rethink farming

vegetables grown where they are sold

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AUTHOR'S VISION

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CORNELIA FRANZÉN

My interest in hydroponic farming started during my fourth year in architecture school when taking the housing inventions studio. The assignment was to design a multifunctional building which would mix housing and work places. As an addition, I chose to incorporate a vertical farm in between my two timber structures with a food hall in the bottom floor where the vegetables would be sold. Hydroponics is a way of growing vegetables using only water and without the need of soil which makes it a perfect system to introduce in an urban environment. Since then, I have thought about how to implement this idea on a larger scale. I started to research existing hydroponic farms and how they are working to distribute their crops to the public. Some have weekly vegetable basket subscriptions and others simply had deals with local supermarkets. I wanted to come up with a concept that would make this easy way of farming the norm, instead of something exclusive only available in selected cities or towns. Through connecting the greenhouses with an established company like ICA and creating a clear hydroponic profile would not only strengthen their sustainability goals but also allow the concept to be adapted by many stores around the country.

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RETHINK FARMING

ABSTRACT

The way that we produce our food today is not sustainable - not for the environment and not for us. Farms are the second largest global emitter after the energy sector (IPCC, 2014) without taking the transportation of crops into account. In a globalized world, we buy and trade products from other countries and rely on them to supply us with necessities. In 1988, Sweden produced 75% of the food consumed in the country and today that number is down to 50% (Lantbrukarnas Riksförbund, 2018).

As people are becoming more aware of their global footprints, ecological and local products are being more sought after than ever. With our growing global population and nearly 68% expected to live in cities by year 2050 (UN, 2018), it would make sense that also 68% of the food production takes place in cities. New and innovative ways to produce and distribute food are required for us to overcome the climate challenges we are facing. Urban farming is a trend which has been caught on by many bigger cities and proves that it is possible to move food production from the countryside, directly to the consumers in bustling cities. Using a lightweight hydroponic system (which has no need for soil, only water) makes it possible to place farms anywhere and adapt to different sizes and roof layouts.

This thesis proposes hydroponic greenhouses on top of existing ICA grocery stores which sells the crops to the public. This allows the stores themselves to take over the role as farmers while at the same time no new land, pesticides or transportation is required. Moving the production of essential foods to where they are sold and consumed by using a system which requires up to 90% less water than traditional farming but gives 2-4 times greater yields (Leaffin, 2019) would reduce our impact on the environment significantly. Connecting farms with a company like ICA, will help implement the new way of producing food on a larger scale, making it the new norm instead of something exclusive in selected locations.

To try out the concept in greater depth and detail, ICA Rosenlund in Gothenburg acts as a platform for a design proposal to investigate how much space is necessary to meet the requirements of a specific store. The ultimate goal would be for all the grocery stores around the world to adapt the same food production idea for a greener future and more self sustained cities.

AIM & PURPOSE

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The aim of the thesis is to investigate how to make food production more sustainable and efficient through urban farming. The result will be a design proposal on a chosen supermarket in Gothenburg.

In a time of climate change, drastic changes need to be made in how our resources are being used. 50% of the Earth's habitable land is dedicated to agriculture (Our world in data, 2017) and 70% of the freshwater is used to irrigate farms (Thirsty food, 2019) while at the same time 1/3 of our food becomes waste (FAO, 2018). Therefore it is one of the biggest sectors where our impact on the globe could be reduced drastically. Bringing farming into the cities for a local food production would be the first step in the right direction. The focus of the thesis will be to research different hydroponic systems and their yield of crops as well as designing a greenhouse proposal for ICA Rosenlund in Gothenburg which will investigate how much space is necessary to meet the selling numbers of the specific store.

DELIMITATIONS

The difficult part of the project is setting limits when it comes to selling the concept of farming on the roof to a stakeholder like ICA. Since this is an architecture project, the focus will not be on making a business model or proposing who will work at the farm, what salary they will have, or how they handle the new supply of local vegetables and greens in their stock.

The first focus point will be to research requirements of the hydroponic systems and what the benefits are compared to traditional agriculture. Calculations of monthly yields of vegetables will be compared to real numbers given by a specific ICA store to get an understanding of the profitability of the concept.

The second focus point will be on programming the chosen roof in the most beneficial ways. The spatial qualities and construction of the greenhouse will be explored through digital and physical models.

The third focus point will be to make the greenhouse a landmark in the city and involve the public in the production by opening up a part of the farm. A cafe will be placed on the roof with clear connections to the farming taking place there.

METHODS



Working in a circular way will continuously improve the design when looking into new reference projects, when reading something interesting, or interviewing someone who comes with an interesting idea or perspective.

Site visits and interviews with experienced people from reference projects as well as stake holders on my chosen location will be the most important source of information and inspiration.

Using a log book to document the entire process to help support every design decision made.

" HOW CAN WE PRODUCE FOOD IN A SUSTAINABLE WAY WHILE TAKING URBANIZATION INTO ACCOUNT? INTRODUCTION

RETHINK FARMING

CONCEPT

ADDING GREEN HOUSES WITH HYDROPONIC SYSTEMS ON TOP OF ICA GROCERY STORES







moving away from food being transported all over the world covering half of the planet's habitable land, the unnecessary waste it produces, harmful pesticides, and the lack of urban cities connection to food production



moving towards a local food production where consumers have a visual connection with the process, exploiting no new land, using less resources in a closed loop system and giving crops potential for a longer shelf life 2. BACKGROUND AND REFERENCES

FOOD PRODUCTION AND SELF SUFFICIENCY IN SWEDEN

75% 1988

50%

2018

In only 30 years, Sweden has gone from producing 75% of the food consumed in the country in 1988 to only 50% in 2018 (LRF, 2018). This is a drastic change and a result of the market becoming more globalized and competitive. The production within Sweden has steadily been decreasing because it is simply more expensive to farm here compared to other parts of the world which have lower wages and use a lot of pesticides for their large scale production.

Even products which we would be able to produce ourselves easily, like tomatoes, are being imported because of the difference in pricing (Sveriges Radio, 2018). It is hard for Swedish farmers to compete and this forces them to shut down and leads us to having to rely on imports and being dependent on other countries. There are some people that would argue that Sweden is not self sustained at all since we even import the fertilizers for our agriculture and food for our livestock (SVD, 2018).

The question about how long Sweden would hold up in a crisis was asked by Tomas Tengby from Sveriges Radio in 2017. At this time there was a shortage of lettuce, squash and aborigine because of a drought in southern Europe where the products are imported from. Clas Salumonsson, head of public relations for

Axfood said that new storage methods has made it possible to sell Swedish apples all year round along with carrots and white cabbage. Although, a lot of other fresh vegetable options there would there be a lack of if the import were to stop.

Jordbruksverket has recorded statistics on different food groups and the production percentage which happens within Sweden compared to how much is imported. The diagrams to the right shows that only grains and carrots are produced with a surplus and are being exported. Potatoes are also to a greater part produced within Sweden but the most common vegetables like tomatoes, lettuce and cucumber are mostly imported.

In Sweden, Götaland is responsible for 64% of the food production (SVD, 2018) for obvious reasons like the season being longer and the soil more fertile. However, if hot and dry cities like Qatar is managing to rely on technology and greenhouses to produce food, a lot more of the land in dark and cold Sweden should also be able to hold farms with controlled temperatures within greenhouses.



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BENEFITS OF HYDROPONICS

CHOOSING HYDOPONICS OVER TRADITIONAL FARMING



LIGHT WEIGHT SYSTEM A lighter load to add on existing buildings than wet soil. Excellent for when adding a new structure on top of an existing building



underground



NO TRANSPORTATION FA Flexible system which can be placed anywhere and therefore eliminate the transportation of the crops using hydr

SPACE SAVER - STACKING You are able to get a higher yield on less space than traditional farming by being able to stack your hydroponics system on top of each other

There are many reasons to choose hydroponics when growing food commercially, some of them being displayed in the diagrams to the right. Being able to farm wherever, even in cities, allows for freedom when starting a business. Less time and resources are used at the same time as it gives a faster yield than traditional soil based farming with less risks for pests and changing environmental conditions.

However, the system comes with a few challenges which should be stated and addressed:

Hydroponics is a system with an initial set up cost which requires some investment. Although, once the installation of the system is in place, the cost to keep everything running is narrowed down to only nutrients and electricity. However, starting a traditional farm also requires a set up cost and much more maintenance, tools and work to prepare, grow and harvest.

Hydroponics requires knowledge of the system since the crops are depending on the urban farmer to keep everything going correctly. System failures or power outages could destroy crops easily. Connecting the system to a back up battery would secure the watering and lighting for the crops. Even though it is harder for pests to attack crops in a hydroponic system, they would spread quickly among plants sharing the same water reservoir if it were to happen. It becomes extra important to keep pests out of the greenhouses and lady bugs have been used in other projects to fight off the bad insects.

There is a lively debate about hydroponic vegetables not being organic even though no harsh chemicals are used in the process. Today, for plants to be classified as organic, they are required to grow in soil without exceptions. As hydroponics becomes a more popular choice for farming, this definition might have to change in the future (Green & Vibrant, 2019).

With the right amount of interest and dedication, the advantages and benefits of the hydroponic system outweighs the challenges it comes with. With more and more people relocating to cities, the food production needs to relocate as well to make the cities themselves more sustainable and hydroponics could be one way of achieving that.



NO SOIL BASED PESTS No soil and therefore no pests that live



NO WEEDS

Requires less work to keep the plants happy. No having to go through the soil looking for unwanted weeds growing next to your vegetables

FARM IN ALL SEASONS

Within a greenhouse and with added artificial light and heat, you can grow using hydroponics all year round



NO CHEMICALS

Because the greenhouse environment is controlled by the farmer, no harsh chemicals or pesticides are needed to keep off pests. Good insects like lady bugs can be used instead to fight off the once causing harm



90% LESS WATER USE

Hydroponics grow in a closed loop system of water and nutrients which is continuously moving and provides just the right amount for each plant



50% FASTER YIELD

Because the surrounding environment, sunlight, moisture and heat is controlled within the greenhouse it is easier to create a place where the plants grow quickly. By adding the right nutrient in the water, they can thrive in the specific conditions the different crops require.

ROOFS

THE PERFECT LOCATION IN CITIES

What is the function of a flat roof? Nothing. From the street level it is close to impossible to see what happens on top of a flat roof. It is probably covered in gravel, vegetation to absorb rainwater, or simply tilting slightly in one direction to not collect pools of water. What are missing in cities? Farmland. See how this connects?

Flat roofs in the city are unused, unprogrammed and inaccessible to the citizens. Building greenhouses on rooftops requires no new land to be occupied - it is already there, ready to be used.

When bringing food production closer to the consumers, the transportation decreases and the vegetables are as fresh as they can ever be when they land on the store shelf. The crops are kept fresh longer which leads to less waste overall.

The excess heat from the building will help warm up the greenhouses which will help especially during the colder months in Sweden.

Combining the greenhouses with seasonal outdoor green spaces for increasing biodiversity in cities will help connect even the most dense city to nature and help increase biodiversity.

The roof tops allow natural light to reach the crops inside the greenhouses which is important for the production rate. Although, in the wintertime when there is a lack of sunlight, artificial lightning will act as a supplement to make sure the crops are getting enough hours per day.

Farming today requires no less than 70% of fresh water use globally (The World Bank, 2018). Collecting the rainwater and reusing it on site would not only ease up the communal rainwater management systems but also save fresh water.

A few stories up, you get to experience the city from another point of view and it is something that should be available for everyone. The views and the atmosphere up here should be seen as a great asset and not be forgotten.

The combination of roof top farming directly above an established grocery store, allows for the shortest transportation distance from farm to consumer. The system to distribute the crops are already there through the store and reaches out to the public directly.





POTENTIAL

How much could we actually produce if we were to start farming on roof tops? Fact is that we could increase all of Skåne's indoor production of vegetables by 137% just by using all of the available ICA store roofs in Sweden that has a total of 1300 stores of different sizes (Icas fastigheter, 2018). Now, imagine all of the other grocery stores available in the country which could adapt to the same concept. Taking it even a step further would be to simply apply greenhouses on any flat roof available to make a city completely self sustained on vegetables. According to Laurence Hamelin, Communications Coordinator at Lufa Farms in Montreal, Canada which started their first roof top farm with hydroponics in 2011, a self sustained Montreal with 1,8 million people would only require the roof space of 19 malls in or around the city (Lufa Farms, 2017).



They have a total of of green houses



with a total of unused roof space



Half of Sweden's indoor farming is located in Skåne. hectares

There are 1 296 ICA stores around Sweden hectares

MEETING WITH SKY VEGETABLES

GREENHOUSES ON TOP OF A RESIDENTIAL BUILDING

VISIT: July 17th 2018 Interviewing Yara Nagi, Operations Director

LOCATION: Bronx, NYC

ON TOP OF: affordable housing building

GREENHOUSE SIZE: 750 m²

VEGETABLES GROWN: arugula, ruby chard, butter head lettuce, bok choy, and herbs.

TECHNICAL DEMANDS: rainwater collectors, solar shading automatic, ventilation and fans

COSTUMERS: local grocery stores and restaurants

On top of an 8-story building in the Bronx borrow, north of Manhattan which holds apartments for lower income levels, a hydroponic rooftop farm is located. Here, 6 people work full- or halftime with keeping the technical parts like ventilation, sun shading, and nutrient levels in tact. The idea was to engage the local community and get them interested in urban farming. Most of the employees live in the building and get a lowered rent because of their work in the farm. Recycled rainwater is used to irrigate crops in a closed loop system. The produce is sold to local pizza restaurants and grocery stores in the neighborhood.

The elevator to get up on the roof is placed in the back of the building and is hard to find for anyone not working there. When at the top of the elevator, the view is immediately blocked by a prep- and storage room made up of metal walls. The structure is basic aluminum framing and glass. Fans and white fabric for sun shading is automatically controlled to keep an optimal temperature, but Yara tells me it is not enough during the hot summer days. An outdoor terrace surrounds the big greenhouse and offers a 360 degree views of the surroundings. The depth is only 1,5 meters except for one small area in the back where a small table could fit, making most of the space useless for anything else than walking around it. The employees have no space for food prepping or packaging which prevents the business from running smoothly. Employees had to go down to the first floor to eat and did not have a place to take breaks or change clothes.

This greenhouse is offering the mere basics for a commercial hydroponic business. With more insight in the business, changes could be made to improve the production rate and revenue.



BACKGROUND & REFERENCES

MEETING WITH KAJODLINGEN

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VISIT: October 24th 2018 Interviewing co-founder William Bailey

LOCATION: Lindholmen, Gothenburg

ON TOP OF: ground level, on a pier in the harbor

SIZE: seasonal farm of 700 sqm

VEGETABLES GROWN: tomatoes, lettuce, kale, herbs, carrots, sugar peas etc

TECHNICAL DEMANDS: outdoors, ecological, waste into soil for crops

COSTUMERS: locals, offices, restaurants

It is the end of October, and it is the last time of the year people can come to Lindholmen to pick and buy their vegetables from the two farmers who work full time with providing Gothenburg with locally grown greens. A few people are walking around, having brought their own bags to collect their greens.

William and Jonas started their first city farm in 2015 and their business have been growing and expanding ever since. Today they have a second farm on the roof top of Clarion Post Hotel where they grow vegetables and herbs for the restaurant Vrå. Through their business it becomes clear that the interest and demand for locally grown vegetables are increasing and their vision for the future is to have a city farmer in every neighborhood so that it becomes just as easy to stop by your local farm as your local store.

Getting off the bus at Lindholmen by Chalmer's second campus, the spot by the harbor feels a little closed off and hard to find, having to pass a fence to reach it. There is a panorama view of the city from the water and it is windy. Spread out are growing beds with different kinds of vegetables and salads. A few benches and flower pots are randomly placed around the area and a container is used as an office and shelter for the two workers. The location could use a more clear entrance and be highlighted in the city to bring more people here and awareness to the business.

William and Jonas have proven that the concept of city farmers is appreciated. The problem with seasonal farms are that they are just that - seasonal, and does not provide food during the winter months and when the summers are too hot and conditions are not ideal, the produce take the hit.



BACKGROUND & REFERENCES

3. SYSTEMS & STRUCTURE

PROGRAM

A program has been developed by analyzing the different reference projects and researching what is necessary for the business. The public part with a highlighted entrance is the most important addition to the proposal which brings attention to the urban farm and the cafe makes it a landmark in Gothenburg instead of just a production greenhouse.

DUTCH BUCKETS

A hydroponic system where buckets are placed along the drip emitter line with individual small tubes that supplies each plant with water and nutrients from the reservoir. Excess water is returned and reused in the closed loop system. Used for growing bigger plants like tomatoes, cucumber, pumpkins and zucchini.





1. WATER RESERVOIR 2. DRIP EMITTER 3. TUBE 4. BUCKET 5. TOMATO PLANT 6. RETURN LINE

VERTICAL RACK

A hydroponic system where stainless steel pipes are stacked vertically on a rack for maximum yield with a small footprint. This system is mostly used for smaller plants like herbs and lettuce.

The Nutrient Film Technique is made up of stainless steel pipes with holes for each plant. A seed is placed in a pot filled with coconut coir which helps absorb water and nutrients. As the seed grows and becomes a plant, the coconut coir can be removed. NFT is mostly used for smaller plants such as salad, herbs, strawberries and blueberries.





1. WATER RESERVOIR 2. SUPPLY LINE 3. NFT CHANNELS 4. RETURN LINE 5. COCONUT COIR 6. PLANT

1. WATER RESERVOIR 2. SUPPLY LINE 3. NFT CHANNELS 4. RETURN LINE 5. PLANT

GREENHOUSE STRUCTURE

The greenhouse proposed is a modular system made up with a thin and light steel structure of frames and beams. The glass is mounted on top of the steel core and can be expanded and fit any size hydroponic system. From the beams, extra LED lightning can be hanged to give the right amount of light all year round and windows at the top can be opened up for ventilation in the summer time.



STAIR MODULE

It was important to make a visible and clear entrance up to the roof to invite the public. A free standing stair module is placed on the ground next to the existing building to signal that something is happening above street level. The structure is a simple staircase in steel and wood with a landing on each floor and a hollow core where plants are growing all the way up to the roof. A thin mesh covers the walls and structure on the outside. A bridge reaches over and connects the stair with the roof top and the outdoor public garden outside the greenhouses.



1. WOODEN RAILING 2. STEEL STEPS 3. HOLLOW CORE WITH GREENERY

ZERO WASTE CAFE

The entrance to the public part of the greenhouse is through a cafe where you can buy a cup of coffee and sandwiches with bread made in the store below and vegetables grown on the roof. The cafe is zero waste which means that no resources or food are wasted, but recycled and composted. Items from the ICA store below that are about to expire are sold here as well and no plastic cups, plates or utensils are allowed. The cafe has a big bar with seating around and small tables and chairs spread out in the greenhouse with lights hanging from the steel structure beams and a possibility to open up the walls and ceiling on a sunny day.



PUBLIC GREEN HOUSE

Inviting the public to take part in the food production process is an important part to bring awareness and understanding of where our food comes from. The idea follows in the same footsteps as the zero waste cafe where the costumers bring their own bags when picking the vegetable or fruits they want to purchase. The little public part of the greenhouse offers costumers a close up look of how the hydroponic systems work and have a few selected kinds of vegetables, berries and herbs growing there which also supplies the zero waste cafe.



5. THIN METAL PROFILE FOR COLLECTING WATER 6. OPERABLE WINDOWS 7. PVS PANELS TO BE MOUNTED

4. APPLICATION ON SITE

HISTORY AND FUTURE OF AREA

To try out the concept, choosing a location and a store became an important part of the development of the design proposal. Since the thesis is written in Gothenburg, it was natural to stay in the city to be close to the site and find connections who could be introduced to the idea.

Originally, Rosenlund got its name from when roses used to grow on big fields in the area. In the beginning of the 1900s, it was an area mixed with commercial spaces and residential buidilings in classic Gothenburg brick (Stadens Historia). This was all torned down in the 60's and 70's, during the million program in Sweden. The office buildings which stand there today, replaced housing which led to the street becoming dead and quiet during night time even though the location is very central, with just a few minutes walk to both Haga and the shopping streets along Kungsportsplatsen. Underneath the arcades, prostitutes started to gather and made the area even more unattractive and unsafe to be around.

Trying to fix the problems which had arose, developers started to invest and renovate the area. Grocery stores, smaller boutiques and restaurants with longer opening hours opened up around the block (Handel skapar trygghet). The arcades closed and the neighborhood regained the activity it had once had.

Now, people are sitting along the water on benches in the summer sun or sipping on drinks outside the restaurants. It is once again a part of the rest of the city center of Gothenburg and more changes are happening in the near future for the city's 400 year anniversary in 2021.

For example is a new air tram line planned which will span from Järntorget across the river to Lindholmen and connect the city across the water.

A new hotel with 30 stories and over 400 rooms will also be built on top of the old classic cinema Draken, in connection to Järntorget. Masthugget, west of Långgatorna, will become a new and lively neighborhood with high rise apartment buildings, offices and commercial businesses (Göteborg 2021).

The new developments and renovations of Gothenburg are many and will change the perception of the size of the city. In the middle of it all, lies Rosenlund just a short distance from all the new activity.



CHOSEN LOCATION

The chosen commercial- and office building holds an ICA supermarket on the entrance floor. On the other side of the street is Fiskekyrka in yellow brick from 1874 which is one of the most iconic buildings of the city with inspiration from both Norweigan wooden style churches and gothic cathedrals. It makes sense to add a new and modern vegetable production and food hall in connection to the old fish market. It is also just a short walk to the lively shopping streets. North of the building is a 20 meter high hill with a great viewing spot of the city and Skansen Kronan, another iconic building from the end of the 1600s.

The building is over 100 meters wide and the roof 2000 square meters are divided into 3 different sections with 1 staircase per section. ICA Rosenlund occupies the east corner, which is the section that will hold the closed production greenhouses. The west side will be open to the public with a public outdoor staircase to reach the top and a cafe at the entrance. The roof of the building is in the same level as the top of the hill and therefore provides the same great views. The roof has a great location for natural sunlight coming from the south, the challenge will be to keep it from overheating in the summertime.





EXISTING BUILDING



BUILDING OWNED BY: Wallenstam (since 2011)

ADDRESS: Rosenlundsgatan 6 -8

STORIES: 6 (+2 floors of parking under ground)

FACADE MATERIAL: metal cassettes

FRAME WORK: Concrete pillars and slabs

The metal sheets which covers the facade has a dark golden color. The windows are rectangular and placed in a straight line which accentuates the rhythm that the facade cassettes are already creating. The bottom floor is mostly glazed from ground to ceiling since it holds commercial spaces.

A metal, rigid solar shading is placed above the windows, horizontally on the southern facade to reduce the worst sun exposure for the offices on the upper floors.

The roof is covered in small pebbles and no railing. The elevator is internal and used by the offices.





MEETING WITH WALLENSTAM

VISIT: January 28th 2019

Interviewing: Karin Mizgalski (sustainability coordinator), Peter Thorbjörnsson (property manager) and Emma Jansson (sustainability department)

To get an understanding of who I would have to turn to in order to make this a reality in the future, I contacted Wallenstam who owns the building in question and asked to meet them and pitch my idea to them. I also wanted to hear their sustainability goals and how they are working internally to reach them.

Wallenstam had just appointed Karin as new Environment and Sustainability coordinator who's task will be to keep track of the different parts which touches upon these questions. Previously she had worked with projects and building manager of wind energy parks to the affiliate Svensk Naturenergi. Up until now, Wallenstam had not had a single person looking over the work in its entirety but now that will change with their three main focus areas of social, economic and environmental sustainability.

The environmental covers the building sector for the biggest part since a lot of new projects are on the table right now. It comes down to making it efficient by choosing sustainable building materials as well as transporting them in a better way by train, and finally taking care of the waste correctly in the end of the process. Most of the new developments meet the demands of miljöbyggnad silver. Installations, computer monitoring and energy use is easier to track in a newly produced apartments but even in the older stock, they are working with exchanging the heating system to geothermal.

The new sustainability focus also requires new structures and reports to measure how effective the building processes are and how they can be improved. One of the biggest new developments in Gothenburg at the moment is Kallebäcks terasses which will hold 2500 new apartments.

When presenting my idea and concept of greenhouses of the roof of ICA Rosenlund, Karin said that she was positive toward the suggestion but that the request has to come from the ICA owner himself since it would be his job to run the farm. As managers of the building, they are simply in charge of making the structure work for the different businesses and activities occupying the spaces they are renting out.



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MEETING WITH ICA

VISIT: January 17th 2019 Interviewing Johan Fristedt, store manager

During my first visit to the chosen ICA, I felt I had chosen the right store to apply my hydroponic concept on. I was told by Johan Fristetd that the store is already working actively to reduce their climate footprint on a variety of aspects and have managed to stick to the goals of improving ever since opening up in 2013.

In the future, when Västlänken, the air tram, Skeppsbron and the new big housing blocks and hotels have been built, the store will see a drastic increase of consumers since so many new developments are taking place in the neighborhood. It is a store worth investing in for the future and making it unique in the sense of growing its own vegetables will attract both locals and tourists.

Local food production is something that is being more sought after, therefore having greenhouses on the roof top will draw attention to and strengthen the store's current sustainable profile. By 2020 all ICA stores are aiming to be climate neutral in its operation and Rosenlund is doing this by choosing renewable energy sources, having a big variety of ecological products in their selection, encouraging to choose vegetarian and vegan with their daily ready-to-eat lunches, going plastic free etc.

Johan reveals that there is already a plan to reinforce the ceiling above the store to make it hold the extra weight of a few faming plots which Kajodlingen have been designing. This roof is only 1 floor up, within the courtyard of the building which means that the other 5 stories are keeping a lot of sunlight out from the site. Shade is ok when growing herbs but other vegetables that need more light could have a hard time growing there. The thought is to have a seasonal farm and not to keep it going throughout the year. The original plan was to have it finished in 2018 but due to long waiting times from the municipality it has been delayed.

Johan sees the suggestion of greenhouses on the chosen location for this thesis as an interesting idea and something which could be the next step towards reaching their sustainability goals. The more people who are involved in their food production, the easier it becomes to make sustainable choices and pick the lettuce that has been grown 5 stories above the store instead of the one which has been shipped from another country.



LAYOUT REQUIREMENTS

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To make the proposal as relavant as possible to the chosen store, real numbers of how many kilos of different vegetables ICA Rosenlund is selling per month is used as a reference when creating the floorplan with the hydroponic systems on the roof top.

The numbers on the next pages, show the amount sold and wasted in kilograms during different months in 2018. The average amount is calculated and later compared to how many square meters are necessary to reach the right production rate. ICA Rosenlund tries to buy vegetables produced in Sweden during the warmer months, but of course needs to import during the colder period. What is interesting to notice, especially for the cucumbers, is the drastic increase in waste that happens when the product is imported compared to when it is bought from within the country.

For future greenhouse additions on ICA stores, the numbers of sold vegetables/month will decide how the layout of the hydroponic systems will look like to supply the right amount for each specific store. The module charts to the right make it easy to calculate how much space is needed.

NFT system footprint & measurements



2m walk

Dutch bucket system footpring & measurements

1m from wall 1,6m spacing between buckets



Vertical rack system footprint & measurements



1,5m walk



ICEBERG LETTUCE



lettuce in NFT system (plan) yields 8,5 kg lettuce / sqm / month

17 lettuce heads per sqm 1 iceberg lettuce = 500 g growth cycle: 4 weeks

numbers from ICA Rosenlund, 2018:

month	country of origin	sold (kg)	waste (kg)
feb	spain	121	10
may	sweden	159	9
aug	sweden	143	2
oct	holland	92	3

ICA's avg demand/month (kg)	129	15 sqm of NFT to
NFT avg yield/sqm/month (kg)	8,5	supply Rosenlund



tomato plants in dutch buckets (plan) yields 2,5 kg tomatoes / bucket / month

1,6 meter spacing between each row 1 tomato = 100 g growth cycle: 8 weeks

numbers from ICA Rosenlund, 2018:

month country of origin		sold (kg)	waste (kg)	
feb	spain	180	4	
may	sweden	242	12	
aug	sweden	125	2,5	
oct	holland	187	1,9	

ICA's avg demand/month (kg) NFT avg yield/sqm/month (kg)

TOMATOES

<u>183</u> _	73 buckets to
2,5	supply Rosenlund

CUCUBMERS

48



cucumber plants in dutch buckets (plan) yields 4 kg cucumbers / bucket / month

1,6 meter spacing between each row 1 cucumber = 500 g growth cycle: 8 weeks

numbers from ICA Rosenlund, 2018:

month	country of origin	sold (kg)	waste (kg)
feb	spain	401	24
may	sweden	911*	7
aug	sweden	323	13
oct	holland	338	20

ICA's avg demand/month (kg)	<u>493</u>	_ 123 buckets to
NFT avg yield/sqm/month (kg)	4	supply Rosenlund

BASIL



2 2

basil in vertical racks (elevation)

26 pipes per 2,6 meter rack (front&back) 1 basil plant = 20 g growth cycle: 4 weeks

numbers from ICA Rosenlund, 2018:

month	country of origin
feb	sweden
may	sweden
aug	sweden
oct	sweden

ICA's avg demand/month (kg) NFT avg yield/sqm/month (kg)



yields 234 basil plants / rack / month

sold (kg)	waste (kg)
4,3	0,3
4,8	0,58
4,6	0,38
4	0,28

4,44 _	1 rack to
4,68	supply Rosenlund

staircase cafe



5. DESIGN PROPOSAL

SITE PLAN

Most of the roof is covered in a glazed shell. The entrance and public stair is placed on the left hand side of the building which takes people up to the top where they first enter a small outdoor garden outside the cafe and the public part of the greenhouse where they can pick their own greens but also supplies the cafe with crops. The rest of the roof is the production part for ICA with the existing staircases and elevators being the direct link in-between.

DESIGN PROPOSAL

LANDSCAPE SECTION





PRODUCTION

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_	#	system	vegetable	yield/system	system size	yield / month
	1	vertical racks	dill	234 / rack	1 rack	234 plants
	2	vertical racks	oregano	234 / rack	1 rack	234 plants
	3	vertical racks	parsely	234 / rack	1 rack	234 plants
	4	vertical racks	chive	234 / rack	1 rack	234 plants
	5	vertical racks	mint	234 / rack	1 rack	234 plants
	6	vertical racks	tarragon	234 / rack	1 rack	234 plants
	7	vertical racks	thyme	234 / rack	1 rack	234 plants
	8	vertical racks	cilantro	234 / rack	1 rack	234 plants
	9	vertical racks	rosemary	234 / rack	1 rack	234 plants
	10	vertical racks	thai basil	234 / rack	1 rack	234 plants
	11	vertical racks	basil	234 / rack	1 rack	234 plants
	12	nutrient film tech	strawberry	5 kg / sqm	33 sqm	16,5 kilos
	13	nutrient film tech	blueberry	0,5 kg / sqm	33 sqm	16,5 kilos
	14	nutrient film tech	kale	5 kg / sqm	26 sqm	130 kilos
	15	nutrient film tech	romane	3,5 kg / sqm	26 sqm	91 kilos
	16	nutrient film tech	butterhead	2,8 kg / sqm	26 sqm	73 kilos
	17	nutrient film tech	arugula	1,4 kg / sqm	26 sqm	36 kilos
	18	nutrient film tech	iceberg	5,8 kg / sqm	15 sqm	129 kilos
	19	dutch buckets	tomatoes	2,5 kg / bucket	76 buckets	183 kilos
	20	dutch buckets	cherry tomatoes	2 kg / bucket	76 buckets	150 kilos
	21	dutch buckets	cucumber	4 kg / bucket	123 buckets	493 kilos
	22	dutch buckets	plum tomatoes	2 kg / bucket	76 buckets	150 kilos
	23	dutch buckets	peas	1,5 kg / bucket	76 buckets	120 kilos
	24	dutch buckets	eggplant	0,85 kg / bucket	90 buckets	76 kilos
	25	dutch buckets	zucchini	0,5 kg / bucket	115 buckets	55 kilos



DESIGN PROPOSAL

FLOOR PLAN



ROOF LAYOUT 1:300 10m

15m



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PICK YOUR OWN VEGETABLES IN THE PUBLIC GREEN HOUSE

ZERO WASTE CAFE WITH VIEWS OF GOTHENBURG

DESIGN PROPOSAL

LANDSCAPE MODEL

SECTION MODEL





SCALE 1:500

SCALE 1:50

DESIGN PROPOSAL

6. RESULT

DISCUSSION

Answering the question on how we can produce food in a sustainable way while taking urbanization into account, goes beyond architecture and requires political decision making in order to fully succeed. Redistributing labor force from farms to cities creates jobs at the same time as it conflicts with current ones. A stop of import and export would not only mean changes for Sweden but all other countries involved which might not be in the same position or have the means to suddenly invest in new technology to become selfsufficient. There are many questions to answer on how to manage the transition into a more responsible usage of our planet's resources in every aspect, but one thing is certain and that is that it needs to be done. To conclude my work and research I want to restate that we are in a time of reinvention where we have realized that our way of living, consuming and wasting is hurting the environment and we need to find new and sustainable ways to use our planet's resources at the same time as making room for more people. The hydroponic system helps save water and space but also produces more and faster than traditional farming. And farming locally cuts down on transportation and waste and helps cities be more resilient in themselves. Inviting the public to take part in the food production is important to raise awareness and empathy for the energy and time it takes for each crop to finally land on our plate. In a sustainable future, I am imagining that people living in cities are not disconnected from the production of basic necessities like food, but live in symbiosis with nature and are more respectful of the Earth's resources.

CONCLUSION

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IMAGES

If nothing else is stated, the author has taken the phots and made the illustrations and drawings