Faculty of Landscape Architecture, Horticulture and Crop Production Science
Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Exploring Agroecology

– Agroecology, urban agriculture and farming in secluded areas

Utvärdering av Agroekologi

– Agroekologi, odling i städer och jordbruk i avskilda områden

Sixten Lundqvist

Polar Permaculture's greenhouse in Longyearbyen. Photo: Sixten Lundqvist

Degree Project • 30 credits
Agroecology - Master´s Programme
Alnarp 2018

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Credits: 30 credits
Project level: A2E
Course title: Master's Thesis in Agricultural Science/Agroecology
Course code: EX0829
Programme: Agroecology – Master's Programme

Place of publication: Alnarp
Year of publication: 2018
Cover picture: Sixten Lundqvist
Online publication: http://stud.epsilon.slu.se

Keywords: agroecology, urban farming, localization, nutrients, farming systems, farming strategies, permaculture

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Foreword

This paper and project was made possible with the aid from the founders and employees of Polar Permaculture, Källby Mölla, and Greenworks, and via the assistance from Beatrix Alsanius from the Department of Biosystems and Technology at the Swedish University of Agricultural Sciences. Their help has contributed to the quality and topic of this paper, and allowed for an eye-opening exploration of what agroecology is, what it can become, and why it is worth studying.

With a background in social sciences I was appreciative and excited of being able to apply and study a program with an interdisciplinary approach and focus. It has allowed me to gain a deeper understanding of what agriculture is, how it affects societies, and the environmental consequences it can have. Agroecology has therefore not only been an interesting school of thought to examine in-depth, but has additionally functioned as an introduction to natural sciences, which was previously unknown to me, and given practical experiences of methods and approaches towards sustainable and fair agricultural activity, as well as basic agronomy skills.

Few university programs, as well as ideologies or schools of thoughts, are without flaws. Agroecology, both as a Program at the Swedish University of Agricultural Sciences and as an ideology or school of thought, is not an exception. My personal opinion is overall one of positivity. However, what is being taught, and a core focus of courses, seminars and lectures, seem to be grounded in conservative structures where economic development is deemed to result in environmental damage. So rather than working with green innovation, such development in regard to agricultural techniques and machinery, it is avoided and solutions to agricultural problems instead lie in traditional practices and structures that date years back.

With that being said, it was this subjective dilemma, the previously described one, that inspired me to throughout my study period at the Swedish University of Agricultural Sciences to examine agroecology differently. Agroecology, as a set of principles, includes fundamental values that should be applicable and appreciated by anyone who engages in agricultural activity, however, can easily be questioned due to its traditional focus. To try and help in making it a more accessible school of thought has functioned as a basis for this thesis and a driver towards the completion of this program.

Abstract

Agroecology, due to its framework and prerequisites, is a limited set of principles with lacking flexibility. Its objective is to create fairer food networks, that are sustainable, on a global scale yet it is seldom seen in practice. Its unconventional means are not convincing enough to engage larger amounts of people who partake in agriculture. Instead of coinciding with innovative farming strategies and working on their improvement, agroecology often rejects them. This paper and study focuses on three different cases of farming systems, located in Stockholm, Lund and Longyearbyen. All have special prerequisites for agricultural activity in terms of location and purpose of the farming system. The aim is to examine to what extent they are applicable within agroecology framework, how fair they can be considered to be with regards to agroecology, and if agroecology can be considered to be an exclusive set of principles. Three case studies, of the different farming systems, were constructed. Semi-structured interviews and participatory observations functioned as core tools in order to obtain subjective thoughts on agricultural activity approaches as well as in depth information on the different components, both socio-economic and natural aspects, that the farming system consists of. To further contribute to the informative quality of the case studies, Peanut Model, stake holder analysis, SWOT-analysis tools were included. To aid the comparison between the different cases and agroecology a Venn Diagram was applied. The results revealed that different farming system's locations, along with mind-sets of the people operating them, has created scenarios and structures that are applicable within agroecology framework. However, also due to the locations the farming systems, along with the small scale of one of the farming systems, they cannot excel within agroecology, due its natural prerequisites and hence become fairer and more sustainable. Aspects like ecological diversity and intensification are hard for farming systems dependent on technology to achieve. Therefore, not all farming system can adopt agroecology features to a full extent, and therefore with regards to agroecology, cannot become completely fair. Its principles can be considered exclusive. If agroecology is to become a broader term, that is commonly discussed, it should operate in a manner that takes all types of farming into consideration, including how farming systems with lacking natural prerequisites for agriculture can become fairer.

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1. Introduction

Urban agriculture is emerging globally (Whittinghill, 2011). The dimensions of space, seasons, and natural circumstances are no longer much of obstacle as farming systems and agricultural activity, with the aid of technology and innovative solutions, has become more space efficient, more compatible and indifferent to weather. Vertical farming, with appropriate lighting, allows one to grow on multiple levels, hence increase farming area. Additionally, it can be placed in areas not previously prone to agriculture. With grow lights, grow medium and nutrient solution, farming structures, as well as entire farming systems, can be placed underground, on roof tops, in people's homes and inside supermarkets. With a lessening of location dependency in regard to natural prerequisites, farming systems can be placed closer to densely populated areas, hence reducing the need for imports for demanded edibles.

However, urban agriculture may not currently be efficient in terms of energy dependency as an electrical input is often required (Wielemaker, et al. 2018). Urban farming systems often rely on imports of materials for construction and for nutrient solutions in order to grow plants. It could even be argued that the imports of materials and nutrients for an urban farming system that aims to provide consumers in an area with local produce merely replaces one imported product with another. Instead of meeting consumer's demand by importing foods, materials and nutrients are imported in order to grow foods closer to the consumers, to try and meet the same demands. A discussion as such can be dissected into many different aspects, such as environmental friendliness, green innovation and technology, benefits of a greener city, and reasons for bringing urban dwellers closer to agricultural activity. Therefore, both from a natural science and social science perspective, it is of interest and importance to examine problematic aspects as well as benefits of a farming system's location.

Urban agriculture is not often discussed within the circles of agroecology and could even be described as excluded from agroecology frameworks. The reasoning behind this is not entirely clear as urban agriculture, even with the aid of technologies and innovation like hydroponics, can share similarities with rural farming and should therefore be able to function within the framework, or guidelines, of agroecology. As it is currently a developing form of agricultural activity, it may well be important to include it in discussions, and support its agricultural strategies in becoming more sustainable and fair, instead of excluding it. This incorporates making urban farming systems become more efficient and less dependent on external inputs,

and instead of considering an urban location as problematic, examine possible positive aspects and how it can contribute to the well-being of people, communities and societies. Therefore, this thesis focuses on urban agriculture's dependency on imports and inputs, why a farming system's location matters, and whether urban agriculture should or could, to a greater extent, be placed and included within the frames and principles of agroecology.

1.1. Objectives

The aim of this thesis is to explore the concepts, principles and guidelines included in the agroecology framework. Agroecology can be considered to be an exclusive framework, and the idea is to discuss if agroecology is only available for people and farmers with certain prerequisites, and whether agroecology can be made broader, or improved upon, in order to make it more accessible, less exclusive and a set of principles that is relatable to more types of agricultural activity. In order to do so this paper will consider urban agricultural activity, looking at both natural and socio-economic surroundings, perturbations and aspects, and discussing it in regard to agroecology. Empirically, this thesis aims to examine and evaluate three smaller cases of agricultural activity. These cases, which are more thoroughly presented, described and analysed in latter sections of this paper, are compared with one and another, and are placed within the framework of agroecology. Benefits, as well as obstacles, are brought forth in order to contribute to the discussion on to what extent a farming systems location matters, with regards to agroecology.

The cases all share some similarities, yet differ in many ways. The reasoning behind this thesis aim is to broaden the understanding of urban agriculture and farming in areas not prone to agriculture. This includes discussing the need for technology and needs of imports and inputs. Additionally, it will question principles of agroecology, and by doing so hoping to shed some light on whether or not agroecology can become a set of principles that is more broadly used, and a practice that can be applied by more farmers and people, and included in a larger agriculture discussion.

The focus of this paper is on agroecology framework, urban agriculture, and farming in secluded areas. These are the fundamental aspects of this paper that defines the general scope in which this paper will operate within. However, in order to narrow this scope down further, the role of imports in relation to agroecology, urban agriculture and farming in secluded areas,

is the key issue discussed, along with a farming systems location. Furthermore, in order not to divert from the aim and incentives, and to remain within the boundaries mentioned, certain definitions, and restrictions, will be presented and followed throughout the paper. This is not only done to keep a narrow focus, but furthermore to avoid ambiguous interpretations. Additionally, this paper does not stretch further than the latter case studies included, and the chosen theoretical frameworks. The research may therefore not be applicable for cases of urban agriculture and farming in areas not prone to agriculture on a general level, but can provide inspiration for further research on similar topics.

Hydroponics will be referred to as plant production that is not relying on soil for the provision of nutrients. Instead nutrients are provided as a supplement mixed with water (Benton, 2005). Nutrients will be referred to as substances needed for plants to grow and survive (Wielemaker, et al. 2018). When writing about external inputs, it indicates anything a farming system decides to import, or a dependency from outside of the farming system (Bawden, et al. 1984). Farming system will be referred to as a group of practices and methods functioning together with the goal of producing plants and livestock (Gliessman, 2015), and when discussing fairness, with regards to a farming system, it will be referred to as is whether or not strategies and actions are taken in order to enhance sustainability aspects, both socio-economic aspects, and environmental friendliness. Self-sufficiency will be referred to as a systems autonomy where no external dependencies exist.

1.2. Relevance to the Agroecology Master's Program

Although agroecology is already a broad set of principles that does include different types of farms as well as different food production patterns, the major focus of the Agroecology Master's Program at the Swedish University of Agricultural Sciences seem to be grounded in Gliessman's (2015), Wezel's (2009) and Altieri's (2009) work, where the idea that natural surroundings are key to fairer food production systems, and that conventional socio-economic structures, such as consumption patterns, need to be changed in order to create fairer food systems. The strategy to achieve this change is by adapting agroecology principles and follow its guidelines. Therefore, challenging the norm, and operate, to a certain extent, outside of the previously mentioned points can contribute in making it a more appreciated subject and university program, by questioning its very foundation. However, to address faults of

agroecology is not the goal, but discussing it in a constructive manner that may contribute to its future development is.

1.3. Research Questions

In order to achieve the different objectives previously described, the following research questions have been established:

Can agroecology be considered to hinder the development and identification of more sustainable and fair food systems due to its prerequisites and framework?

- What factors determine the dependency on importing nutrients?
- How does a farming systems location affect its farming strategies?

This research question, including the sub-questions, is thought to be broad enough to encapsulate the aim and incentives, yet narrow enough to keep a precise focus and therefore remain within the limitations and boundaries previously described. The overarching research question focuses on agroecology and how its principles are formulated. The two sub-questions have more narrow focus, yet still relates to the overarching research question as they question aspects included within agroecology framework.

1.4. Background - Agroecology

This section is included to provide the reader with general background knowledge on agroecology, urban agriculture, the role of imports when farming in areas not necessarily prone to agriculture, and to what extent location matters. It will give an insight to various problem found within the dimensions of agroecology and urban agriculture. Additionally, it will function as a foundation of the entire paper, adding to a deeper discussion and more focused conclusion.

Agroecology is an interdisciplinary framework that spans across social and natural sciences, hoping to bring forth fairer and more sustainable food systems (Francis, et al. 2003). With a holistic approach, agroecology challenges conventional food systems, and is often critical towards technologies, practices, policies, and research done with regard to conventional food systems. The overarching goal is to create fair food systems on a global level (Gliessman, 2015). However, agroecology is sometimes deemed too critical of the current norm of agriculture, and that it might not deal with the two sciences with the same depth, lacking focus on social sciences aspects (Buttel, 2007).

Agroecology as a set of principles, provides different ideas and can theoretically handle social sciences with depth. One major focus is stakeholder involvement (Francis, et al. 2003), which emphases the importance of a dialogue between producers and consumers. This is thought to strengthen transparency and legitimacy, hence contributing to fairer methods and prices as both producers and consumers are well informed of farming activities, consumer needs and production means (Ibid). Furthermore, it highlights the need for holistic analytic approach, as the different stakeholders become aware of the different components that a farming system need in order to function. However, this on its own may not be enough to impose a change that matters. Therefore, it can be argued that agreements, such as national policies regarding the topic of fairer systems are required (Chambers, 1994). These policies should include a wider range of people with socio-economic background, leaving policies more befitting for a population as a whole (Beddoe, et al. 2008). As food security, the sufficient access to food in order to obtain a healthy diet (Jagadeesan, 2011), is becoming more and more problematic, as poverty and agriculture are intertwined (Wheeler & Von Braun, 2013), alternatives, such as farming systems based on agroecology principles, are being more appreciated and considered a solution to this problem. Generally, global trends such as; the demographics of farm population and a change in demand of foods, are becoming central topics in regard to agricultural activity, and especially how to deal with issues as such. Although these aspects are commonly discussed within the framework of agroecology, it is hard to determine on what level, or with what dynamic, such issues are being dealt with.

The natural science aspect of agroecology too gets criticized for lacking research that proves, or spurs enough of interest, of its unconventional methods to be appropriate. It could be possible to go as far as to consider the whole idea as unrealistic, as cheap, effective and efficient structures would have to be replaced (Hill, 1998). Therefore, more daring research approaches are required in order to promote, and present the benefits of, agroecology (Weiner, et al. 2005). Conventional agriculture is in many ways unsustainable (Bell & Morse, 2008; Hill, 1998) and would therefore need to shift if planetary boundaries are not to be crossed, meaning not surpassing a line where ecological and natural resilience and restoration is no longer possible (Rockström, 2010).

Natural scientists, who do promote agroecology principles and ecological advantages, are providing legitimate reasons for adapting less environmentally harmful strategies (Gliessman, 2015), yet still maintain high productivity. Examples include transitioning from monoculture,

higher focus on crop rotation and polyculture, farm in a manner that maintain ecosystem functions, meaning contributing to the ecological well-being (Hill, 1998), and organic farming (Lipper, et al. 2014). However, although research on the natural aspects of agroecology farming strategies have proven to ensure productivity and environmental friendliness at the same time (Gliessman, 2015), the guidelines do not seem to be convincing enough to adapt on a national or global level. Companies, and larger farming systems, often abide to market demands and therefore aim to apply strategies as cost effective as possible (Porter, 2003). This does not result in complete neglect of environmentally friendly farming system. It does however, make it a minority, as more profitable, often conventional and more convenient strategies, are available (Simpson, 2014). As the natural science based agroecology research can be questioned (Weiner, et al. 2005), or as other perhaps more accessible conventional strategies and structures are available, current conventional means become more of a clear choice. As the social aspects of agroecology, such as high community engagement and circular economic structures (Fernandez, 2013), may not be reassuring enough or proven to function to a great extent, agroecology may remain a somewhat uncommon phenomenon.

The strength of agroecology as a set of principles can be considered to lie in the holistic, or systematic, approach that it holds and embraces (Francis, et al. 2003) as it manages to encapsulate a wide range of components that are needed if food networks and farming techniques are to be improved. However, the principles and guidelines can be considered to be demanding certain prerequisites. Although, many farming systems can be developed, and become fairer and more sustainable, not all can necessarily adopt agroecology features to a full extent. Agriculture can still emerge in areas with no natural prerequisites for farming. This includes cases of urban farming, located in cities like Stockholm and Lund in Sweden, and farming activity in secluded areas, such as in Longyearbyen, Svalbard. Urban agriculture and farming in secluded areas can due to its prerequisites not excel with regards to agroecology framework. As urban farming system do not necessarily depend on natural circumstance like nutrient provision via soil or sun light, they instead often depend on technology, such as artificial lighting and hydroponic solutions, as well as external inputs, like energy, materials and nutrients, which hinders the adoption of agroecology principles. However, farming systems that have emerged without the dependency on natural prerequisites can still function with many of the features and guidelines that can be found within agroecology. Therefore, it may not essentially be the fault of the farming systems, but rather of agroecology, as it is exclusively available for certain farming systems.

Urban agriculture should not be excluded from the agroecology discussion. Instead they should be included, noted that their prerequisites are taken into consideration, and with such a discussion, contribute in making agroecology a more accessible school of thought.

2. Context – Urban Agriculture

This section has been included in order to narrow down the discussion presented in the background, and furthermore contribute to the understanding and legitimacy of the objectives. Hence, provide more specific insight to the problematics of agroecology, and urban agriculture. Additionally, provide examples and arguments for why this paper's aim and objective is of importance.

Small scale urban farming in economically developed countries (Sachs, 2005; Lorenz, 2015), just like small scale rural farming (Vandermeer, 1995), suffer economic difficulties (Cabannes, 2012). It remains hard for urban farmers to compete with rural farms and farmers, and therefore cannot upscale their productivity (Ibid). They often remain stuck in an economic situation with little profit, threatening survival and existence of a farming system. However, there are positive aspects of urban farming systems that can be considered advantageous. Urban agriculture, often deals with the dimension of space and natural perturbations in a different manner from rural agriculture. Vertical constructions can allow for a maximisation of space efficiency, meaning square metres of farm land can instead become cubic metres. Climate can be regulated more easily in order to grow specific plants, as indoor production avoids seasonal weather changes and unstable climatic conditions (Treftz & Omaye, 2016; Wielemaker, et al. 2018).

The localisation of agriculture has often been associated with food security, providing a group of people with produce (Rothwell, et al. 2016; Zezza & Tasciotti, 2010). Smaller circular economies, such as an agricultural system located close to a community, is often considered, within the frames of agroecology (Wezel, 2009), as a fair food system, both socio-economically as people are brought closer to agriculture and with regards to environmental aspects, as transportation means can be reduced. Along with innovation, political will, and policy implementation, science based technology is needed for battling food insecurity (Jagadeesan, 2011). Green innovation, or scientific development in relation to farming, should and perhaps will spur greater interest (Schiederig, et al. 2012), and economic development, in regard to

urban agriculture, which is why it is an emerging form of agriculture (Whittinghill, 2011). This includes updating value chains by examining what is needed and wanted in cities, in terms of what to produce, and then how to make it more efficient, including how to reduce negative environmental impacts (Yun, 2012).

Environmental impacts regarding urban agriculture are debatable. Technology based urban agriculture is a western phenomenon, often occurring in wealthy northern cities (Goldstein, 2016). It is perceived as environmentally friendly as food miles are reduced, where food is grown at a specific location rather than being imported to a specific location. However, as urban farming systems, that are dependent on technology, do require rather high amount of energy, it may not be an optional type of industry as other initiatives, such as higher use of solar panels, might be more environmentally friendly alternatives (Ibid). Therefore, this remains a debatable topic as a clear choice for how urban spaces should be used is not determined (Rothwell, et al. 2016).

The global emergence of urban agriculture, and as it is occurring it can contribute to economic development, both via job creation and community building, and contribute to food security in cities. However, it is still limited by the competition of space. Other industries, that are considered to bring about higher economic revenue are increasingly being located in urban centres (Porter, 1998). Other issues include health regulations in urban food production and unclear land use boundaries or rights (Whittinghill, 2011). Urban agriculture is, in the northern cities, becoming part of urban planning, as benefits, such as food security for urban dwellers, are becoming clearer and the concept of locality, that food can be produced at a specific site rather than being imported to a specific, is seen as advantageous (Lorenz, 2015).

Indoor farming, that rely on hydroponics and technology, require considerably less water. Additionally, it can be regulated on a higher level, but still needs to be included in academic agroecology research on how to become more efficient, less energy dependent, and more environmentally friendly. In general, as urban resource use is being improved so is urban agriculture (Lucas & Chhajed, 2004), as urban agriculture is becoming less dependent on imports due to technological advancements and an increasing interest in it (Wielemaker, et al. 2018). Although, self-sufficiency is not achieved at this point, it may well be in the future and as it is becoming more popular it should be examined, and in is this paper from an agroecology angle.

As a reader's reminder; the aim of this paper is to explore agroecology. Whilst doing so discuss how and if agroecology can emerge and be identified in areas without beneficial prerequisites for agricultural activity. Three cases of urban agriculture systems are to be examined and discussed with regards to the aim and research question.

3. Theoretical Frameworks

The selected theoretical frameworks have been inspired by location theories and agroecology as a set of principles. They are thought to provide legitimate discussion points with regards to the research question and be applicable in the examining and analysing of the different cases, and thought add more depth to the discussion, hence aid the creation of appropriate conclusion as well as proposing relevant ideas for further research.

3.1. Gliessman's Scale of Conversion

The scale of conversion is a descriptive tool that allows one to determine to what extent a farming system operates within the principles of agroecology. It brings forth key guidelines required for an agricultural operation to be fair and contribute in creating fairer and more sustainable food networks. Additionally, it highlights non-fair features, or unsustainable features, that can be present if a farming system is not environmentally nor socially friendly (Gliessman, 2015). The farther up on the scale, or higher the level, the more agroecological, hence fairer, a farming system is. The lower the level, the more unfair a system is, as more conventional features are present. It is a holistic approach, or scale, as the aspects brought forth are often interrelated with other aspects in the same system. With the latter presented results, this framework will encapsulate the overarching goal of this paper and aid the creation of answers for its research questions.

The table below displays the different levels. The case study approach will determine how each farming system does with regards to the different levels. This scale is one of three representations of agroecology included as boundaries for the research questions, and their answers, to operate within. The different levels will be referred to throughout the latter discussion section.

Table 1. Gliessman's Levels of Conversion (2015)

Gliessman's Levels of Conversion
Level 1 – Decrease damaging inputs by enhancing or increasing the efficiency of conventional practices
Level 2 – Replace conventional practices for alternative practices
Level 3 – Design the farming system in manner that allows it to function with a new set of ecological principles
Level 4 – Create a better and more direct connection between producers and consumers
Level 5 – Create and build new global food system by creating farming systems based on the previous levels

3.2. FAO Guidelines

The Food and Agricultural Organizations (FOA) guidelines (2014) are similar to Gliessman's scale of conversion. But instead of a framework, that groups specific cases, or labels them, it is used as an index, containing key points, or elements, of what agroecology is. It helps to understand agroecology as a set of principles, and helps one to further examine a case with regards to agroecology. Elements of both socio-economic and natural nature are included in this index. This index has been comprised in order to contribute in the identification of whether or not the different cases, that are included in the results section, can operate with features of agroecology and how. It has been included to complement Gliessman's scale of conversion, as it is thought to contain aspects lacking in Gliessman's (2015) scale.

The table below compromises FAO's general perception of what defines agroecology. The key points are in bold writing, followed by a brief definition. A farming system that contain these elements, or key points, can be considered as a agroecological farming system. With the key elements one can discuss whether or not a case holds agroecology features, or what a farming system need to do in order to obtain elements. Which information as such, it will become simpler to answer this papers research question. This framework, is the second agroecology framework included. The different elements will be referred to throughout the latter discussion section.

Table 2. Elements of agroecology according to the FAO (2014)

Agroecology Elements by the FAO
Resilience– maintain self-regulatory features of ecosystems
Efficiency – minimize external inputs and preserve natural resources
Diversity – increasing biodiversity in order to maintain a healthy farming system
Co-creation of knowledge – knowledge transfer and participatory processes and practices
Recycling – keeping waste at a minimum
Synergies – selective design of a system where components benefit from one and another
Human and social value – allowing the farming system to benefit communities
Circular economy – connecting producers and consumers
Responsible governance – effective governance on local and national scales
Culture and traditions – supporting and producing appropriate produce with regards to cultures

3.3. iPES Principles

The International Panel of Experts on Sustainable Food Systems (iPES) report (2016) was conducted in order to highlight the importance of more sustainable and fairer food systems and how it can be possible for existing farming systems to adapt friendlier strategies and structures towards socio-economic norms as well as natural standards. The report can be compromised into key points, or guidelines. The iPES key points differ from both FAO's guidelines and Gliessmans' scale of conversions, as it does not directly operate within similar agroecology context. Much from it is alike, such as diversity and efficiency aspects, but still it diverts, hence allows for more of an in-depth analysis of the latter cases and for a fairer discussion as well as conclusion. The most noteworthy guideline included in the iPES principles is the encouragement of technology, which is lacking in both Gliessmann's scale and FAO guidelines. The iPES report considers it as essential for farming systems to develop in search for structures that are sustainable and fair. The report reflects on how technology is not environmentally harmful by nature, and can instead help farming systems become more environmentally friendly.

Therefore, as the other two agroecology frameworks that were previously mentioned, does not emphasise the importance of innovation or technology, this framework, being the third and last agroecology framework, has been included to fill this gap. A different angle, the angle being innovation and technology, of agroecology will benefit the latter discussion, as the range of what can be considered agroecological has been broaden. Technology and innovation, with

regards to agriculture, opens up for new locations, and can compensate for less favourable geographical, or natural, conditions.

3.4. Agricultural Location

Agricultural location has existed as an academic framework since the 19th century, first made famous by Von Thunen (1826). Back when it was established, the core idea was where a farm, or agricultural activity in general, should be located in order for it to be as profitable as possible. Factors such as what types of crops to grow in order to meet demands, as well as necessary distance between production site and market were foundational parts of the model. Since the first model of agricultural location was established, it has continuously been updated in order to be befitting for modern settings. Lucas and Chhajed (2004) deconstructs the agricultural location model since its creation and highlights aspects crucial for it to keep evolving and stay up to date. Generally, the product price of a crop or edible will increase with the distance from the market where it is being sold. Therefore, a production site far away from a city, where the majority of the demand is, is not as profitable as having the production site, or agricultural activity, right beside the city. However, as land nearby a city is often highly valuable (Lucas & Chhajed, 2004), agricultural activity located at such a site has to be highly profitable for it to remain an agricultural activity site. Otherwise, other options, like constructing housing, may be more economically profitable.

However, as aspects such as technology are developing in regard to agriculture, such as the efficiency of hydroponics and artificial lighting, the need for agricultural prerequisites, such as good quality soil, are not as essential as they used to be. Therefore, other aspects that still relate to agricultural location play a different, and perhaps larger role. The environmental and socio-economic aspects of local markets and engagement, that can be found within the previously described frameworks of agroecology are considered important in order create fairer food systems. Transportation costs have seen a dramatic reduce in the past decades (Dicken, 2011). It is possible to import produce from all over the world at a low cost. This pattern may not be static as environmental policies, that aim to reduce long distance transportation, can come in motion, making an urban location economically beneficial (Hayter, 1997).

To further elaborate on localization, one can take other aspects, apart from agroecology elements and transportation reduction, into consideration. Locating a farming system in an

urban or secluded area can be of positive matter, although natural prerequisites are lacking, which is described in the following section.

3.5. Porters Competition Model and the Advantages of Disadvantages

This framework focuses on how trade cluster, and how regional or small-scale economies, will affect productivity and incomes on a national level, hence contributing positively to a countries economy. Porter (1998) suggests how economic policies should be brought down on a smaller scale, becoming decentralized, and with such a strategy, benefit inhabitants more directly. Porter's article questions previous economic models, such as Adam Smith's (1776) fundamental competition model, and proposes new phenomenon's and patterns concerning competition in microeconomics. Porter discusses advantages and disadvantages in trade clusters with high competition, and concludes with arguing that suffering from disadvantages can become advantageous. Structures and operations can investigate all different types of possibilities and niche within a specific area, as well as re-branch in order to fill a missing gap. Therefore, an urban farm may find alternative strategies in order to function. This includes adapting technology in order to enhance efficiency or finding strategies in order to reduce imports, hence becoming more self-sufficient. With this concluding remark, the framework of the advantages of disadvantages has been included as it can relate to urban agriculture and agricultural activity in secluded areas. It may provide legitimate answers for why the farming systems have decided on certain farming strategies, and whether or not these strategies are due to their geographical location. It relates to Boserups (1965) argument of necessity being the greatest cause for innovation and invention as it forces people to solve emerging and existing problems. Therefore, the current problematics of urban agriculture may not always be present, and as farming systems locate in areas with natural geographical disadvantages they might turn it into an advantage, still making the systems fairer, hence more agroecological.

3.6. Connecting the Frameworks

On their own, the focuses of the frameworks vary as they touch upon different aspects of the overall theme of this paper, and will therefore allow for in depth discussions regarding different aspects deemed vital for the research questions. The frameworks have been selected in order to function together. Gliessman's scale of Conversion, FAO's Guidelines and the iPES Report, are all a little different yet operate within the frames of agroecology, and therefore aids the understanding of what agroecology is or can be. To merely rely on one of these frameworks

would result in an unjust discussion. Porter's Advantages of Disadvantages and Agricultural Location, allows one to discuss agriculture in areas with natural geographical disadvantages from an angle that brings their location may be of positive matter, yet still hoping for it to be applicable in a setting that can be considered fairer, perhaps even within the frames of agroecology.

4. Methodology

For this study, three different farming systems were selected, visited and examined. Same methods have been applied for all three cases. The interviews and field visits were prepared, structured and performed similarly. The interviewees names are not revealed in order to keep an ethical academic standpoint, hence allowing subjective thoughts to remain anonymous. The names of the farming systems are accurate, being Polar Permaculture, Källby Mölla and Greenworks, and are presented more thoroughly in the results section.

Methods applied for this paper have been selected in order to portray detailed and just information on the topic and of the different farming systems. Therefore, the core tools applied for this paper are semi-structured interviews (Holliday, 2007; Punch, 2005) and case study approach (Yin, 2014). In order achieve in-depth examination of the different farming systems, and create detailed case studies with relevant information to the research question and objectives, the additional tools; Peanut Model, SWOT analysis, Cause and Effect Diagram and a Stakeholder Analysis (Chambers, 1994), have been included for each case. It will contribute in obtaining data that spans over the interdisciplinary form of agroecology and of this thesis (Cousin, 2005; Bryman, 2012). It will permit the inclusion of aspects that transcend beyond the internal elements and structures of a farming system and therefore produce empirical material on aspects that directly and indirectly affect them, from their specific natural and socio-economic environments. Additionally, it will allow for a simpler comparison between the cases, urban agriculture and agroecology.

4.1. Semi-structured Interviews and Participatory Observations

The semi-structured interviews were conducted with founders and employees of the different farming systems. The interviews were both conducted individually and in group format. The interviews were recorded, or written down in forms of notes. The topics discussed were based on pre-made interview guides that included overarching themes and guideline questions that

allowed the interviews to remain within specific frames relevant for the topic. Additionally, it hindered the loss of conversation, allowing the interviews to keep a constant flow. The interview guides were created with regards to the different farming systems, and therefore differed with one and another. The duration of the interviews spanned between 30 minutes to 1.5 hours. All cases were dealt with in similarity, where the first interview functioned as an introduction to the topic of this thesis. The second interview was more specific and contained question on vital points and topics that emerged from the first interview. The interviews were held in English and Swedish, depending on the first language of the interviewees. The guides for the different cases can be found in the appendix section.

The reasoning behind choosing semi-structured interviews was in order not to limit the interviewees' answers (Holliday, 2007). Questions asked did not require a right or wrong answer. Instead, the interviews functioned more as conversations about the farming system, urban agriculture and agroecology. The participatory observation process occurred during the farm visits, which contributed to the completion of the different tools within the case study approach. Questions regarding farming components and aspects were asked and explanations and clarifications were provided. Notes were taken throughout the participatory observation process.

The gathered empirical material collected through this qualitative approach (Brydon-Miller, et al. 2003), was treated with inductive grounded theory (Bryman, 2012), allowing themes relevant to the aim and research question to emerge freely and on their own. This means that the recorded interviews were written down and the answers were then dissected. Answers, thoughts and ideas were grouped into themes allowing for simpler identifications of topics relevant for this thesis' aim and research questions. This reveals general ideas and thoughts, and core principles of the stakeholders representing the different cases. Furthermore, it functions as a focused summary of the interviews where links between the empirical material and the research objectives was established. However, in order to add to a deeper understanding of the different cases and their current scenarios, and to the latter discussion, quotes from the interviews have been included in this paper.

4.3. Venn Diagram Examination

The Venn diagram compiles the results from the case studies, hence all the previous methods applied. Once the cases were constructed, it was possible to make comparisons between the different farming systems (Chambers, 1994). It has been adopted in order to make this comparison simpler and more visual. It allows for pin pointing difference and similarities, and how agroecology can be relatable.

The Venn diagram tool was not applied on an individual level for each of the cases as it is used for encapsulating different aspects from different cases, and compare and describe with one and another. Its purpose is to aid the discussion and provide answers to the research questions. The figure below illustrates the Venn Diagram process.

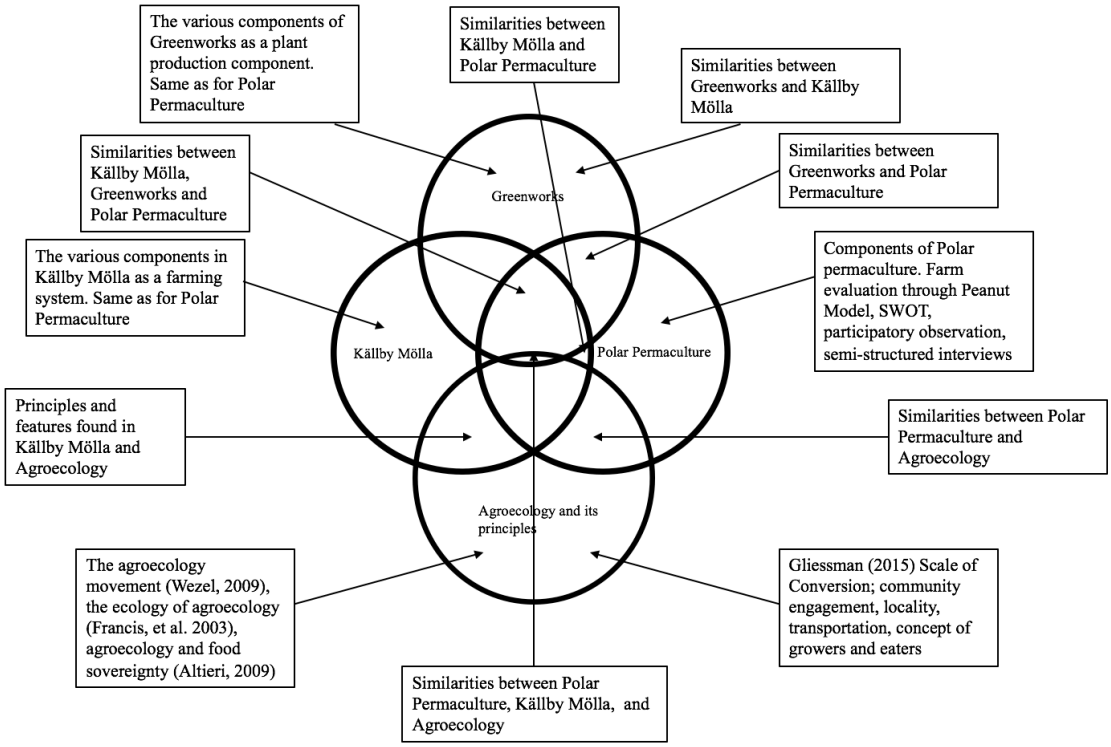

Figure 1. Venn Diagram

5. Results

This section is divided into different parts where all the farming systems, or cases, are presented and examined in separate sections. This is done in order to maintain a constant flow, and to allow the material to function on its own as well as within the aim of this paper. With this

structure, contribute to an in-depth discussion and analysis that brings forth the research questions and a sound conclusion in line with this paper's research questions.

5.1. Case 1. Polar Permaculture

Polar permaculture is an indoor and greenhouse farming system located in Longyearbyen, Svalbard. It provides hotels, restaurants and parts of the local population with produce grown in Longyearbyen. Additionally, what they produce is being sold at the local supermarket. Furthermore, it engages the local habitants and tourists with their agricultural activity, as guided tours of the farm are available for a fee. Included in the tours are hands-on farming activities where the guests are taught their strategies and why the founders of Polar Permaculture have decided to engage in agricultural activity. Apart from the help from tourists, at this point, one volunteer who otherwise lives in Longyearbyen helps on a regular basis out with on farm chores. Polar permaculture is what can be described as a family business, where the founder, along with his two children, engages on a daily basis with different farming chores.

Two interviews were held. The first session was a group interview with the founder and one of his children. It lasted for approximately 1.5 hours. During the second session only the child of the founder was present. It lasted for approximately 1 hour. After the interviews, the farm was visited and farm aspects were explained by the interviewees.

Picture 1. Parts of Polar Polar Permaculture indoor cultivation Photo: Sixten Lundqvist

The most relevant themes that emerge throughout the inductive grounded theory process were locality, location and a holistic farming approach. The interviewees of Polar Permaculture spoke of locality with high regards, and related it to their location. As Longyearbyen is

dependent on importing food, they consider their operation to be of importance as it both contributes less imports of food, although only to small extent, and to a circular economy, between them and its stakeholders who consume their produce.

> "It is very easy to ship materials and nutrients here and grow a lot of food. But then what is going to happen? You have to ship it and then you have to dump it somewhere. So, if we just wanted money we could very easily just set up a bunch of systems and grow a bunch of food. But we want to find a solution to the waste strategy here in Longyearbyen, which currently is dumping waste into the sea. […] If we were able to produce more we would be able to sell it. However, we still want to stay true to our values. As I said, if I wanted to, we could just import all materials needed and grow as much as possible, but that is not our goal."

As can be seen in the quote above, the founder of Polar Permaculture's goal is to abide to a different agricultural strategy. The goal is not only to be able to grow edible produce in Longyearbyen, but to do it in a manner that is less environmentally harmful. Furthermore, the quote below describes Polar Permaculture's strategy, or their mind-set, as a constant search for components that can contribute to a more closed system with interaction between different elements.

> "Yeah partly, I chose the name Polar Permaculture not because of permaculture principles but because I want it to become more mainstream and less exclusive. We focus on what work, circular systems and circular thinking. I want as many benefits as possible. For instance, when we compost with worms we get this fertilizer. And when we get our digestor tank we can get heat, power and even more fertilizer. We look for the most benefits. […] We want to continue with this holistic approach. For instance, we do not only want to grow salad. I believe that many operations are to specific. They lack multiple components, and because of this fail to understand the broader picture."

These statements allow one to understand what Polar Permaculture is and what they want to achieve. The participatory observation processes and interpret analysis added further information on what Polar Permaculture does and functioned as key in order to complete the Peanut Model. Question regarding the farming system, during the participatory process, derived from the Peanut Model. Example questions included what different components of the heterotrophic, autotrophic and decomposition sub-systems exist, what is currently being imported, and how does the farm affect its environment vice versa. More detailed information regarding the various elements of Polar Permaculture as a farming system can be seen in Figure 2 below.

The inputs, that can be spotted in Figure 2, are essential for Polar Permaculture to function. Although the inputs are plenty at this point, the purpose, which too is visible in the diagram, is to achieve a sustainable and self-sufficient farming system, according to the founder. In order to do so, the idea is to reduce the inputs to the farming system to a bare minimum. The strategy in order to achieve this, according to the creator, is through innovation and development of farm components. This includes designing it in manner that reduces human interaction hence a general lessening of care taking of the farming system. Furthermore, although the perturbations and forces do not affect the farming system to a great extent as it is located indoors, the development of the farming system includes reducing impacts of these external impacts visible in the diagram. The impact Polar Permaculture have is that it displays the possibilities of farming in secluded areas, and how innovation can contribute to the very existence of a farming system.

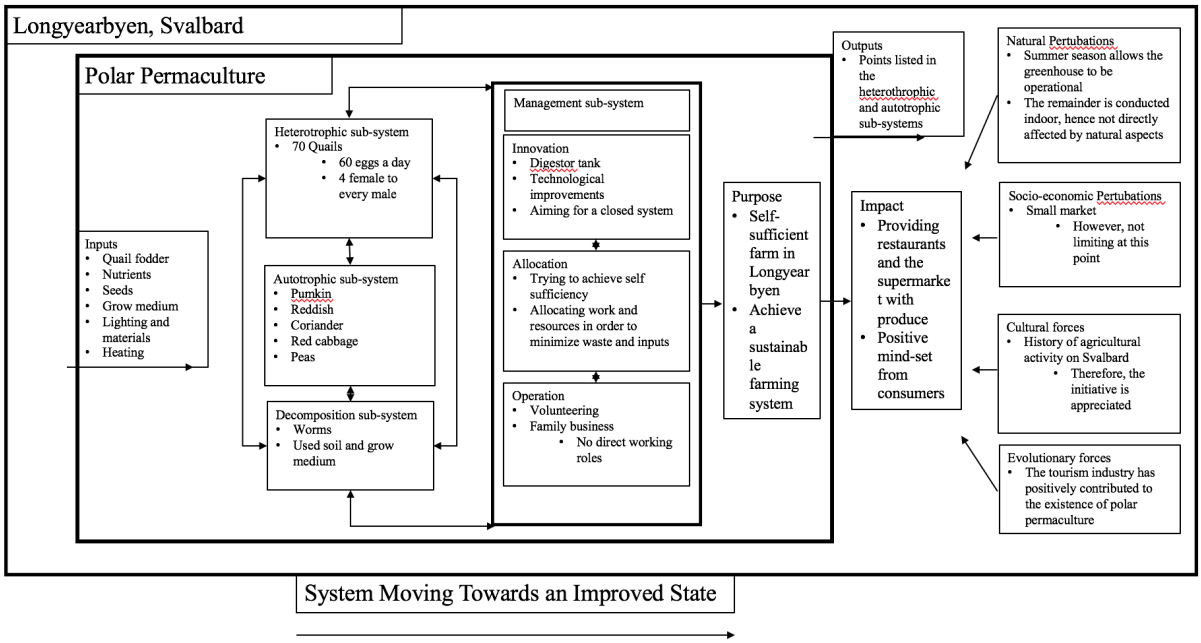

Figure 2. Complete Peanut Model of Polar Permaculture

The stakeholder analysis model below, Figure 3, reveals that there are many different actors, indirectly or directly, involved with Polar Permaculture. The community of Longyearbyen, both tourists and locals engage with them by either consuming their produce or helping at the farm. Furthermore, the local government contributes economically to them as they consider it to be a valid initiative that should be present on Svalbard. Therefore, it becomes somewhat clear that Polar Permacultures creation and existence is appreciated by the community.

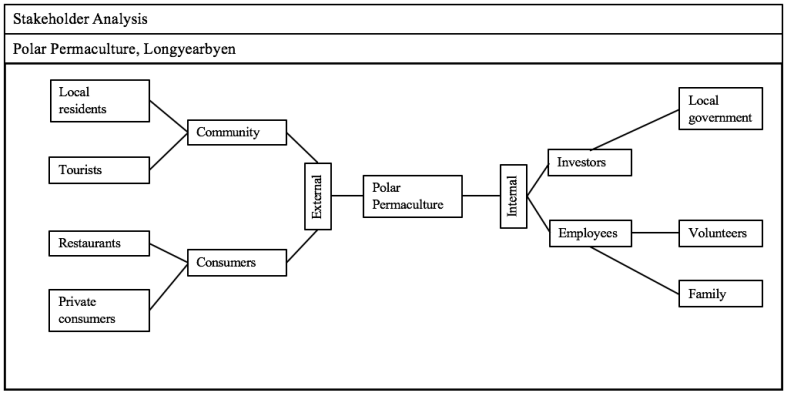

Figure 3. Stakeholder Analysis of Polar Permaculture

To further understand Polar Permaculture and parts of their strategies, the cause and effect diagram below portrays the causes for not, or trying to reduce, importing nutrients and what effect it may have.

The lack of options with regards to importing nutrients, together with a mind-set of the tenders of the farming system is key reasons for why Polar Permaculture is striving to create a self-sufficient system. This, according to the interviewees, has to do with the location. Had Polar Permaculture been located elsewhere, perhaps in a major city the aspects of convenience would have allowed them to find simpler solutions that would not necessarily strive towards creating a fairer farming system. Therefore, the effect of the location results in innovative solutions and the designing of a farming system that can, with time, become independent of importing nutrients, turning a disadvantage into an advantage.

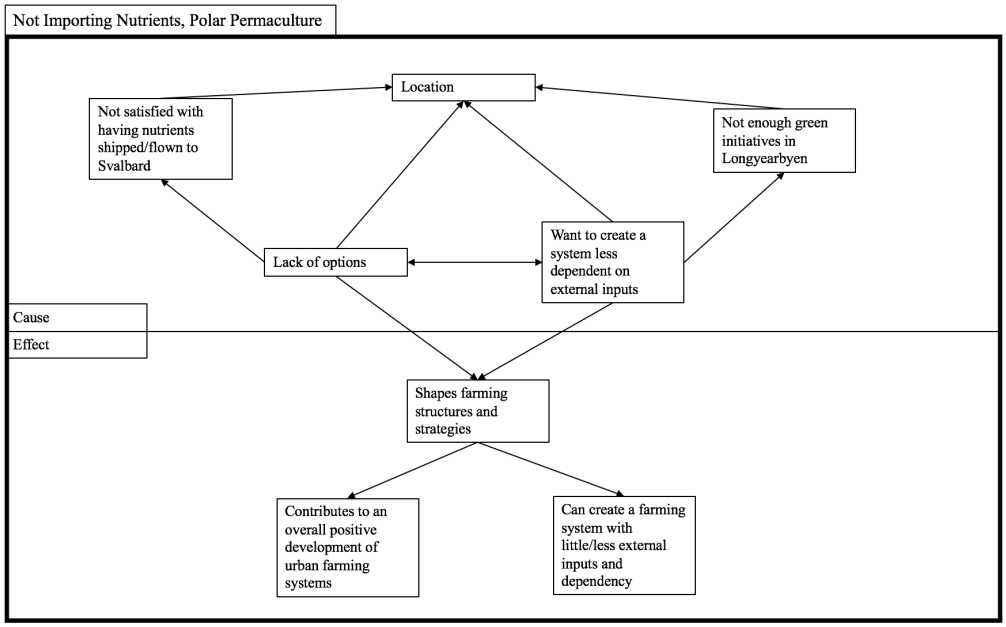

Figure 4. Cause and Effect diagram of Polar Permaculture

When compiling the different results from the various methods presented and applied, and placing them in a SWOT-Analysis it reveals that the current strengths, which are internal to Polar Permaculture, to be the location of the farming system, the mind-set of the creators, and the vision that they share. Location is considered an internal strength as well as external. As long as the location of Polar Permaculture can remain a source of inspiration for striving for solutions for self-sufficiency it can be considered both an internal aspect, as it benefits the vision and mind-set, and an external, as it is beyond the control of the creator and farming system, yet still contributes to an interest from both the inhabitants of Longyearbyen and its municipality.

The internal threats however, are labour demands including keeping costs relatively low. The external weaknesses include what to produce, meaning if specific consumers demand is more important than achieving self-sufficiency, and whether or not expansion is a requirement, or possible without damaging the basic idea.

SWOT Analysis, Polar Permaculture		
Internal	Strengths • Location • Mind-set • Vision	Threats • Labour demands • Current costs
External	Opportunities • Location • Interest of the population • Interest from the municipality	Weaknesses • Produce demands • Possibility of expanding

Figure 5. SWOT-Analysis of Polar Permaculture

5.2. Case 2. Källby Mölla

Källby Mölla is a communal lot located in the city of Lund in southern Sweden. The lot is approximately 100 square meters and is used for growing edible plants. It is part of an initiative that allows city dwellers to engage in agricultural activity. There are many lots located next to each other in central Lund and are all occupied by people with interests for small scale agricultural activity and gardening. Residents of Lund are able to apply in order to be given a lot and once they receive one required to pay a yearly fee and maintain the land in visually beautiful manner in order to keep it. The communal lot that is part of this study and paper is currently managed by one person, and the overall goal with the communal lot is to function in a subsistence manner, by producing as much foods as possible for the owner.

Two interviews with the owner of Källby Mölla were held. The first interview lasted for approximately 1 hour and the second interview lasted for approximately 0.5 hours. After the interviews, the farm was visited and farm aspects were explained by the interviewee.

Picture 2. Parts of Källby Möllas farming area. Photo: Sixten Lundqvist

The most common terms and themes that emerged during the inductive coding process for Källby Mölla were farming principles and the benefits of agriculture in urban areas. The quotes below portray an example of this.

> "I think that I am trying to work with technical improvements. My goal is to minimize the amount of manual labour. Especially in regard to pest and weeds control. I use textile products such as nets and cloths to cover the ground. Building materials like reclaimed wood. This all to minimize my own working hours. […] My long-term goal is to use it as a natural way of contributing to my food consumption. Including developing what I grow and how I grow it, making it more efficient and in the long run benefit to a feeling of being self-subsistence. The main challenge is not producing food but conserving it. I need to become better with the timing, in order to reduce food waste."

As can be read, the owner focuses on making the farming system as functional as possible, and this is mainly due to time constraints. All elements of the system are constantly improved upon in order to require less labour. Furthermore, as can be read below, the owner considers urban agriculture to be highly valuable for communities. That it contributes to social well-being and a constant positive interaction between the people who have communal lots near Källby Mölla.

> "The communal lots are for many a place for socialising with family and friends. But one lot is cared for by an organization, who wants to maximize their output. What is happening is that there is a lot of swopping of foods between neighbours. There is a tendency that people are left with lots of surplus and therefore give it to other people."

Källby Mölla can be dissected further with the Peanut Model. Example questions, that functioned in line with the Peanut Model, included what perturbations and forces affect Källby Mölla. More detailed information regarding the various elements of the farming system can be seen in Figure 6 below.

The Peanut Model reveals that the overall purpose of the farm is to become a self-sufficient farming system that will eventually grow enough edible plants and different varieties to sustain a diet for one person. With that as a primary goal, measures in order to achieve this are currently on-going. The inputs to this farming system are relatively high. The only internal strength comes from a joint composting system, which aids the autotrophic sub-system. The different management sub-systems are currently not designed for maximum efficiency, according to the interviewee. However, the secondary goal of the farming system is for it to function with as little manual labour as possible. Therefore, future allocations, operations and innovations are trying to achieve this. The impact that this system has is that it portrays the possibilities of urban farming, and by example shows that it can perhaps be possible to grow food for subsistence use as side activity. However, this system differs from the other ones as it is located outside and suffers from pests as well as seasons. But, it has the advantage of being located on high quality soils.

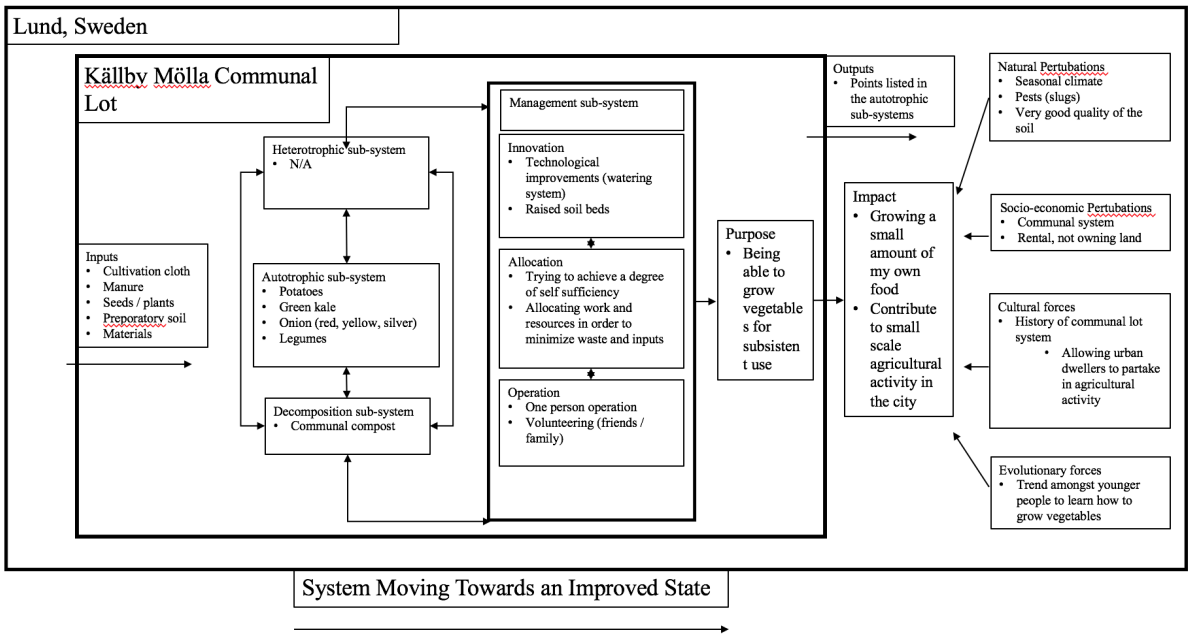

Figure 6. Peanut Model of Källby Mölla Communal Lot

The analysis below, the stakeholder analysis diagram, show little stakeholder interaction. The only ones working the land, are linked to the owner on a personal level. These people are also the consumers. The community however, benefits as such an initiative is accessible to a larger population.

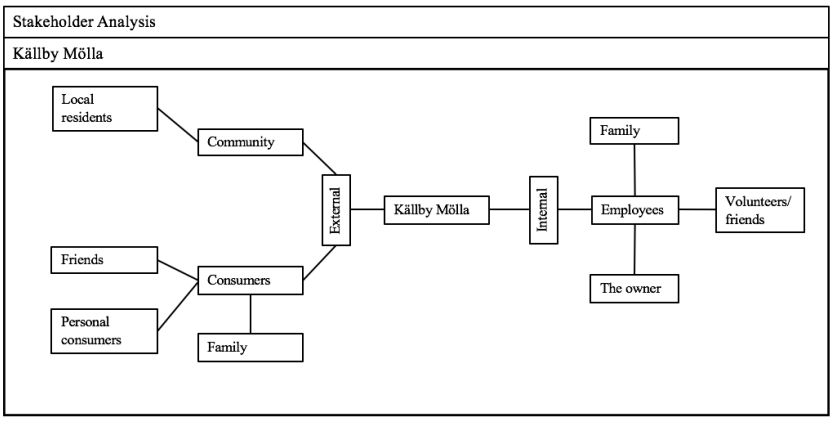

Figure 7. Stakeholder Analysis of Källby Mölla

The cause and affect diagram below portrays the reason, or cause, for not importing nutrients, and what effect it can have. The two causes, included in this figure, are that the soil is of high quality, and contains enough nutrients, meaning that the dependency does not need to be that high. The second one is the mind-set of the owner who does want to minimize all types of inputs. The effect that this has is that the farming system is under an ongoing transformation that can allow it to be designed in a manner that reduces its import of nutrient dependency.

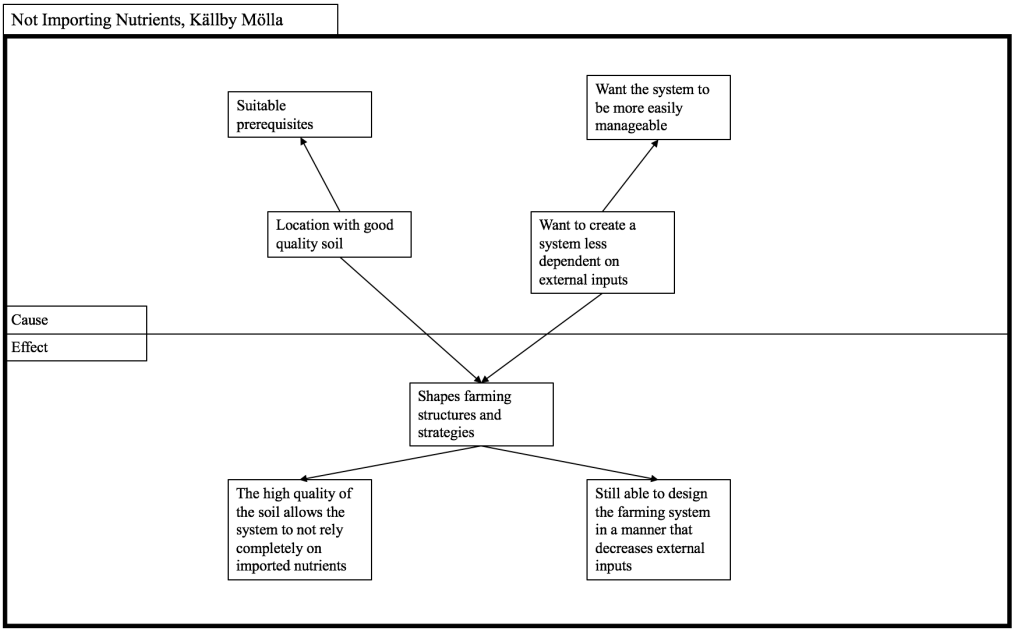

Figure 8. Cause and Effect diagram of Källby Mölla

The different results reveal that the internal strengths of the Källby Mölla farming system is the mind-set of the owner and their engagement. The internal threat is time, knowledge and labour as this is still a side activity.

The external opportunities include the natural circumstances and prerequisites, like the high-quality soil. Furthermore, the surrounding communal lots which can create knowledge transfer between the different owners of the lots. The external weakness however, can still be considered to be the natural perturbations, as the internal threats previously mentioned, limits the owner from working the land and tending the farming system on a regular basis.

SWOT Analysis, Källby Mölla		
Internal	Strengths • Environmental awareness and engagement • Mind-set	Threats • Knowledge • Labour • Time
External	Opportunities • Natural perturbations • Surrounding communal lots	Weaknesses • Natural perturbations

Figure 9. SWOT-Analysis of Källby Mölla

5.3. Case 3. Greenworks

Greenworks is company in central Stockholm that construct vertical plant walls for indoor and outdoor decorations. They currently do not engage in any agricultural activity for edible produce, however are considering expanding and entering this industry by producing constructions for vertical farming along with own production of lettuce and microgreens for restaurants, offices and domestic consumption. At this point, they do share similar features to an urban agricultural company. They rely on hydroponics, the use of vertical construction for sustaining plant life and visual impact, and an import of nutrients, plants and materials used for construction. The reason for including this case is because their system is completely reliant on technology. As plants do not know whether or not they are going to be eaten, their constructions might as well be functional for edible plants.

Two interviews were held. The first session was a group interview with the founder and two employees. It lasted for approximately 1.5 hours. During the second session only the founder was present. It lasted for approximately 1.5 hours. After the interviews, their production system was explained by the interviewees.

Picture 3. Vertical hydroponic construction by Greenworks. Photo: Sixten Lundqvist

The themes that emerge during the inductive coding process were technology and innovation in regard to agricultural activity, and the importance of urban agriculture. The interviewees consider there to be an educational value in urban farming, as can be read below.

> "Everyone is beginning to understand that it is possible to produce healthy foods locally. And as people are brought closer to it they start to understand how it functions. And even though it is completely technology dependent, people may appreciate it. […] Regarding imports, there will always be a transportation moment. However, it should be possible to reduce it. I think patients is key."

Furthermore, they acknowledge urban agriculture as a growing trend. They consider it important to make sure that companies, like themselves, can contribute in making the technology dependent systems efficient and environmentally friendly.

> "There is feelgood moment to urban agriculture. It is a growing trend as it arguably contributes to people's well-being. However, it is still of importance to determine how efficient the systems can be, how environmentally harmful they are, and how they can be improved upon. […] But anyways, urban agriculture should be encouraged. It is of importance for urban dwellers to gain a connection to agriculture."

The Peanut Model, which follows, is slightly less informative than the other two cases. Still the information was obtained similarly. Example questions included Greenworks' different

management sub-systems function. More detailed information regarding the various elements of the farming system can be seen in Figure 10 below.

Greenworks, from the results in the Peanut Model is close to completely dependent on its inputs and does not, as can be spotted in the management sub-system, innovate, allocate or operate in order to change this and become more self-sufficient. Its strategy, or even business plan, is niched and self-sufficiency and sustainability are not central aspects, according to the interviewees. The management sub-system's focus is to enable the autotrophic sub-system to be as functional as possible, both in terms of growth of plants and cost effectiveness, hence enabling the overall purpose of the farming system. The perturbations and forces that affect Greenwork's impact taken into consideration and the system does well in letting it be little affected by it. However, perhaps the most noteworthy external impact is included in the socio-economic spectrum. Greenworks is currently battling the dilemma of their services being dependent on a populations interest, and can be considered a want rather than a need. The impact that Greenworks have is that it highlights the possibilities of plant production.

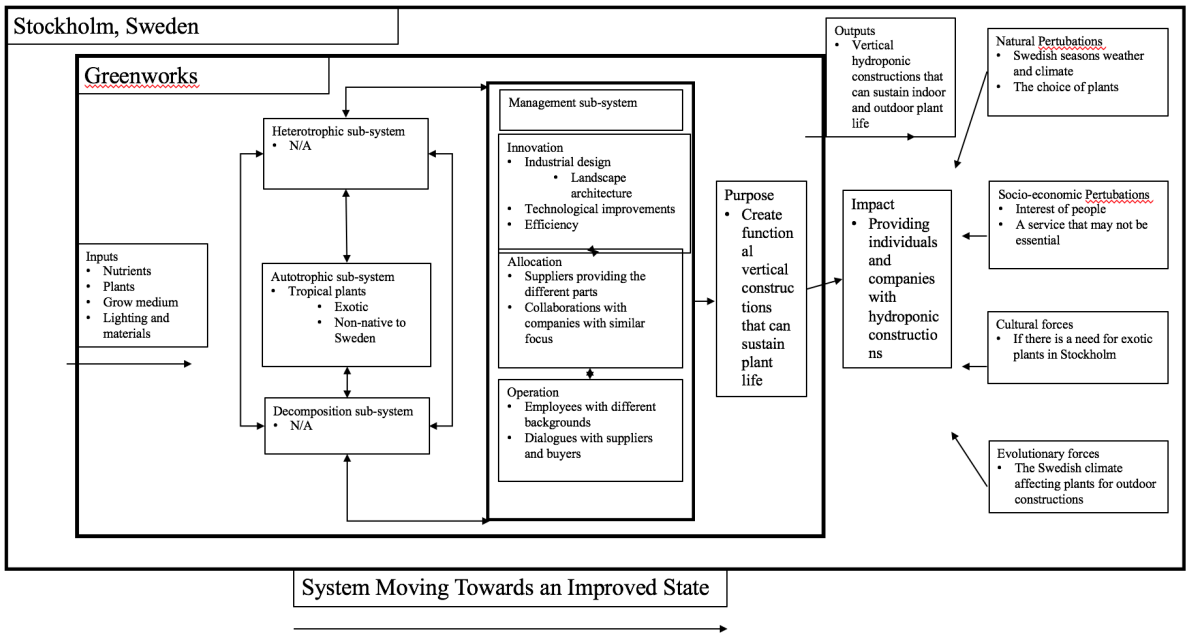

Figure 10. Complete Peanut Model of Greenworks

The figure below represents a stakeholder analysis of Greenworks. It portrays how Greenworks currently does not involve too many different, both internal and external, actors. As its services,

providing functional hydroponic constructions constructed to sustain plant life both in-and outdoors, is a niche market, the level of interaction with stakeholders are limited.

The external stakeholders, included in the community and consumers labels, are the ones who buy their services or observe it. Its internal stakeholders are merely investors and employees who allow the company, or farming system, to keep functioning. Therefore, it is hard to draw any conclusions merely by abiding to the figure below.

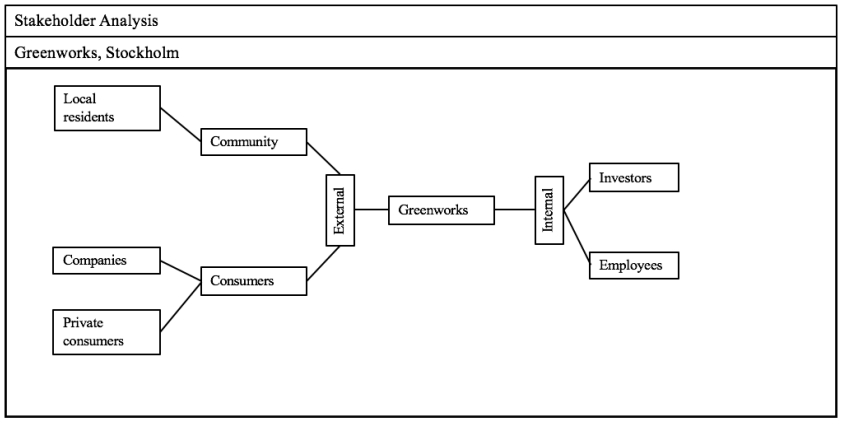

Figure 11. Stakeholder Analysis of Greenworks

Instead, with the aid of the previous method presented and applied, a cause and effect diagram was established which yielded more relevant results for this thesis. The figure below represents a cause and effect diagram with regards to the reasoning behind importing nutrients. Meaning what is Greenwork's cause for importing nutrients in order for the plants to remain alive, and what effect does it have on them and their surroundings.

The two major causes of importing nutrients is lack of options and the element of convenience. This is due to location, labour demands and time restrictions, lacking knowledge, price and a limited market. The interviewees mentioned how they never considered the possibility of finding sources, or producers, of nutrients closer to their location, which would reduce their import requirements distance wise. Although reducing the import distance for nutrients would not make Greenworks independent, as nutrients are still being imported, it would show an initiative towards taking measures with consideration of fairer and more sustainable agricultural systems, hence also agroecology.

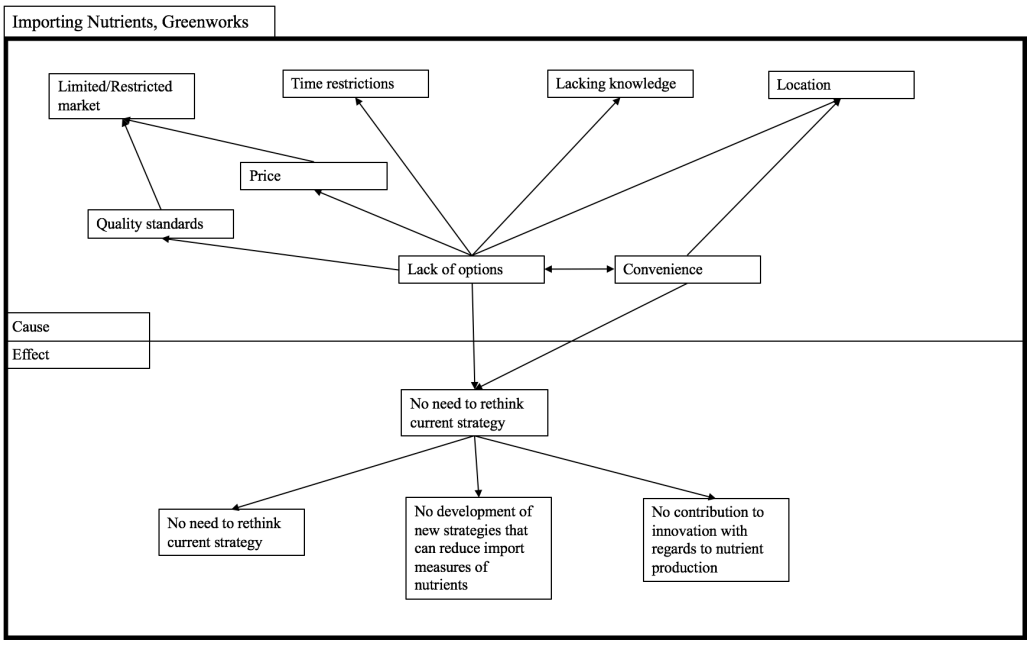

Figure 12. Cause and Effect diagram of Greenworks

The different methods applied have all yielded some type of results. The more vital, or more accurate for the topic of this study has been compiled into a SWOT-Analysis diagram which can be seen below.

The internal strength of Greenworks lies in their entrepreneurial spirit. They are, according to the interviews, willing to expand and start producing edible plants. They do not see any major obstacles. However, the internal threats remain knowledge and labour, which are intertwined. They currently lack the knowledge of producing edible plants of a certain standard and a certain amount. Therefore, more labour would be required, both time investments and hiring new staff, which currently does not seem to be plausible. They do still consider expanding as an opportunity, an external one, as a general interest in urban agriculture is present. However, the external weaknesses, of economic uncertainty is present, which considerably can be related to the internal threats.

SWOT Analysis, Greenworks		
Internal	Strengths • Entrepreneurial spirit	Threats • Knowledge • Labour
External	Opportunities • Expanding • Interest of the population	Weaknesses • The uncertainty of economic profitability

Figure 13. SWOT-Analysis of Greenworks

6. Discussion

The discussion section that follows has been divided into different section with different focuses in order to remain with a similar structure that follows throughout the paper. The cases that were earlier presented are compared with one and another, and discussed with regards to agroecology, location and import strategies. Furthermore, the principles of agroecology, along with the role of nutrients and geographical location are discussed in a critical manner that makes it relatable to the aim and research question of this paper.

6.1. Comparison of the Different Cases and Framework Relation

The three different cases, or farming systems, presented and examine vary from one and another. They all niche in different fields, providing different services and producing different plants and edibles, and are located in different places. They all have different agendas, Polar Permaculture wants to become a self-sufficient farming system in the secluded area of the Arctic, Källby Mölla aims, via appropriate design, to become productive enough for subsistence farming, and Greenworks simply wants to provide functional hydroponic constructions for sustaining plant life anywhere. Concerning the import methods for nutrients, both Polar Permaculture and Källby Mölla are undergoing a structural change in order to reduce, and perhaps even eliminate, this process. Greenworks on the other hand, are not actively considering or exploring different possibilities for changing their nutrient import patterns, but are considering alternative means for the future

The similarities are still rather many. Although the locations vary, the surroundings are not too different. All are located in cities or towns, exposed to urban dwellers, hence some sort of direct interaction between the consumers and producers. They all share a forward striving mind-set aiming for constant improvements in regard to each farming system. What is noteworthy is the reasoning behind this. The different interviewees, representing the different farming system, ultimately aim for becoming fairer and more sustainable, but pursue it differently. Polar Permaculture's location is key in order for it to become fairer, hence more agroecological and sustainable. The interviewees claimed that Longyearbyen had to be location for them to follow an unconventional track. The owner of Källby Mölla wants the farming system to become less time consuming, as it is a side activity, and therefore wants its design to allow for greater self-maintaining aspects. Greenworks strategy, although not currently in motion, is to look for different sources for importing nutrients in order to make their system fairer. As this is the current situation, the results that the methods have yielded, which were presented in the three different case studies, relate to the theoretical frameworks included in this paper, as well as the research questions. But to what extent they are applicable remains to be discussed.

6.2. Agroecology Dimension

With regards to Gliessman's scale of conversion, presented in the theoretical frameworks section, Polar Permaculture can be placed somewhere between level 3 and level 4, level 3 being a design of a farming system that allows it to function with a new set of principles and level 4 being the creation of different connection between producers and consumers. The farming system, via innovative design, has decreased damaging inputs and enhanced its efficiency, and allowed it to function with a different set of agricultural principles. Furthermore, it has created a different food network, being that it is the only farming system located in Longyearbyen. Inhabitants and tourists partake in their agricultural activity, not merely by consuming Polar Permacultures produce, but by either volunteering at the site or via touristic visit. However, it may be stretching it to place Polar Permaculture on level 4. Polar Permaculture's alternative practices are technology dependent. Polar Permaculture does not necessarily operate with a new set of ecological principles, with natural synergies. Instead the components of the farming system have been selected with caution, for it to become more self-regulatory, self-maintaining and self-sufficient. Gliessman's scale, and idea of what agroecology is, is based on how farming systems can function in harmony with nature, how it can benefit natural well-being, and how it can profit from ecological and natural geographical prerequisites. With such prerequisites, it is

hard for a farming system like Polar Permaculture to excel on the agroecology scale of conversion.

Similar outcome is present when discussing it with regards to FAO's key elements. Circular economy is existent, as well as social well-being, appropriate governance, knowledge transfer and cultural consideration, as a certain level of interaction between consumers and producers exists, and as the founder mind-set is grounded in the belief of creating a fairer and more sustainable system. Furthermore, one could argue that both recycling and efficiency are elements of Polar Permaculture. But as Polar Permaculture is an indoor farming system it does not qualify as containing the elements of resilience and diversity as described by FAO. These two elements are natural phenomenon's that are not directly related to, or affect, Polar Permaculture.

However, if this is to be considered a problem, an obstacle that does not allow Polar Permaculture to be considered as an agroecological farming system, one can take iPES principles into consideration. Their advice is not to avoid technological improvements but instead embrace them, improvements such as Polar Permacultures being able to engage in farming in a secluded area with little to none appropriate natural prerequisites for engaging in what they are doing. The reasoning behind this may well relate to Porters article on the advantages of disadvantages. Polar Permaculture is disadvantaged because of its location, yet because of this has developed an impressive farming system. Furthermore, it matches with the agricultural location model as the produce it provides for Longyearbyen is cheaper than what was previously imported. The location has allowed Polar Permaculture to not succumb to convenience and due to the location disadvantage, treat it as an advantage in order to create a fairer farming system and contribute to better and more sustainable food networks. The systematic approach of Polar Permaculture does not follow all principles of agroecology due to its methods which have been constructed in order to avoid the natural surroundings. But it is still a farming system that constantly strives for improvement and diverts from conventional means.

Källby Mölla communal lot can too be placed rather high on Gliessman's scale of conversion. What remains to be discussed and addressed is to what extent it actually fits within the levels. The design of the farming system diverts from conventional norms and aims to reduce external inputs. However, this may well be to the small scale of the system, and that it does not have to

meet any consumer demands, as the produce is solely being consumed by the owner. As it is only a side activity, it may not be fair to argue that it functions with an alternative set of ecological features, or that it has established a different and more direct connection between the producers and the consumers. With that being said, in this paper it will be placed between level 3 and 4.

With regards to FAO's key elements; social well-being, appropriate governance, knowledge transfer and cultural consideration can be considered present, because of its recreational benefits, its management strategy, the engagement between neighbouring lots, and the cultural heritage of the county. Additionally, recycling and efficiency are present elements of Källby Mölla and considered as important by the owner. The diversity of different crops is present. Circular economy is absent as the only stakeholder involved is the owner. The resilience of farming has not been measured for this study. Therefore, Källby Mölla may well be considered as a rather fair system according to both FAO and Gliessman. But as it is merely side activity, the owner is not dependent on its success or economic profit. Instead, it is a trial an error process where the owner can try and design it in a manner that allows it to be easily managed, and keeping FAO's elements as well as Gliessman's guidelines in consideration, without having to worry about lower yields or a specific quality of produce. Had the farming system suffered the pressure of depending customers, it remains hard to determine whether or not the farming system, and the owner, would abide to the current principles. The FAO and Gliessman's scale would classify Källby Mölla as a somewhat fair farming system as it holds many common themes and elements, listed previously. But due to its current side activity status, one cannot determine to what extent it contributes to a national, or even global, change toward more sustainable and fair food systems.

Its location contributes to the accessibility, allowing the owner along with all other owners of neighbouring communal lots, to engage in agricultural activity. But as the soil quality is of such high standard, it does not place Källby Mölla in a disadvantageous situation. The current disadvantages, that were described as obstacles and threats in earlier sections, such as labour and time, that Källby Mölla suffers from has instead benefitted its systematic approach where solutions have been designed to improve the system as a whole, making it less labour demanding and more self-sufficient. But it does not coincide with Porter's competition model and the agricultural location model, nor does iPES technological improvement recommendations apply.

Greenworks farming system is by far the least agroecological case included in this study and paper. It does not surpass level 1 on Gliessman's scale, level 1 being decreasing damaging inputs, as all its strategies and practices are conventional. Nor does it contain any of FAO's agroecology elements. However, it does embrace iPES recommendations on how technology can be an efficient part of agricultural activity. With their applied hydroponic system and grow lights they are able to grow and sustain plants indoor and outdoor in Stockholm. Furthermore, they have maximized space by designing these systems in a manner that allows the plants to grow vertically.

Therefore, it may well be applicable to discuss Porter's competition model with regards to Greenworks. Their disadvantage is indoor plant production, and because of this disadvantage they design functional systems for indoor production that maximizes space. If they are to put their plan of producing edibles in motion, they are able to localize as closely to consumers as possible. Hopefully, abide to the different agroecology principles of Gliessman and FAO, including a systematic farming approach where different components benefit from one and another.

6.3. Location Dimension

The location of the different cases has had a diverse effect. Polar Permaculture, located far north above the polar circle, has been forced to apply technology and innovative solutions in order to produce food. But still, as the founders of the farming system and company have an environmental and sustainability agenda, the design of the system includes a broad range of agroecology principles as previously mentioned. Therefore, one could argue that the disadvantage of being located in a secluded area in the Arctic region, with little to none prerequisites for farming, has instead become an advantage. Had Polar Permaculture been located in a more accessible area, for instance a city like Stockholm, one could think that they would succumb to convenience, like Greenworks, and instead of applying a systematic approach where components of the farming system are designed to reduce external inputs it would instead rely on external resolutions and imported solutions, making it a system that is dependent on external resources.

Källby Mölla's location, on the other hand, is an advantage. The owner, the one working the land, is able to keep this farming system as side activity yet produce sufficient amounts for personal consumption due to the high-quality soil. The natural prerequisites allow for high yields although the farming surface is small. Another positive aspect because of its location is that is easily accessible, which contributes to a functioning way of engaging in agricultural activity. Källby Möllas location has therefore, on its own, not enabled it to obtain the various agroecology components that were previously described. Instead it is the mind-set of the owner that has allowed agroecology principles to emerge.

Greenworks does not have a fix location, like the other two cases. Its location can therefore instead be described as to where Greenworks place their constructions. They are in urban areas, often placed along walls and indoor without natural sunlight. Therefore, Greenworks has designed its hydroponic constructions with regards to these three aspects. But in difference from Polar Permaculture, their location has not allowed agroecology features to emerge.

6.4. Imports

The import strategies of nutrients of the different farming systems are due to different reasons. Greenworks, in current status, has decided not to take any measure in regard to decreasing this external input. They are considering changing their strategy and look for alternative sources, which includes farming companies offering this service and are located closer to them, which could include farms near the Stockholm region. Källby Mölla, is currently not dependent on importing nutrient due to the high-quality soil. However, as a composting program exists, where the different owners of the communal lot do composting for all to use as a measure to keep the soil fertile, Källby Mölla can rely on this instead of importing. Polar Permaculture is currently importing nutrients, but are taking measures, such as composting, in order to eliminate this external input.

As long as nutrients remain an external input for a farming system, one can raise the question whether or not it is better to import nutrients in order to grow plants or just importing plants directly. Therefore, if a farming system does not take measure towards finding alternative sources of nutrients, such as generating through composting or to the very least look for nearby providers of it, one import is merely replaced with another. It may be an import that requires less transportation than importing fully grown plants, or at least is transported in a more

efficient manner, but it is still an external aspect that a farming system in an urban area will most likely be dependent on. However, as agroecology is more than a natural science, a core principle of agroecology is the alteration of food networks. Therefore, even if a urban farm is dependent on conventional methods and on external inputs, due to lacking natural circumstances and prerequisites for farming, it still can bring consumers closer to producers. Urban dwellers may therefore be able to interact with farms and farmers in urban areas, causing a legitimate case for including urban agriculture in agroecology frameworks. With regards to iPES, technology is not necessarily environmentally harmful and if so, can be improved upon in order to cause less damage.

6.5. Synthesis

The agroecology principles, the ones included as theoretical framework for this study, cover large ground and allows one to systematically consider the fairness of a farming system. However, its principles and elements are not always relatable to urban farming systems that rely on technology and innovative solutions, such as Polar Permaculture. The elements of diversity and resilience, and level 3 on the conversion scale where a farming system should function with a new set of ecological features, are hard to achieve. This does not necessarily make the farming system unfair or unsustainable. It holds other positive qualities as discussed in the previous section. Therefore, agroecology framework, apart from iPES where technology is embraced, does not necessarily fit urban farming, or to the very least farming in areas not prone to agriculture with little to none prerequisites for agriculture. On the contrary, it portrays technological support as a problematic obstacle in the quest for more sustainable and fair farming systems due to maintenance and dependency aspects that arise with it.

With regards to the research questions. A farming systems location will have an effect on its farming strategies. Polar Permaculture wants to create something on Svalbard that differs from conventional norms. Källby Mölla wants to become even more accessible, by being more easily managed. Greenworks wants their constructions to function anywhere.

The factors that determine why and how the systems import nutrients are due to availability, convenience and a certain mind-set. Greenworks import as it is the simplest option. Polar Permaculture do it as they currently cannot generate it themselves. Källby Mölla is lucky

enough to have a communal composting system available, as well as the high-quality soil on which it lays.

Agroecology does not necessarily hinder the development of more sustainable and fair urban food systems. But as its frameworks are somewhat limited it does not actively contribute in broadening its spectrum of what should be considered fair. In doing so agroecology might miss an opportunity to affect an emerging form of agriculture.

7. Conclusion

By addressing various aspects of urban agriculture and by questioning agroecology this paper has highlighted how agroecology is a narrow framework in need for greater inclusion. Its framework is currently bound within certain natural prerequisites and therefore does not allow urban farming systems to be considered as fair as they perhaps should be. By examining and discussing three different urban farming systems and how their different location has affected them, this paper provides reasons for why urban agriculture, even with the aid of technology, holds positive features. Instead of excluding such farming systems, agroecology should instead embrace them, and help their development, by reconsidering its core foundations, towards becoming fairer. Therefore, future research should focus on the social benefits that urban agriculture may have, and how urban agriculture can become efficient yet environmentally friendly, as well as fair.

8. Critical Reflection

The following sections discusses this paper in a self-critical manner, hoping to highlight how it can be improved upon, as well as what could and should guide future research with regards to urban agriculture and agroecology. The paper has yielded legitimate results and provided an interesting discussion that can be beneficial to both agroecology as a set of principles and to the different farming systems included. However, the complexity of this thesis can be questioned. The topic may not be scientific enough to be considered vital for agroecology research, and the results will perhaps not contribute to any direct solutions. The flaws of this thesis, along with recommendations on how it can be improved upon are evaluated in the different sections below.

8.1. The Topic of Choice and Objectives

The topic of choice is critical as all types of science need be question and discussed with a critical mind-set in order to contribute to academic development. Agroecology, as a set of principles, may be emerging in regard to agricultural activity as it battles current hot topics, such as environmental awareness and food security. But it is still a rather unheard-of type of science, which could be due to the image it portrays by going against conventional means and promote strategies, both social and natural science, that are alternative and can be considered less attractive and less plausible. Therefore, it is of importance to discuss if and how agroecology can become more inclusive and remove a perhaps unattractive image. However, there are other aspects of agroecology worth researching, analysing and discussing that could have yielded more interesting results and furthermore benefitted agroecology as a topic or ideology more directly. This includes looking at natural sciences aspect, such as the comparison between different types of nutrients, or actual transportations measures for nutrients, which still would have been possible with the aim of this thesis.

The aim and research questions has allowed this thesis to provide a broad understanding of the three different cases, how they are applicable to agroecology and how urban agriculture should or could be embraced. But it can still be considered to be too insignificant as the answers to the research questions do not bare enough weight to make a difference. A research questions that spanned equally over natural and social sciences would have provided more sufficient answers and be made more applicable as agroecology research, as agroecology takes pride in being an interdisciplinary scientific form. An example of this would be to form a broad research question with regards to agroecology. Adding two sub questions where one question dealt with a specific socio-economic issue, with a subjective incentive, and the other question dealt with a natural scientific issue, with an objective incentive.

8.2. The Methodology

The methodology functioned in a befitting manner for this thesis. However, more cases could have been included to further enhance legitimacy of this paper and in order to obtain a broader range of answers as well as different approaches on urban agriculture. Although follow up interviews were made, more could have been done in order to obtain more specific answers. The fact that one of the cases does currently not engage in the production of edible plants can be considered as illegitimate.

The frameworks have all been valid for this thesis, and allowed the formation of acceptable answers to the different research questions. But once again, natural science data on the transportation of nutrients would have contributed to a paper with greater depth.

The results allowed for a deep discussion that provided answers to the research questions asked, however perhaps not deep enough to question the very foundation of agroecology, which can be considered either good or bad. However, this means that the results and discussion did not provide a conclusion convincing enough.

8.3. Proposed Research

Examples for recommended future research includes evaluating transportation means that exists in urban farms. Evaluating the difference between importing nutrients and importing edible plants would yield interesting results that would have further benefitted the topic of this paper. Another aspect to consider is the subjective effect urban farms have on urban dwellers. To try and measure if urban farms are appreciated by people in urban areas too would have yielded results befitting for this paper. Furthermore, how circular economies with regards to urban agriculture can function would to be of great interest. Such results and answers could even contribute in policy planning and making.

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10. Appendices

10.1. Interview Guide Polar Permaculture

Polar Permaculture

- What is it?
    - A farming system?
    - A company?
    - A life style?
- How did it come about?
    - An idea?

    - A goal?
- What made it work?
    - Location
    - Contributions?
        - Economic?
        - Social?

Svalbard

- Why this location?
    - Network?
    - Demand?
- How has the location affected Polar Permaculture?
    - Positively?
    - Negatively?
    - Could it have functioned in other places?
        - Urban areas?
        - Rural areas?
- How is it appreciated by local people?

Future plans

- What are the goals?
    - Expand?
- What aspects can be improved?
    - Economic terms?
    - Environmental terms?
- What does the ideal Polar Permaculture look like?
    - What are key components?

Permaculture

- Why permaculture?
- How has it affected Polar Permaculture?
    - Imports?
        - Decreasing?
    - Productivity?
        - Increase?
        - Decrease?
    - Appreciation?
        - People?
        - Restaurants?

Polar Permaculture

- What are obstacles facing Polar Permaculture?
    - Components?
    - Demand?
    - People?
    - Can they be overcome?
- What positive aspects are worth further developing?
    - Design of the farming system?
    - Relations with customers and local people?
- Can polar permaculture function as an example of agroecology and agriculture in areas not prone to agriculture?

10.2. Interview Guide Källby Mölla

- How does the communal lot system work?
    - Who is eligible?
    - Why do people want it?
    - What do people want to achieve?
- What is the purpose of your communal lot?
    - Subsistence use?
    - Recreational?
    - Side activity?
- What do you plan to achieve in the future?
    - Economic incentive?
    - Provide edibles for friends and family?
    - Expand somehow?
- What are your imports?
    - Labour?
    - Materials?
    - Seeds?
    - Manure?
    - Nutrients?
- How does Lund benefit from Källby Mölla?
    - Communal engagement?
    - Knowledge transfer?
    - Agricultural awareness?
- How has the location of your farming system affected you?
    - The quality of the soil?
    - The accessibility?
    - Convenience?

10.3. Interview Guide Greenworks

Urban Agriculture

- Is it necessary?
    - Why bother?
    - Can it be considered a hype?
    - Is it about how you are perceived rather than what you do?
        - Does that matter?
    - Can it function as more than just a type of farming?
        - Profits?
        - Well-being?
- Is it attractive?
    - Does appeal to you?
        - Growing in plastic tubes?
    - Does it feel unnatural?
    - Would a restaurant that only serves food that has been grown indoors be considered high class with healthy food?
    - How
- Can it replace urban produce?
- Environmental aspects?
    - Is it environmentally friendly?

    - Can it function with sustainability features?

Greenworks

- If Greenworks were to engage in the production of edible plants what would the main objective be?
    - The actual production?
    - The design aspect?
- How would Greenworks make a shift towards becoming a company that provides urban agricultural services?
    - Minor prototypes?
    - Collaborations?
    - Upon requests?
- Other companies are producing equipment for urban agriculture, what do you consider to be their main flaws?
    - In regard to what Greenworks does

Agroecology

- Are people willing to engage in farming?
    - Can urban agriculture become community supported?
        - People helping with maintenance etc.
- Do people have time to engage in farming?
    - Too time consuming?
    - Merely as a hobby?
    - Is the arguable inconvenience of producing food problematic?
- Can urban agriculture become central within the frames of sustainability with time?
    - How?
    - What do you think?