainable cities where people should be able to satisfy their inner needs and experience well-being.

A second driving force that must be given particular attention is the need to make use of the residual heat in the city. The potential to use the residual heat for warming of greenhouses or aquaponic-farms in the city, was emphasized by a few of the interviewees. It would be of interest to look for benchmarks and practices and investigate the potential of making use of residual heat further. It was equally emphasized that dead spaces in the city need to be utilized, and there is a big potential to combine these two, as seen in real life examples today i.e. green roofs and aquaponic farmers in basements.

Some of the forces restraining upscaling of UA in Gothenburg are related to national (or EU) legislation, and thus difficult to change on a regional level. However, it was indicated during the interviews, that ways of working around these are being tried, both in Gothenburg and other parts of the country. "Constraints in public procurement" is an example of this, where the municipality of Tingsryd (Tingsryd Kommun 2018) could be a potential benchmark to consider through community-supported

agriculture as explained in section 6.5. When the city is the producer of the food, the constraints in public procurement are apparently different. The barrier "Certification difficulties for non-traditional agriculture" is another legislative barrier that can be addressed by creative minds, as seen in Lyon, where the city has its own local label on products and services, guiding consumer to a more sustainable choice (see Appendix A.2).

The "Lack of an in-city compost system" was a barrier primarily mentioned by urban farmers. It is relevant to remind that a local compost model has for decades been developed by "Leffe på Hörnet", in the district of "Majorna" (see section 7.2.0.2). It would be interesting to explore if this model could be expanded to cover other parts of the city as well. Another major barrier to be considered in order to improve and establish a sustainable, local (or even regional) food system, is the challenge of improving the logistics around it.

One of the biggest barriers in scaling up UA in Gothenburg is considered to be the lack of space. Paradoxically the abundance of unused spaces was also frequently mentioned during the interviews. Hence we conclude that the problem is not the existence of spaces, but the mapping and matching of unused (dead) spaces in the city with urban farmers, that is lacking. The public actor "Fastighetskontoret" and private actor Foodprint Lab both offer services of providing citizens with spaces for farming activities but these are usually located in the surrounding area of the city. There still seems to be a considerable amount of work to be done before all aspiring urban farmers will have access to empty spaces. A relevant practice to consider would be the ongoing UA campaigns in Paris, Parisculteurs, that successfully have created public awareness about available farming space in the city through their campaign (see section 9.2).

The current spaces that are made available for UA by 'Fastighetskontoret' are mainly for traditional soil-based agriculture. A cross-institutional collaboration with other departments of the city, as for example 'Lokalförvaltningen', would be necessary in order to provide space for less conventional types of UA. A possible good practice to adopt would be the conversion of basements, flat rooftops and other unused spaces into food producing spaces with aquaponics, hydroponics, vertical farms, rooftops and/or greenhouses, best suited for the space in question. The need for a cross-institutional collaboration was also highlighted during the final work-shop. Simultaneously, the problem of insufficient collaboration structures between the departments of the city, was mentioned as a major challenge which undermines this collaboration.

The third objective to "In a multi-stakeholder dialogue co-create recommended actions for further developing UA in Gothenburg" was addressed by the work-shop, containing a multi-stakeholder dialogue. Here the restraining forces "Limited Space" and "Not prioritized in the discourse of urban planning", were addressed. We consider the realization of the need for a cross-institutional platform and a proposal for establishing one in form of a thinktank, one of the greatest achievements of the

workshop. The proposal was collectively brought forward by the stakeholders during the workshop and will hopefully be developed into something concrete. UA being a topic that could engage several of the city's departments should thus be seen as an opportunity to enhance the cross-institutional collaboration in the city, which was found to be lacking and problematic by several of the stakeholders.

Another important recommendation mentioned by the stakeholders during the workshop was the need to integrate UA into long-term city planning. Here, the ongoing pre-studies for a local food-strategy, previously mentioned in section 7.1 are of importance. Inspiration for such a food strategy could be brought from the practice "What feeds us – Vancouver" (see section 9.3). A food strategy strategy has the potential to support and address several additional forces that were not brought up during the workshop, but that are equally important for a sustainable growth of UA in Gothenburg. One restraining force that will have to be addressed as the practice is scaled up in the city is logistics. Vancouver's local food strategy action 3.8 states to "increase the number of farmers markets in Vancouver from nine to 22 by 2020", this could be one way to address logistic issues. The outcome of a local food strategy will not only be increased resilience but hopefully also increased public awareness about the origin of our food.

We conclude that the establishment of a local food strategy has the potential to support many of the driving forces and counterbalance some of the restraining forces acting upon an upscaling of UA, and by doing so, it would reveal the full benefits of UA for a sustainable development of Gothenburg.

13
Conclusion

The dire sustainability challenges arising from the currently ongoing urbanization – and the global food system – calls for substantial action. This thesis aimed to explore how UA can be enhanced in the local context of Gothenburg, and thus contribute to a sustainable development of the city and the region. The aim was addressed by conducting a force field analysis through interviews of relevant stakeholders, and then hosting a multi-stakeholder dialogue based on the results of the analysis. Four main recommendations were summarized during dialogue, which all needed cross-institutional collaborations, and consequently led to the creation of a fifth recommendation – the desirable future establishment of a think-thank. The establishment of a cross-institutional think-thank would be an opportunity to further improve collaboration between departments of the municipality.

Creating a local food strategy was found to be useful for enhancing UA in the urban planning discourse, while integrating the practice into long-term city planning. This would be necessary in order to unravel UAs potential in contributing to a broad range of sutainability aspects. The municipality should seek inspiration from practices around the world in creating a local food strategy. The food strategy should also aim at enhancing less conventional forms of UA which could support the creation of new symbiosis opportunities. Symbiosis opportunities could include making use of residual heat produced in the city, or using aquaponic fish-skin within medicine. Policies and legislation relating to public procurement, agricultural subsidies, zoning categories and building permits should be looked over. Further research could focus on quantifying key aspects such as *"how much food that can be produced in the city", "how much space would be needed in order to produce a certain amount of food" or "how much space should be reserved to UA practices in a neighborhood"*. Defining such key numbers would create further credibility for the practice and make it easier to consider UA in the discourse of urban planning.

To conclude, Gothenburg has defined ambitious goals to reduce GHG emissions and the environmental impact from the city and its citizens. With food being one of the biggest contributors to environmental destruction, it is apparent that the topic should be given higher priority in the discourse of urban planning. Turning dead spaces of the city into living, food-producing, areas and simultaneously creating multipurpose meeting places should become an even higher priority in the future.

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A

Appendices

A.1

Social Sustainability
S.1 Horizontal relations (interaction within and between groups)
Acceptance
Communication
Cooperative - Learning
Empathy
Helping each other
Openness
Participation
Respect
Trust
S.2 Vertical relations (interactions with institations)
Accountability
Adaptability
Alertness
Awareness
Integrity
Representation
Respect
Responsibility
Transparency
Trust
S.3 Equity/justice
Consciousness
Equal access (education, freedom, safety)
Equal opportunity (legal and normative)
Equal rights (legal and normative)
Fairness
Freedom of movement
Impartiality
Inclusion
Power balance
Welfare

Ecol. Ecological Sustainability
-Alterations made in the crust or biosphere should be reversible
-Meeting the needs of the earth (planet and living beings) today, without compromising its ability to meet the needs of tomorrow
Preserve
Protect
Restore/regenerate
-Serve the environment:
-Substances should be produced/extracted so that they can be degraded/reabsorbed within reasonable time

Economic Sustainability
Econ.1 General
Conscious consumption
Fair distribution
Long-term-vision
Transparency
Econ.2 Natural cap
Efficiency
Substitutability
Sufficiency
Econ.3 Man-made capital
Dematerialization
Flexible & adaptable systems (buildings, transport, infrastructure)
Life-cycle assessment
Maintenance
Sharing
Econ.4 Human capital
Collaboration
Shared & accessible knowledge
Sub-category to increase
Econ.5 Financial capital
Fair distribution of wealth
Growth indicators
Responsible investments

Well-being
W.1 General:
Equal opportunities
Equity
W.2 Knowledge:
Access
Broader connection
Education
Global participation

W.3 Autonomy (self-determination):
Deciding one's own fate
Freedom
Independence
Ownership of your time
W.4 Self-fulfilment:
Recreation for personal Development & Opportunity to pursue Happiness
Space for self-expression
Self-improvement/ development
Spirituality
W.5 Purposefulness:
Appreciation
Contribution
Love
Respect
Sense of purpose
W.6 Belonging:
Acceptance
Acceptance of diversity
Community
Culture
Family
Freedom
Identity
Inclusion
Personal independence
Positive social interaction
W.7 Subsistence:
Clean air
Clean water
Employment
Food security
Home
Minimum wage
Nutritious food
Safety
Secure
Sufficiency
W.8 Health: *Access to healthcare Services*
Good health (mental, physical)
Green spaces
Recreation
Weather

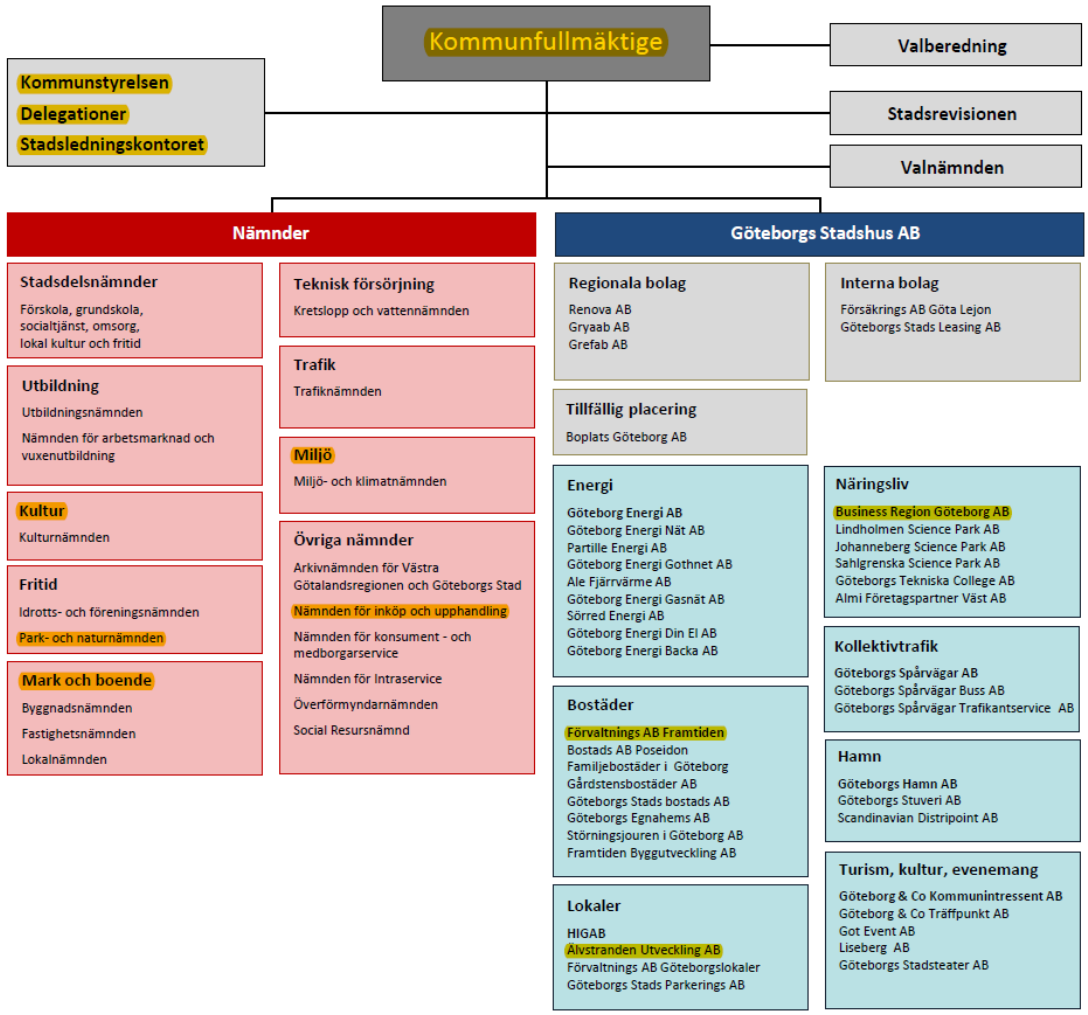
A.2

All identified practices.

Name	Description	Place	Impact	Level of implementation	Integration with city planning	Duration	Nr of connections	Total score (impact, integration, connections)
PRINZESSINNENGÄRTEN	Once an underwhelming park now a community farm driven soley by volunteers	Berlin	neighborhood	100%	No	2009 - ongoing	>10	2
Gardening My School / RHS Campaign for School Gardening	Organisation that offers guidance for establishing gardens for educational purpose	Montreal / UK	National	100%	No	2016 - ongoing	7	3
GARDEN REGISTRY	Online map and network for connecting farmers with land	San Fransisco / USA	City	100%	No	2008 - ongoing	3	1
SOIL KITCHEN	A city initative to try spark the interest of farming by offering citizens the possibility to test their soil and based on soil recomend what to grow.	Philadelphia / USA	City	100%	Yes	2011 - 4 month project	2	2
DEPAVE	Transforming un-used pavement to farmland, run by volunteers, tactical urbanism approved by city	Portland, Oregon / USA	City	100%	Yes	2013 - ongoing	4	2
LUFA FARMS	Company that has built a profitable businessmodel farming on old industry rooftops (aquaponic)	Montreal	Neighborhood	100%	No	2011 - ongoing	9	1
LYON FAIR AND SUST. CITY	Established a local labelling system for fair and sustainable projects	Lyon	City	100%	Yes	2010 - ongoing	1	2
AgroParis Tech	Higher educational institute research on sustainable food production. Result was a producing rooftop	Paris	City	100%	Yes	2012-2013	9	3
CITY FARM	Self sustinaing city farm with compost system	Chicago / USA	City	100%	No	1999 - ongoing	>10	3
EDIBLE SCHOOLYARD	Wants to ensure a edible education for everyone	NYC /USA	National	100%	Yes	2010 - ongoing	9	4
ESTO NO ES UN SOLAR	Transforming dead spaces in Zaragoza to urban farms. Tactical Urbanism	Zaragoza / Spain	City	100%	Yes	2009 - set of at least 12 month projects	6	3
2020 CITYWIDE PLAN	Revised the city's policy and zoning regulations to enable UA	Cleveland, Ohio /USA	City	in progress	Yes	2007 - zoning regulation for urban faring established	7	3
WHAT FEEDS US	A local food strategy	Vancouver	City	100%	Yes	2013 - ongoing	>10	4
SKIP GARDEN	Tactical urbanism in central london, creating cross-boundary meeting-places	London	City	100%	Yes	2009 - ongoing	>10	4
PORTLAND ZONING	Zoning regulations for UA established	Portland	City	100%	Yes	2012 - zoning regulations for urban farming established	>10	4
PARISCULTEURS	Project to increase green areas in Paris with 100 hectar. A third of these will be farming that produces food	Paris	City	In progress	yes	2016 - ongoing	>10	4

A.3

A detailed map with highlighted stakeholers.



A.4

Results from the first part of the brainstorming. The posters show the answer given by each group to the questions why, who and how.

Figure A.1: Results from 'Creating space in the city for UA'

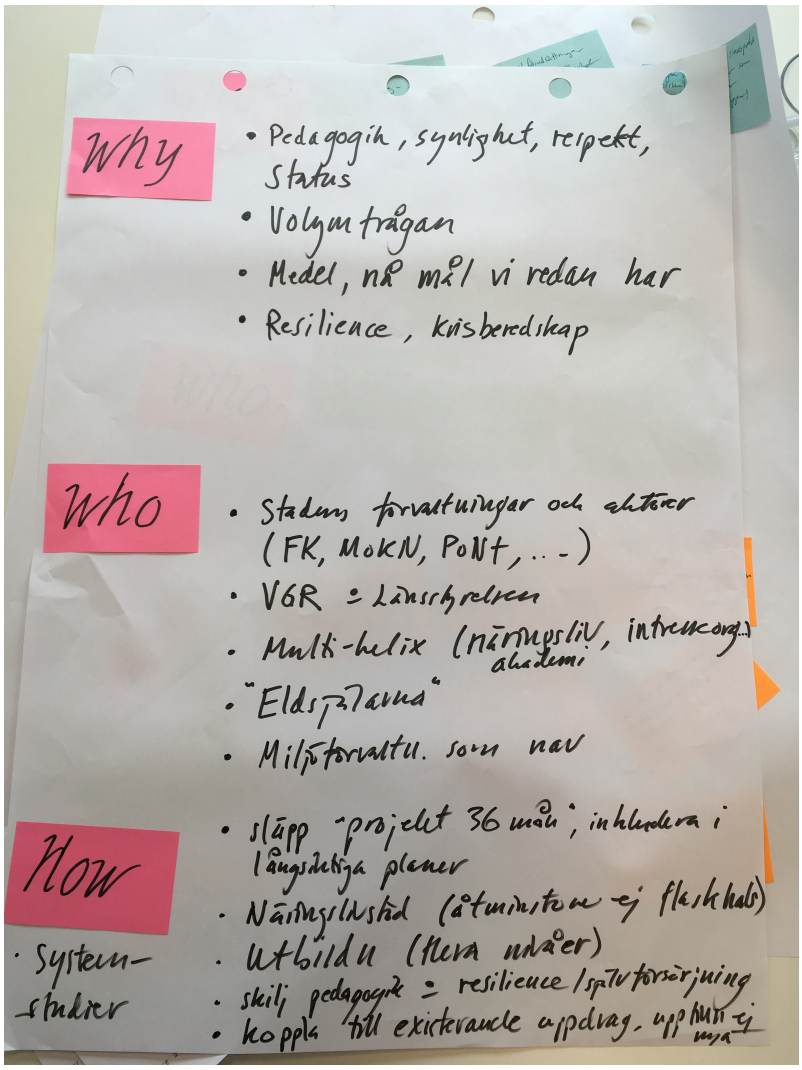


Figure A.2: Results from 'Inclusion of UA in the discourse of city planning'