

The model farm

Setting up an educational Market Garden within the public sector

Februari 2022





Foreword

This guide aims to give a clear overview of the basics of setting up a Market Garden from scratch within a framework provided by the public sector. It covers the theory behind choosing a site and designing a farm, what tools and equipment to invest in, and gives practical advice on how to start and manage a farm, including statistics and data regarding working hours, crop planning and harvest yields. It relates to a financial scenario where a municipality runs an educational Market Garden and where the customers are the public kitchens.

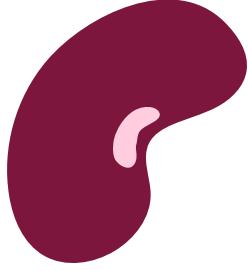

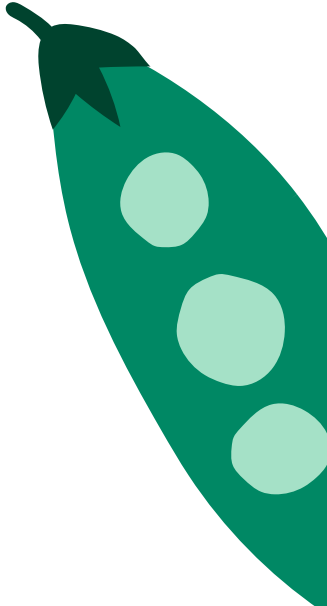
The guide can be used by farmers-to-be as a matrix for a farm set up, as well as by public servants and urban developers looking to understand the needs of a small-scale farm and farmer in relation to integrating local food production in peri-urban areas.

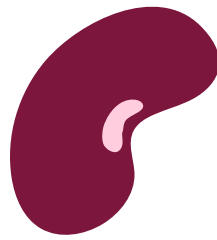
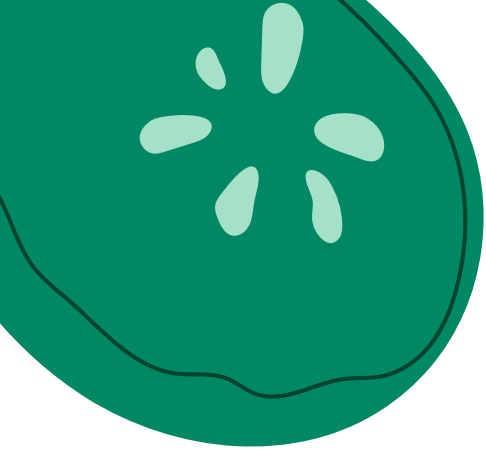
The intention is to enable new Market Gardens to swiftly move into an efficient, productive mode, where farmers can provide high yields of tasty vegetables stemming from an organic, regenerative agriculture.

The data and statistics underlying this guide have been generated during three years, while setting up and running a so called “Model Farm” located in Gothenburg, Sweden. The aim has been to collect unbiased data as a way of serving the small-scale farming community. This data is perhaps the most important outcome of the project, as the detailed information you can find there can serve as a template for someone setting up a farm. The written account is intended to add nuance and clarity where the numbers are not enough.

To also allow for a more subjective take of what it is like to start and run a farm there are “Farmers Notes” interspersed throughout the guide, rooting the guidance given in a local context and from a personal view.

Resources covering farming specifics such as how to grow a certain crop or what type of manure to use is available in different forms: books, videos, online classes, agricultural department resources etc, and is therefore not included in any depth. A short index for this type of information is included at the end of this guide.





About the author

I had a background in entrepreneurship, permaculture design, engineering and gardening before becoming a farmer. I'm drawn to working with biological solutions as a way of reversing climate change, and farming plays a huge role in this challenge. If I can grow both biomass and biodiversity at the same time, I'm also creating a positive footprint in this world. Know this: You don't need to have a degree in agronomy to start a Market Garden. An inquisitive and flexible mindset and a strong body makes for a good start as your own farming journey unfolds.

I have been all over the foodscape scene for about a decade, carving out opportunities to work towards regenerating our soils, learning from and together with other gardeners and farmers through employment, internships and networks how this can be done on a small, biointensive scale. When the opportunity came to take lead on setting up and running a Market Garden for the City of Gthenburg during 2019-2021, I knew I could make something good out of it. I was yearning to start collecting data and statistics while farming, to give our small-scale farming community a head start when planning for and setting up new farms and Market Gardens.

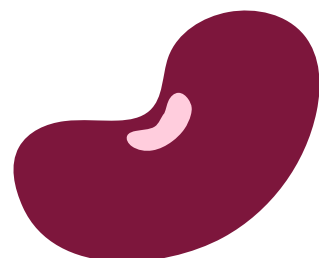
Now, let's dig into what this project has taught me and others, so that you can use this information to start a farm and become a way more successful grower than I am!

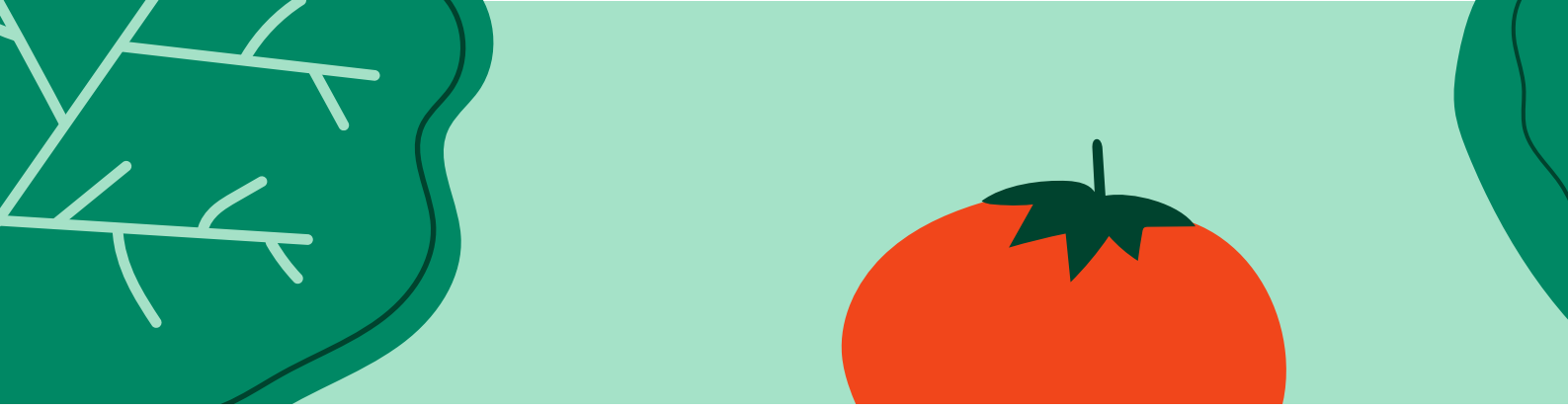
Klara Hansson, Project Manager and Urban Farmer

A note of thank you

In the middle of the project, I had my first child and went on maternity leave. Ebba Wilhelmsson took over the reins at the Model Farm and championed the second season from April to November in the best of ways. Thank you, Ebba! Also, a special thanks to Agnes and Anja who put in hard work as summer interns which allowed Ebba and I to go on vacation for two weeks during the summer. As you can see, there are a lot of fierce female growers out there – kudos to you!

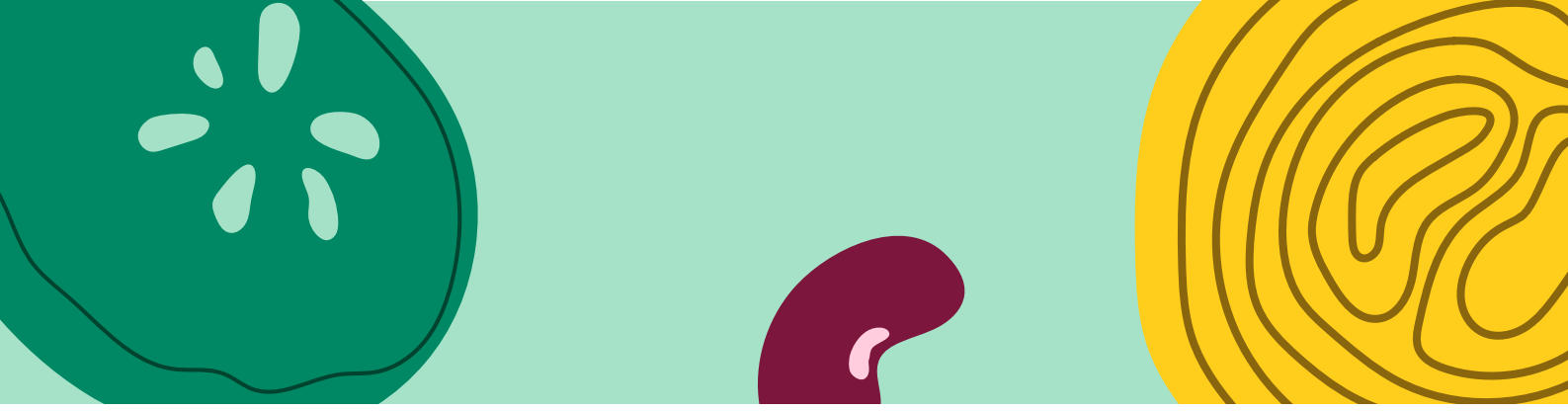
Without my fellow colleagues at Fastighetskontoret and all actors at Angereds Gärd, the larger network within the city and especially within the small-scale farming community, this project wouldn't have been a success. We stand on the shoulders on those who came before us. Much gratitude goes to my closest colleagues Martin Berg, Martin Bae Pedersen, Annette Gustavsson, Lars Brikell, Elsa Ogalde, Jan Andersson, Erica Svensson, Jonas Unger, Tony Johansson, Mauricio Sagastuy and Jonas Lindh. Keep growing farmers and food!





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1

The Model Farm project: A brief recap

With an Urban Farmer/Project manager hired at 75 percent and an investment budget of approximately 20,000 Euros, an old pasture was over three seasons transformed from a heavily compacted clay soil covered in grass and weeds to a highly productive Market Garden, rich in biodiversity.

This small plot of land is currently producing over 3,000 kg of vegetables per season from 700 square metre, with a potential harvest capacity of at least the double.



The project has shown that a Market Garden ...

- » can be successfully established in a short time span, with the right knowledge and a small, but significant, budget
- » can produce the same amount or more of vegetables per hectare compared to large scale organic farming
- » can quite easily be integrated as part of a municipality's food and educational system.



Klara Hansson, the Urban Farmer, overlooking the tomatoes.

1.1 Mission

The Model Farm is a highly productive small scale farm unit, providing food and education.

Definitely achieved!

1.2 Vision

By showcasing both the farming and business model behind a sustainable and successful small scale farming enterprise, the Model Farm will serve as a driver for the integration of regenerative farming practices in the continuous evolution of urban and rural multifunctional landscapes.

The business model was initially intended to align with the private sector, but since the project is run by the City of Gothenburg, it turned into a business model for the public sector. The vision has come alive – in an unexpected area.

1.3 Strengthening the Market Gardening community

A lack of data and statistics regarding working hours, crop planning, harvests, investments etc is hindering the growth of small-scale vegetable farming in the EU.

Without relevant information, how can someone wanting to start a farm make appropriate business decisions?

A key element of this pilot case has therefore been to gather detailed information for the startup of a Market Garden.

This includes data regarding:

- » Timing each performed task
- » Budget for tools, materials, seeds etc.
- » Crop planning
- » Harvest weight per crop and m²



*Green manure in full bloom (blue/purple) with additional edible flowers (orange) in the adjacent permanent bed.
Photo: Anja Enström.*

1.3.1 Example of key figures, 3rd season

- » 720 square metre efficient growing area
- » More than 40 different crops
- » More than 3,200 kg vegetables harvested 25,000 school servings
- » 19 weeks of harvest, delivered to 8 local schools and 2 care homes
- » 18,000 – 28,000 Euros potential sales revenue
- » 1 Urban Farmer/Project Manager working 75 percent, 30 hours per week
- » Tutoring of 6 part time interns
- » More than 10 practical site visits with student groups
- » Over 10 guided group visits from civil society
- » Weekly Instagram posts, over 1,000 followers @modellodlingen
- » Featured in Swedish radio, newspapers, magazines, podcasts etc

1.4 Vision 2025

The Model Farm is active year-round, serving as a central hub connecting seasonally active satellite farms spread throughout the municipality.

The Model Farm is delivering vegetables and educating new urban farmers, whilst also providing know-how, plant material and tools to the satellite farms.

The satellite farms are linked to nearby schools, delivering vegetables and functioning as pedagogical learning environments.

1.5 Voices from the public kitchens

“We think it’s a fun challenge with vegetables were not used to handling in large school kitchens. We use everything you deliver, so we have no specific wishes when it comes to volume or kinds of vegetables. Today they are preparing stuffed rolls made from the Swiss chard, as a vegetarian alternative for tomorrow. A tasty filling is made from zucchini, tomato, onion etc. The carrots we just rinse and serve as they are, different fun shapes and colors, and very yummy.”

“Both children and teachers have really appreciated the veggies! When we got the last delivery this season, we put together a display on a large table with most of what we got, including a vase with the edible flowers. The children gathered around the table and chit catted about the vegetables, looked at, smelled and touched them. The most exiting crop seemed to be the edible flowers which they brought back to their tables and munched at.”

“We think the vegetables had a fresher taste compared to what we can buy from the procured wholesale dealer, and that the smell and aroma, especially the tomatoes was way better.”

“When we have told them about where the veggies come from, the vegetables [from the Model Farm] have awoken the curiosity of the children, and they have asked for more of for example the edible flowers which they though were extra fun. We made marmalade from the green tomatoes which has been highly appreciated at breakfast.”

1.6 Voices from the small-scale farming community

“I used the data from material the Model Farm have shared to make an application for a business start-up grant, and I got it! I also received monthly financial support from the Swedish Public Employment Service during a full year. I used numbers from the harvesting records, potential revenues, and the initial investment budget to calculate my own budget and make a business plan. I also got great advice for how to set up a caterpillar tunnel.”

“For those who dream about growing vegetables there’s a whole world of inspiration on the internet, in magazines, and social media. But for those who want to start a business in small-scale farming without relying on heavy machinery, the basic data regarding budgeting and planning is harder to come by. The farming calculations from the Swedish Board of Agriculture usually stem from larger farms dependent on heavy machinery. This information can hardly be translated to the growing scenario of a small-scale farmer working mostly with hand tools and with a broad variety of crops, since there’s an obvious gap between these two farming systems. At the same time, many are dreaming of starting up small-scale farms.”

“I am currently working for IKEA planning a new Market Garden in Helsingborg for H22, a housing fair, and it has been immensely helpful to use the data from the Model Farm. Information regarding harvesting volumes and growing surface in relation to documentation of when and what has been planted, the amount of working hours spent for the different asks – it’s all you want to know! By following the journey of the Model Farm it is easier for me to set reasonable goals both for the first farming season and for the following ones. The substantial set of information, data and statistics is also important in communication with both colleagues and external actors.

I hope everyone who’s planning on starting a Market Garden will find this information!”

2

Setting up an educational Market Garden within the public sector

Most Market Gardens are run as private enterprises, but what about running a Market Garden for the public sector? What needs and wants will inform the planning and management of a farm delivering vegetables directly to public kitchens while simultaneously serving as an educational site for future farmers? In what different ways can a Market Garden serve its community?

In the following pages you'll find a summarized version of a three-year project looking into, testing and documenting these questions and some of their answers.

Let's start from a farmer's perspective!

2.1.1.1 Farmer's Note: Is farming really something a municipality should be doing?

At this point in human history, the answer to this question is definitely yes. Farming and food systems are strongly interlinked with both the problems and the solutions to the climate crisis our society is currently facing. Each single action taken towards regenerating our ecosystems counts, and it is also what we as a society have promised to do through various agreements and goals we have signed off on. To argue over whether or not farming should be part of what a municipality does and spends its taxpayer's money on is to miss the larger picture: Small-scale farming presents a clear and precise opportunity to actively work with regenerating our ecosystems whilst creating long lasting, expansive values for its citizens.

2.2 Finding and evaluating land

When looking for a piece of land to start up a Market Garden, there are a number of factors to consider. A “perfect” site will be hard to find, but by identifying and balancing different key factors with both personal and community-oriented needs and wants, a much more realistic judgement can be made. The evaluation process takes aim at answering an important question: Is this really the site for you and your community?

The following chapter outlines the basic key factors to take into consideration when starting a Market Garden for the public sector.

2.3 Size matters!

After years of networking with farmers and gardeners, a minimum size requirement for a profitable Market Garden run by one person working full time seems to be around 1,000 square metre or 0,1 hectares. If you're a team, go ahead and multiply that figure with the number of persons working full time. The upper limit seems to be somewhere around 3-4 hectares. Move beyond that, and the distances and acreage covered often leads to a need for larger machines and more infrastructure investments, which means you're leaving the world of small-scale Market Gardening behind. There's nothing wrong with a larger operation, we need all sizes for a functional mosaic in the agroecological landscape, but it is not what is described in this guide.

A larger sized operation also leads to an extended need for a manager overseeing the production, and many farmers realize they feel uncomfortable or bored in this position after a while. The lack of direct contact with the soil and not fully partaking in the tasks of farming can leave many a farmer feeling emptied out. Be mindful of your own personal needs and wants in relation to the work you're undertaking and the farm size you're planning for.

2.4 Site specific factors

For a Market Garden to function well long term in a temperate climate, the site should be at least 1,000 square meter and preferably offer up a fairly square layout. Smaller or oddly shaped plots can of course be used for growing vegetables, but the production efficiency is often lost which means that the operational costs go up in relation to how much vegetables are being produced. For the public sector, initiating a farming operation and paying a farmer as part of what the taxpayer's money go to is often a big leap, which means there's a strong need for quantifiable

outcomes to communicate to the public. Some examples are the kinds and volumes of vegetables produced, the number of school children visiting the site, the number of interns partaking in the farm work, the number of kitchens receiving vegetables and for how many weeks per season. From an environmental standpoint all public entities need to work with for example Agenda 2030, which means specifics such as the amount of carbon sequestered on site, water retention capacity, increased biodiversity and so on is of interest. Measuring these factors can be less straight forward but they can still be communicated as ecologically positive values connected to the farm.

*“I don't want
to be a manager
– I want to grow
food!”*

*Peder Wenderfors, small-scale farmer
at Björnhyllans garden*



The Model Farm: smallscale, standardised and efficient.

This all feeds back to the notion that the factors underlying the choice of site for a publicly run Market Garden are slightly different in comparison to when starting a private Market Garden. Creating a mind map or list of the different needs and wants identified within the community serves as a starting point before doing the actual scouting for land.

In the case of the Model Farm, the main goals have been to produce vegetables to be able to document how the Market Gardening-model functions in a Swedish setting, and to integrate the education of new farmers at the site.

2.4.1 Angered's Farm - an innovative hub

The Model Farm is located at Angered's Gärd, a farm owned by the City of Gothenburg and leased by the Region of Västra Götaland's Department of Natural Resources. The region is running a school at the farm, with several different vocational programs such as agroforestry and market gardening. The Folk high school of Angered is also running an educational satellite at the farm. There is a strong collaboration between all stakeholders at the site, and there are several other actors in the vicinity and further away who are using the farm as a platform for communi-

cating innovative farm practices etc. This context has provided both stability and explorational possibilities, as well as a social context for the sole Urban Farmer employed by the SATURN-project.

The farm hub and its far-reaching network has been key to the success of the project, and this backdrop shall not be underestimated.

2.5 Basic infrastructure components

Getting back to the farmers point of view, when starting a farm you will need access to some basic but important components: suitable farmland, pressurized water, access roads, buildings or sheds, electricity, fencing (if needed), a toilet and preferably a breakroom and/or changing room with a shower.

If these basic infrastructure components are not already in place, it is wise to either plan and budget for installing them as soon as possible, or to find another better equipped plot of land. Do not start farming without access to basic farm needs.



Observing what is happening is key to staying on top of the farming game.

The stress of not having water for irrigation, a shed or building for storing tools and harvested crops, a road for vehicle access etc, will be too much of a challenge for a serious start-up farming operation. Weather and seasonal shifts alone will be enough to handle.

2.5.1.1 Farmer's Note: Scale of Permanence

The above checklist is a minimum starting point, but a more thorough scouting process should be conducted. When looking for land, consider underlying factors before you move ahead into details. As one of the permaculture design principles state: "Design from pattern to details". It can be helpful to use a reference called Yeoman's Scale of Permanence to recognize how easy or difficult it will be to change different aspects of the farm over time.

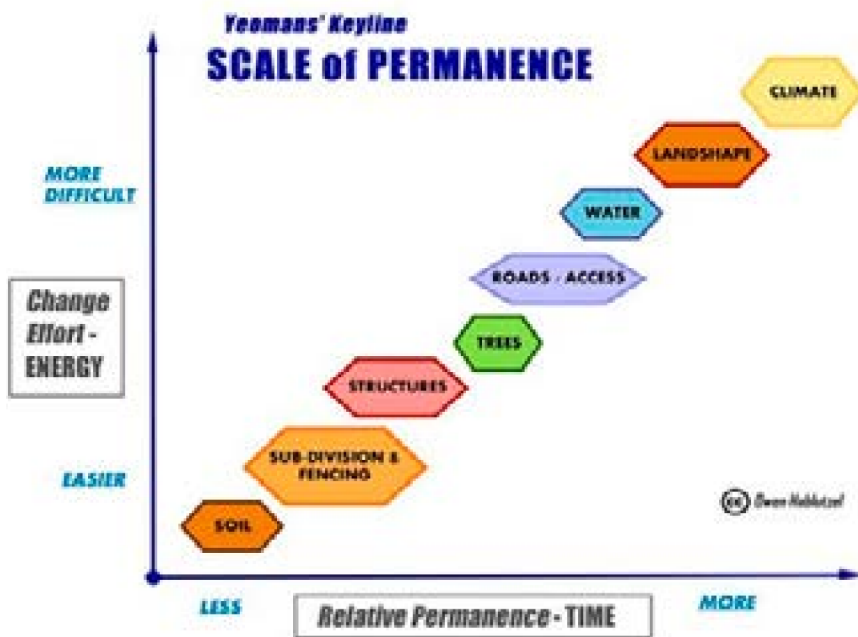
The climate and the topography of the land will not bend to the will of the farmer. Is the site in an inland or coastal area? What climate and weather data can be sourced as a backdrop for understanding the site, for ex how many frost-free days you can count on and the length of the growing season?

Is the land level or on a slope, and how will this affect your set up and farm design?

Access to water and roads are costly long-term investments, benefitting from correct placement from the start. What's the status to begin with and where can this type of infrastructure best be integrated? How is water naturally moving through the location? Is there for example a dam, a creek or other bodies of water enabling low-cost irrigation of your crops? How are the different forms of water, i.e. snow, frost, hail, mist and rain, affecting the site through the season?

Are there access roads already in place or is there a need for additional earth work? Can they act as water catchment features through collecting run of water?

Trees are potential long-term biological structures on site, standing tall for hundreds of years. Are there standing trees to take into consideration? Is there a need to plant more trees to create for example a shelter belt, hold back erosion on a slope or create habitat for birds etc? Are the trees shading the site?



Scale of Permanence. Illustration credit: Cornell Small Farms, <https://smallfarms.cornell.edu/2016/04/scale-of-permanence/>

What structures in the form of buildings and sheds are in place and how can they be incorporated into the farm design? Are they located in a beneficial spot or is there a need to move them?

Fences and the ability to close your site of can be crucial in an area where there's a high pressure from wild animals and curious people. What's the current set up and what needs can be identified at site? Scout the surrounding landscape and talk to neighbors to get a sense of the flow of animals and humans.

The soil type on site will directly impact your growing strategies but can also be amended. What's the starting point: A sand, silt or clay soil? Send in a soil sample for evaluation. Working with enriching the topsoil can have an impact relatively quickly. What types of organic matter are easily available in the vicinity of the farm? Can the nutrient loops be closed in interaction with the surrounding community and other farmers, or is there a need for long distance inputs?

With the needs and wants plus the short checklist and Yeoman's scale in mind, scrutinize the sites you are looking at. Will this site serve your farming needs and the needs of the community?

2.6 Access to community

Ideally, the location of the farm is within walking distance from the community it serves, be that a school, a care home or any other type of public institution. This can often be a utopia, since it is highly dependent on what type of land the public sector owns or has the possibility to lease, and whether or not this land is suitable for farming. In the case of the Model Farm, the site is in a peri urban sector located about 15 km from central Gothenburg, with the closest school unit about 3 km away. During the project deliveries have been made by car to units at a distance of 3-30 km. Some of the kitchen staff have come out to the farm, but no site visits were made by pupils.

2.7 Design process

A Market Garden is based on a human scale, with tools, bed shape etc attuned to the measurements of the human body rather than machinery. A smooth, efficient workflow is of the essence to ensure the wellbeing of the farmer, both physically and mentally. The weekly and yearly rhythm of planning, seeding, transplanting, watering, weeding, fertilizing, harvesting, packing, transporting and selling produce to market thus feeds directly into the layout of the farm. The fewer steps a farmer needs to take each

day, the better. Centering the farm design around a functional core infrastructure and bed layout helps building efficiency from scratch.

Allow for the design process to take some time since it will influence the farm in the long term. An easily remembered acronym used to guide this process is SADI: *Survey, Analysis, Design, Implementation*. First observe the site, get the facts straight and make a master plan, then start digging. Use this acronym as a friendly reminder, both when looking at land and when working with the actual design work. Remember, designing a farm is an iterative process which you will go through over and over again, with most farmers taking note of what is working and what needs tweaking during the growing season, then taking the time during the colder months to improve the design and set up for the coming season.

For your initial farm design, do your best but know that it neither will be nor needs to be a perfect design!

Make sure to sketch a few different versions putting all necessary elements into place: Blocks of permanent beds, pathways, plant nursery, washing and packing station – preferably with a roof, cool harvest storage, vehicle access through the site and at a pick-up point, tool shed, water access points and irrigation system, compost piles, indoors shelter for breaks and on-site-administration needs, toilet, hand washing station, access points and parking for car and/or machinery. If planning to use permanent greenhouse structures, include those. If the site is windy, plan for hedges or other types of wind breaks.

Ask for advice from other Market Gardeners, preferably local ones. Present the different sketches, discuss pros and cons with positioning the different elements in different places. Identifying weaknesses such as frost pockets, wet areas or insufficient vehicle access can shift the whole design. If relevant, integrate the feedback in a final version.

A valuable point of making the effort to draw your farm design on paper or digitally is that it creates a record for you to look back into. It serves as a reference of where you started out and shows how far you've come. Take plenty of photographs! They'll come in handy when you need to remember where you ended up positioning different elements if you're diverging from the design but don't have the time to update your sketches while working. This is especially important when it comes to hidden or semi-hidden elements such as drainage, dug down water lines or biochar amendments.

2.7.1.1 Farmer's note: Human scale – your scale

How tall are you? How much do you weigh? What size are your feet and your hands? Your bodily measures will inform your farm design. When in Market Gardening we talk about working on a human scale, it's easy to roll with the standard of 75 cm wide beds because there are now tools and equipment fabricated to suit that measurement. But if your human scale is a different one, then you need to offset your farm design to align with your own body. The width and length of the permanent beds, the height of the washing and packing station, the height of the tables and shelves in the nursery, the size of the spray gun, the secateur, the wheelbarrow, the spade etc, it all needs to follow measurements which allow you to work ergonomically. If, for example, you continually broadfork with a fork that has too long or too short handles for you, that repetitive movement can over time build into an occupational injury. Maintain an internal checkup routine, scanning your body: Neck, shoulders, upper and lower arm, elbows, hands and fingers, upper and lower back, chest, core, hips, glutes, thighs, knees, calves, ankles, feet and toes. Is there a buildup of stiffness, a low-grade inflammation, or a nudging awareness of something not feeling right? Act on it today, not later! Take time from your busy farmers life to maintain a healthy body through training, stretching and eating in accordance with what works best for you. Ideally you will get stronger, faster, more flexible and generally in tune with your body from working physically. It might take some time to get there, so the bottom line is this: Make sure that you don't let your body break down from farm work!

2.8 A system of permanent beds

The standard width of a Market Garden bed is 75 cm, give or take 10 cm, while the length usually varies between 10 and 30 metres. Pathways vary from 30 to 45 cm with the greater width allowing for easier access during weeding, harvesting etc. Sticking to the 75 cm width makes it easier to find standardized farm equipment, and it can be extremely useful from a planning point of view since there is data available regarding planting distances, harvest records etc for this bed width, which can help you determine how many bed meters of a crop you will want to grow. The aim is to design a functional, standardized bed system adapted to the specific site and to the farmer.



Know your soil: Feel it, smell it, taste it.

The layout of the bed system is designed with available farmland, sun angle, slope, prevailing winds and farm equipment in mind. A standard orientation on flat land is to have beds running from north to south to enable the highest amount of sun exposure for each crop. If it's a sandy soil and the farm is situated on a slope it is generally a good idea to orient the beds at a 90-degree angle to the inclination, to prevent run off of water and nutrients. If it's a clay soil the opposite is true because the paths might otherwise act as ditches and catch and store too much water, creating a water-logged soil. If the farm is situated in a windy area it is generally a good idea to orient the beds according to the prevailing wind direction. For ex, if the prevailing winds come from the West, beds should be oriented east to west This is particularly important if poly-tunnels will be an integrated part of the farm design, since they withstand strong winds way better if the wind hits them from the gable, not from the side.

The bed system will be divided into smaller blocks in your crop plan, to allow for a well-functioning crop rotation. For example, at the Model Farm there are currently forty-eight beds divided into twelve blocks. Each block contains four 20 metres long beds, because this fits well both with the crop plan and with the width of the caterpillar tunnels.

An example of how the permanent beds have been established at the Model Farm can be found can be found in the Appendix.

“In regenerative farming we build both biomass and biodiversity at the same time.”

Ben Falk, architect, farmer and permaculture designer.

2.8.1.1 Farmer's Note: Bed size

What length shall my beds be? This question can be answered with a few different factors in mind, for example: If you're planning on using a machine such as a two-wheel tractor, make them 20 metres or longer to be able to operate the tractor with efficiency. If you are working alone, 20 metres is a good limit, allowing you to drag around silage tarps etc without this type of infrastructure getting too heavy. It's also mentally forgiving to be able to see to the other end of your bed when you start harvesting or weeding, something which shouldn't be underestimated when it comes to a farmer's mental health.

2.8.2 A living soil

The soil is the living foundation of a farming operation. In a Market Garden the interaction with and the enhancement of the soil and its biology is a key factor for success. By establishing and working with permanent beds the disturbance of the soil is minimized and bio intensive growing practices can be upkept. The basic idea is to over time replace mechanical tillage with biological tillage. This allows the farmer to harvest enough produce from a small area to make a viable living, while simultaneously working to support the soil biota.

If we go back to a basic level, from a geological perspective soil types are defined by the mix and percentage of sand, silt and clay, and from a biological perspective soil types are defined by the organisms inhabiting them. There's a myriad of lifeforms found in our soils, providing ecosystem services such as cycling and retaining nutrients, improving the soil structure, increasing water retention capacity, suppressing disease, breaking down pollutants and increasing the soil's biological activity and diversity. As farmers we need to be aware of both the geological and biological perspective to be able to work regeneratively with our unique soil condition.

A practical and simple first step to take when assessing a farm site is therefore to get your hands on a guide on how to do a soil texture test, for ex the *USDA Soil Texture by Feel Key* (see Appendix), then bring a spade and dig around! It is also good practice to send in a soil sample to a soil test lab, to get an overview of nutrient availability, organic matter content etc. There are often regional advisors who can help with interpreting the numbers and data in the test analysis, so that it becomes a useful tool when planning what type of fertilization scheme you should incorporate with your crop plan.

Looking at the biological side of things, most critters are too small to be seen with the naked eye, but a very good initial gauge is to measure the number of earthworms in the soil with a block test. The earthworms are so called indicator species. If they thrive, so do other species.

Dig up a 20x20x20 cm large cube. Count the earthworms. Less than four worms per cube signals low biological activity. 10-15 worms per cube indicates a healthy biological activity. For a proper overview, dig 10 cubes per hectare and count the number of earthworms. In a healthy soil there should be a total of 100-750 individuals per hectare.

2.8.3 Long-term fertility

"If you focus on feeding the plant, you're thinking only about this year. If you focus on feeding the soil, you're investing in the health of your farm for years to come. The first approach is extractive and short-term. The second approach is regenerative and long-term."

From 'Grain by grain' by farmer and plant biochemist Bob Quinn.

To grow healthy crops providing healthy food from a resilient agroecological system, we need to look underground just as much as we look above ground. Science is only just beginning to form a better understanding of what many farmers and eaters have known intuitively and through observation for a long time: Adding industrially produced fertilizers to farmland does not create the same conditions as providing fertility in situ via the soil food web. A healthy soil can help crops withstand climatic extremes such as draught and flooding, thereby increasing the resilience of the farmland.

In effect this means that maintaining and regenerating the soil sponge, the thin living layer in between the atmosphere and the subsoil, is one of the best ways to stay in business as a farmer. The biological capital under your feet is your living insurance for keeping up the production of high-quality crops. Observe it, prioritize it, enrich it.

This can be done in many ways, for example by adding green manure into the crop rotation, adding mulch and compost, keeping the pathways covered in wood shavings, leaving roots and organic matter in the beds and by adding compost tea. There is no single solution to maintain and regenerate a living soil, simply because the soil food web is a highly complex system.

2.8.4 Crop rotation

Looking at a long-term perspective, what the farmer and customer might want is less important than what the ecosystem needs – it will always be imperative to integrate regenerative practices such as crop rotation, manure and green manure, biodiversity strips etc in a crop plan. To regenerate the soil in the permanent beds and in the surrounding ecosystem must be a long-term goal if you want to continue farming.

That said: Where to start?

The basis for the crop rotation lies in knowing what family the different crops belong to and to keep them together in the field. Both fertility and disease are strongly linked to the plant families. As with the initial farm design, remember that your first crop rotation plans neither can be nor need to be perfect. You will most likely be adding more permanent beds over a few years' time, which means that you can't establish a "perfect" crop rotation to begin with anyways. Aiming to understand each crop's need for nutrients and what nutrients are left behind when harvesting, and striving to wait at least six years before having a family rotating back to the same beds to avoid disease makes a good start.

Keep planting the same crop in the same bed year after year and you will end up with a depleted soil while simultaneously providing both food and shelter for a number of unwanted guests such as carrot flies, bean weevils, club root etc, which have their life cycles linked to specific crops.

There are indications from soil scientists that a healthy soil can help mitigate the insect and disease pressure, but until you have accomplished a healthy condition of your soil, stick to the crop rotation.

Before you continue with creating a crop plan for the season based on the underlying factors of the farm design, the bed system, the soil condition and the need for integrating a crop rotation, it's wise to get to know the possibilities and limitations and the wants and needs of your customer a bit better.

3

Budget and investments

Getting a Market Garden up and running at full speed will take some time, but with a startup investment of roughly 20,000 Euros and a yearly budget around 200-300 Euros you will come a long way as to speeding things up. Key elements such as irrigation, silages tarps, caterpillar tunnels etc can help jump start the operation and it will also save the farmer a lot of hard labor compared to starting on a shoestring budget with a shovel and a watering can.



An organically run Market Garden in dependent on a well functioning soil. Investing in compost and other organic materials is therefor highly prioritized.

The investment data from the Model Farm, see Appendix, provides a complete register of what investments have been done. All tools, machinery, seeds etc which have been bought are listed. This has been done per year to give a clear overview of the cost period. You will find the name of the item, the quantity, the cost, the vendor, and any comments regarding the investment. Most investments were made in 2019, and the data is very detailed for this year. For 2020 and 2021, some items have been grouped together, for example gloves, perlite, spade, string which were bought at the same time from the same procured vendor.

What is not mentioned so far is the largest cost of any farming operation: The farmers salary. During the project one person has been employed at 75 percent, or 30 hours per week, resulting in a cost of about 45,000 Euros per year. In relation to the potential revenues of 18,000-28,000 Euros per year, there's a definite gap. For any entrepreneurial

business, you need to plan for at least a three-year start-up stretch where your costs might not match your revenue. In the case of small-scale farming the business is not only dependent on the market and what can be sold, but even more so on the climate and the weather which sets the stage for a more or less productive season and higher or lower yields. A more reasonable timeline would be to plan for a five-to-seven-year long start-up stretch.

This might seem odd for someone with an industrial or financial perspective, a bank clerk might for example be skeptical towards this outlook. Try to keep your head high and your mind clear, and explain that you're working within a living system. Farmers have to adapt to a very different backdrop compared to someone starting a factory or creating an app, but this living, climate dependent set of rules has been forgotten by many and it is partly your job as a farmer to explain it.

4

Rules and regulations

Being nervous about not complying with the rules can make it hard to dare starting a food producing business, but keep in mind that most regulatory bodies are there not only to perform controls but to help you. Ask them for their advice and be open with what you find hard to understand.

In Sweden, the regulations you are acquired to follow when you start up a Market Garden are basically divided into two sections, one regulating your business and the other regulating your use of farmland and your handling of farm produce. It might seem like a jungle to get it all right, but often a phone call to the tax office plus your local administrator at the regional level will be a good start, as they can guide you through many steps.



Starting a farm in Sweden

- » Bolagsverket: starting a business
- » Skatteverket: setting up taxpayment:

Licenses and permits in relation to farming:

- » Länsstyrelsen: registration of vegetable production for market (mandatory), for permit to irrigate with surface water (optional)
- » Local municipality, environmental department, for registration of vegetable production for market (mandatory)
- » Control bodies for example KIWA, HUSH, for certification of organic production (optional)

There's plenty of information on a general note in relation to farming:

- » Jordbruksverket: on farming practices, budgeting, manure handling etc
- » ekofakta.se: a database gathering information regarding ecological farming



Leafy greens are an important, fast growing crop in a Market Garden.

4.1 Procurement legislation

When starting a publicly funded Market Garden, you will run into the Public Procurement Act and questions of procurement and unfair competition. Is it legal for the public sector to produce its own food? Yes. Is it legal for the public sector to limit trade through unfair competition? No.

One way of navigating the first questions is to position the employment of a Market Gardener in the same category as other green services undertaken within the public sector, such as maintaining parks, cutting lawns etc. The farmer is primarily providing a service; a public Market Garden, where a byproduct are vegetables. These can be internally distributed to public kitchens without any monetary transaction taking place. The public sector is thereby not entering the market since it is not selling any services or products.

To answer the second question, one needs to look at whether or not there in reality are any businesses to unfairly compete with. If there is no existing private market and/or the volume of services or products sold by the public sector is small, the public sector can provide its own solution. Today there are very few, if any, regions in Sweden where there are small-scale producers who could deliver enough produce to be able to enter a procurement contract

at a municipality, region or state level, since there is a requirement to deliver larger volumes. The competition is thus sadly non-existing, not because there aren't any small-scale farms out there but because they can't offer enough produce.

A third alternative is direct procurement. If for example a municipality wants to buy in a specific product not available in the procured segment, a direct procurement can be made. The monetary limit for these transactions is currently set for around 60,000 Euros per listed group, for example fresh vegetables, or per public unit buying the products, for example the school kitchen unit at a municipality. A trial was for example made by the municipality of Gothenburg where vegetables were bought from a local Market Garden via their weekly CSA-scheme.

The Model Farm has been delivering vegetables at no cost to the public kitchens, and it has been very small amounts of vegetables when compared to the total amount bought in for the municipality of Gothenburg. It can therefore not be seen as unlawful competition.

Looking at it from another angle, the effect of introducing fresh, local produce to the public kitchens is firstly an increase in awareness regarding the potential quality and variation of vegetables, and secondly an increase in demand which over time creates an entry point for privately run small-scale farms.



As a farmer, your body, hands and brain are important tools. Take care of them.

4.2 Farming during the Covid-19 pandemic

In relation to the practical work of producing vegetables, not many changes were needed to address the pandemic. Clean hands and a face mask plus leveling up hygiene during harvesting by using disposable gloves were the basic changes. When there were interns on site distance was kept, everyone made sure to stay at home if any symptoms arose and time indoors during breaks was minimized.

The more daunting task was to continue to function as an educational site for larger groups of students who were scheduled for practical site visits. These site visits were either cancelled or rearranged to allow only for smaller groups of 8-10 persons at a time.

“We had to cancel a lot of the educational work shops but maintained our production of vegetables.”

*Klara Hansson, Project Manager
and Urban Farmer*



5

Time tracking and time management

“Cap your hours, set a schedule, respect the schedule!”
J-M Fortier, “The” Market Gardener



Keeping track of the vegetables. What's ready to harvest this week?

To stay in the game as a farmer, you must be able to plan and manage your working hours in an efficient way. But how do you know how much time to allocate to all the different tasks throughout the season? Some will say that this type of knowledge is something which evolve as you work, but when you're a beginning farmer working with tight margins it would be immensely helpful to get at least some idea of what your workdays might look like as the season progresses.

With this in mind and in order to help the burgeoning small-scale farming community to become more successful, a time tracking app has been used during the project. Starting in June 2019 and ending in December 2021, each single task undertaken by the farmer has been logged, and most interns who have been participating in the daily chores have logged their tasks. This set of time tracking data can be found in the Appendix, with the tasks performed by the employed farmer being presented in a more detailed way and for the interns in a summarized version.

The individual tasks have been listed under headers such as *Administration*, *Bed preparation* and *Harvest* which are then summarized both monthly and yearly. It might not be something you sit down to read, but rather a piece of information which you can look up as you are planning your season. How many beds can reasonably be prepped during one week? How much time does it take to harvest 20 meters of beans?

This detailed information is based on one specific individual, so of course it doesn't provide a material which in any way is statistically proven. Use it mindfully as an extra planning tool and as a starting point to gathering your own data for your own workflow.

It is worth mentioning that both the farmer and most interns have felt that tracking their time has helped them to not stray into other tasks during the day, but to stick to whatever you're working with before pressing the stop button in the app and then moving on to the next task. Using a time tracker has had an unintended side effect of creating an even better workflow.



Always remember to sample your own produce. Who doesn't want an extra sugarsnap pea?

5.1.1.1 Farmer's Note: Honesty in relation to working hours

Are you farming alone or are there more hands and minds available? How many hours per week are you willing to work? How many months per year? Do you have another income source? What's your start-up budget?

Part of the background to how I planned the physical layout of the Model Farm was by zooming out to look at a larger picture. To me, the fact that I had a chance to gather data during these three seasons was very inspiring. I could finally dig deep into a question which is a tough one for most Market Gardeners: The amount of working hours.

Someone said, jokingly: "I left my nine to five-desk job so that I can work twentyfour-seven as a farmer".

If that is the backdrop to running an economically sustainable farm, then we've lost sight of social and personal sustainability. And if we've lost sight of social sustainability, then how can we ever expect more people to want to become farmers? Not just the few who are willing to work around the clock, but a larger mass of people who are probably transitioning from a semi-to well-paid job with limited working hours into a

Market Gardening career with uncertain outcomes regarding both salary and leisure time.

For three seasons, I have diligently recorded and timed all my tasks with an app: broadforking, 42 minutes, transplanting kale, 52 minutes, harvesting beans, 1 hour 12 minutes, admin, interns, 13 minutes etc. I have detailed information on crop planning and investments, and I have measured all vegetables harvested. All in all, I have started gathering the type of data which I myself was looking for for many years but couldn't find. The type of data which can allow a Market Gardener to make a more solid plan for how to run her/his farm based on previous local experiences regarding yields per crop during a season, worthwhile investments in material and infrastructure and so on.

The Model Farm is simply trying to transparently show a way of running a Market Garden, not the way. Every farmer sets her/his own mark regarding how the farm is operating, and no two Market Gardens will be exactly the same. But I hope that we as a farming community are beginning to create valid benchmarks or starting points, information which can be freely accessed by other farmers-to-be so that they can kickstart a Market Garden and then surpass their farming forerunners.



Using a smart phone in the field to take notes is a fast way of keeping the to do list updated.

Market Gardening resides in the cross-section between farming and gardening, to areas of work where wages are generally on the lower end of the spectrum and where interns and students are frequently included as an unemployed, non-paid work force. Of course the farming community needs to pass on knowledge and hands-on-experience to the next generation of farmers, but we also need to show that our businesses do not rely on free labor. A farms revenue and profit need to stand in relation to the amount of working hours.

It has been imperative for me to show how much work one farmer can get done on one piece of land without relying on extra free labor. However, with the goal of the pilot case being to produce both food and farmers, there has been a number of people helping out on site while receiving guidance and tutoring. Looking at the time tracking data for the days when students have been on site, I can clearly see that my own work as a farmer has been offset by 50-75 percent per day, meaning that I haven't done practical farm work at my usual speed – I've shown someone else how to do it.

An intern or a student who is new to farming and might not have a very broad previous farming knowledge and/or experience from physical work can hardly be asked to match a more seasoned farmer in their work capacity. Each part of the season has its own set of tasks, and it

usually takes around two or three weeks before a new intern has adapted to the farming system and can work more self-sufficiently and with more consistent results. During these three seasons, most students who applied to come for an internship at the farm were partaking for three to five weeks, leaving the farm just as they had gotten some momentum. Each summer a paid substitute came in for six to eight weeks, allowing the farmer to go on vacation for two weeks.

The Model Farm is very much intertwined with the rest of the actors at Angerds Gärd, which is an educational hub where many students pass through each year. Some of these students have practiced their lawn mowing skills in and around the Model Farm, and the staff have helped with some specific heavier tasks such as putting down drainage and moving bedding from the stable to the field.

The overall result of this educational piece of the Model Farm is that an additional 25 percent or ten hours per week of practical work has been added on a yearly basis, with the actual work performed from April to October.

In total, the amount of work put into the Model Farm adds up to one person at 100 percent, 40 hours per week.

6

Educating new farmers

The number one goal of the Model Farm is to be a highly productive farm unit, producing both food and farmers – in that order. Without a well-functioning farm, there is no outdoor classroom in where to instruct farm interns on how to plan, run and manage a Market Garden through all the seasonal shifts. It has been a true challenge to ensure that both these goals can be met, and to make it happen it has been crucial to prioritize production.



Farmer Klara Hansson (left) instructing two students on how to identify and eliminate cabbage moth caterpillar.

During the third season, a guideline formed regarding accepting interns:

- » Maximum two interns during the same time period
- » Minimum 12 days on site
- » Maximum three days per week
- » Min 30 minutes per day without interns on site
- » During practical site visits with external groups, an external tutor must be partaking.

It became obvious that it was an overwhelming task for someone working at 75 percent to tutor interns and external groups and deliver a harvest and document all tasks and administer the project at the same time.

There has been no set program for interns to follow, instead they have been invited to participate in all tasks at hand throughout the year, from broadforking and raking beds at the beginning of the season to harvesting and preparing the harvest for delivery at the end of the season. The different tools and techniques, the crop plan, the to do lists etc have mostly been explained while working in the field, sometimes with added on indoor sessions.

The main feedback from interns is that getting the chance to try out the job of a Market Gardener is extremely helpful and illuminating in relation to the plan of starting a farm of their own. Encouragement

comes from understanding the workflow and the detailed plan underlying the work done over the season, and how much value this effort creates in terms of reducing stress and instead being on top of the end goal of producing, selling and delivering first class vegetables at the right time to your customers.

"It was extremely rewarding to get access to all the numbers and statistics which showed in an obvious way what possibilities there are and how much harvest you can produce from such a small area. I have already used a lot of it in my own plans! It was also great to see the time tracking reports to better understand how much time is spent on different tasks. I am so inspired by Klara and the Model Farm and I highly value my time there. I wish I could have stayed a full season!"
Anja, summer intern 2021

There have also been groups of students enrolled in different vocational educations coming for practical site visits. The size of the groups has ranged from 5-20 persons, allowing for more or less direct passing on of knowledge. One of the more important connections has been with the Market Gardener education at Angereds Farm, which is run as a semi-distance program. The students have had the chance to work with the urban farmer at the Model Farm during intensive on-site days, with the work undertaken matching whatever is in season.

7

Public kitchens – Communicating a vision of organic, local food

It all starts with a conversation and a question: Who would like to get fresh vegetables from their local farmer to serve in their kitchens? Start building an internal network of people interested in this question and go from there. Find out who's in charge of the kitchens and the food served at the different units and build a relation with these key persons so that you are sure to have allies at the receiving end of the system. Ask for their help in adjusting your crop plan to make it fit better with the needs of the kitchens.

To start up a direct communication with the staff from all different units you will deliver to will probably be tricky at the start. Over time, when the deliveries have started, some individuals from the kitchen staff will be sending you more nuanced feedback regarding volume, taste etc. Be aware that you might not get any feedback at all from some kitchens due to lack of time or skills in communicating. Don't be misled to think that all your hard work isn't appreciated, it's just that others are also working hard and with tight time margins.

Try to arrange for meeting the kitchen staff both at the Market Garden and in their own kitchens at least once per year, so that you get a mutual understanding of each other's workplaces. Having the kitchen staff visiting the farm is also a perfect way of letting them tell you what kinds of vegetables they want and more specifically how they want them – size, with or without tops etc, and you can get feedback straight away while tasting vegetables together in the field.

7.1.1.1 Farmer's Note: Weekly harvesting letter

Sitting down for 15–30 minutes to write a weekly harvesting letter is a nice way of sending along not only a list of what crops have been harvested but also a little note on what is happening at the farm right now, and maybe add some ideas for what to cook. Definitely put some effort into presenting whatever odd vegetables you are delivering. Some have never tasted kohlrabi, tomatillos or turnips, but a little presentation can help the kitchen staff unlock the tastiness of these crops.

7.2 Setting delivery goals

A reasonable set up for a new Market Garden is to promise 20 weeks of deliveries, in the time span of June to November. Make sure to communicate that you are farming with the seasons, and that the volume of vegetables available will increase, peak, and decrease during the year. Try to give the kitchens a rough estimate of how much produce they will receive so that they can buy less vegetables wholesale accordingly. Look at the crop plan and the harvest chart from the Model Farm to get an overview of what can be achieved in relation to deliveries for a startup Market Garden.

7.2.1.1 Farmer's note: Future proofing the local food system

Working as a Market Gardener in a cool temperate climate, the ability to easily deliver fresh food to customers year-round is limited. With greenhouse structures housing winter greens, a hydroponics system providing microgreens and a storage of crops such as onions, cabbage and carrots, the lay over months of the year can be partly handled. In the case of the Model Farm, the down season span roughly from early November to late April. Without the forementioned structures set up, there's simply nothing to deliver during these months. One very interesting way of overcoming this delivery gap in relation to the school kitchens is through the potential of preserving vegetables. The schools close for summer holidays from mid-June to mid-August, the same time of the year when the Market Garden is entering peak production. For the duration of the project, the kitchens have been able to use the fresh vegetables even during the summer months since there are always a few units who operate summer schools and other holiday activities for children. If the production is scaled up and the crop planning is tweaked for an earlier and prolonged bumper crop, the kitchen staff could have the chance to work with preserving food for the upcoming winter months. This would mean using the school kitchens more efficiently from operating the facilities parttime throughout the summer. It would allow the farmer to work more in tune with the growing season, planning for several crops to be harvested in July instead of late August, allowing an extra rotation of crops in the beds, further enhancing the yield from the farm.

“Promise to deliver vegetables, but not exactly which ones or how much. You need to get to know your farm first!”

*Klara Hansson, Project Manager and
Urban Farmer*

8

Crop planning

The Model Farm has been run as a municipality-operated CSA. A basis for Community Supported Agriculture is that the community trusts the farmer to make the right decision regarding the planning and production of crops, and that the community allows the farmer to decide what shall be harvested and delivered each week. For the public kitchens receiving vegetables, this set up has worked out very well. They have gotten the chance to access seasonal, fresh produce, and have enjoyed the creative side of not knowing exactly what to receive each week.

For the farmer, having the possibility to work with the conditions of each specific season rather than a fixed delivery scheme, the CSA-model enables a work structure which is sustainable and enjoyable. Crops can be harvested at the peak of their growth to be delivered in prime condition, as tasty as can be and full of nutrients.

8.1.1.1 Farmer's Note: Planning your growing season

A great place to start planning your farming season is from your own highly subjective opinion of what veggies you want to grow because you think they taste good. If you're not into radishes or kale, farm something else! You are more likely to take good care of what you yourself like to eat. There are some 30–40 different crops which are commonly farmed in Market Gardens and many more to integrate if you and your customers which to add them, so there's not a lack of crops to choose from.

For a beginning farmer, the complexity of managing many different crops with many different needs might seem overwhelming. If you have had the chance to work your way through at least a couple of seasons at other Market Gardens, you might want to jump right in there with 25 or more varieties. If this is your first go at farming for a living or for a community, keep it simple to begin with. 10–15 different crops can be a great starting point. As you make friends with the vegetables over the seasons, you'll start finding the similarities and differences between them and it'll become easier to manage a complex crop- and harvesting plan.

The crop plan is set to provide a variety of flavor, color, structure, volume and size of vegetables throughout the season. It needs to be a robust plan which allows the farmer to fully enter executive mode during the growing season, instead of having to drop back into planning mode. There simply is no time for that during the busy outdoor season! With a solid crop plan to inform your weekly and daily operation, when things go sideways – as they always do at some point, be that an insect infestation or a lack of nutrients blocking the growth in a certain bed – you have a good chance of handling the situation without collapsing from the added stress. Being specific in what needs to be done when is key to staying on top of your workload. Planning the season in advance, you'll be able to identify potential peaks of labor and to stretch them into a smoother workflow. Be kind to yourself: Look to diversify the work that needs to be done each week so that your body and mind can not only cope but thrive as a farmer.

The Model Farm crop plan can be found in the Appendix. It is based on two Excel sheets, one with a full list of all vegetables grown, grouped by their families. This sheet contains distilled information regarding the management of the crops, such as when and where to plant them. The second sheet presents a bed layout giving

an overview at a weekly interval of what crop shall be planted where and indicates when the crops are ready for harvesting.

In the crop plan there are dates set for when to plant and transplant the crops, and there is also an estimated first and last harvest date per crop and per bed. The way these dates are developed are through a back casting process cross-referenced with seasonal limitations. When do I want to harvest for ex my first broccoli head? How many days does it take for the broccoli to develop? When do I need to plant it in the nursery, and when shall it be transplanted to be ready for harvest at the desired date?

When looking at seed packets or in seed catalogues, there's usually a specified DTM – Days to maturity. This can be used as a guide for how long time the crop needs in the field during perfect conditions, which for most annual vegetables refers to planting in May and harvesting in July to September. Each specific growing location will give variations to each specific crop depending on the soil, access to water, the climate, microclimate, wind etc. During shoulder seasons, it is wise to add in general at least two weeks for the crops to reach maturity. It will take a Market Gardner many seasons to develop intimate, detailed knowledge of the farm and how the crops tend to grow. Enjoy this process, observe the crops, take notes, try new ways – through iteration and documentation you will become a better grower.

At the beginning of each season, the crop plan and bed layout files are printed, laminated and brought to the field so that the farmer has easy access to the information and can share it with interns and other visitors. It also provides an alternative for taking notes in the field. For example, when direct seeding a crop, the date is noted on the laminated sheet with a permanent marker. This serves as a backup for the information which is then noted in the master Excel sheet on the computer.

There are of course many ways to handle this type of specific information from and in the field, but the main take away is to make sure that you do take notes during the season! This is the information you need to be able to set an even better crop plan next season, which makes the effort well worth your time.



Educating new farmers on the usage of tools and farm management tricks such as walkabouts.

8.2 Walkabouts and to do lists

Maintain a habit at the beginning and end of each week of taking a walkabout: Walk through the field, inspect the separate crops, check the condition of the soil, check the plants in the nursery, note what need to be harvested, adjust the caterpillar tunnels etc. Taking the time to slow down and absorb what's going on at your farm will help you make better decisions regarding the detailed management of the full operation.

Each week will get its own dedicated to do list, preferably typed into an app on your phone. This way you will have listed the information of what needs to be done in a condensed format which you can also share with interns. You can prioritize, decide what to do when, add more tasks as they appear during the week, and push anything you haven't had the chance to finish into next weeks to do list. Adding tasks to the weekly to do list during your walkabout and then revisiting it daily is an easy way of staying on track with what needs to get done whilst also creating a record of what has been done, not to mention the satisfaction of ticking of that list!

8.2.1.1 Farmer's Note: Keep it tidy

Efficiency is the strategy underlying all the work done in a Market Garden. To be able to produce large quantities of fresh, nutrient dense vegetables for a full season you have to be on top of planning and managing all the tasks in front of you. That way, when life inevitably throws you a curveball, your farming operation won't fall to pieces and you'll be able to bounce back quickly.

Farming efficiency relies on a detailed crop plan telling you what, when, the quantity of and where to plant your seeds or seedlings. This can be connected to an infrastructure- and bedprep plan which tells you when and where to mount irrigation, caterpillar tunnels, low tunnels and various other temporary structures, as well as timing which beds need to be prepared for sowing or transplanting at certain time intervals. A weekly to do list allows you to keep track and to prepare for the different tasks so that they can be undertaken without interruption. A habit of always making sure that you bring all the tools etc which you need will assist a smooth-running operation since you don't need to go and get the xxx that you forgot in the shed. If you're an absent-minded person, make a point of stocking your garden trolley before you head out to increase the chances of having the tools you need at hand.

At the end of each task or working day, make use of an "each thing has its own place" mentality to put all your tools back where you got them. It's very frustrating to spend time looking for a displaced tool. If you're a team farming together, agree upon where tools etc should be stored and stick to it!

LEAN as a system is very much a Market Gardeners friend.

9

Crop management in the field: From seeding to delivery

A complete list of tools, machinery, materials etc that have been used to manage the Model Farm can be found in the budget, see Appendix. The aim has been to buy in a standard kit of Market Gardening tools, so the budget also serves as an inventory list when you are trying to remember everything you need to get to start your own farm. In the following chapter some tools etc will be mentioned, others not, but know that everything in the budget has been in use at the farm.



Andrea, springtime intern 2020, using the Jang seeder to direct seed beets.

9.1 Direct seeding and transplanting

Roughly 20 percent of the crops at the Model Farm are direct seeded with a seeder or by hand. The rest are seeded in plug trays in a nursery and get transplanted after three to eight weeks depending on variety. Starting seedlings in a nursery will allow the farmer to grow sturdy plants which can be transplanted in the permanent beds at the right time during the right conditions. Having healthy, larger plants to transplant is a good insurance against for example early season setbacks due to cold spells. A sturdy transplant with a well-developed root system can quickly re-establish itself in the field and shade out weeds, and it can tolerate to get nibbled on by slugs and insects without this resulting in a total crop failure. It is a great way of getting the crops started early on while simultaneously preparing the beds for the season.

At the Model Farm the following tools have been used for direct seeding at transplanting: Jang JP-1 seeder, SixRow Seeder, plug trays, push out plates, bed preparation rake, row markers, spade, wire hoops or plastic hoops, fiber cloth, drip tape, anchoring pins.

9.1.1 Direct seeding

The Jang seeder is used for crops such as carrots, beets, radishes, spinach, coriander, dill, leafy greens and green manure. The SixRow seeder is used for salad and leafy greens such as rucola and baby kale. Different settings on the seeder will drop the seeds at specific intervals. In just a few minutes you can plant for example five rows of carrots in a bed, which saves a lot of time compared to direct seeding by hand. It also allows you to work ergonomically, standing up and pushing the seeder in front of you instead of kneeling down to plant each separate seed.

To work well, the seeder needs a well-prepared bed surface. If the soil is too wet or if there are too many rocks or clumps of soils or organic matter, this will clog up the machinery. It can be a challenge to find the right settings for the differently shaped and sized seeds but there are quite a few guides to be found online, and it is well worth the time to experiment on your own on a flat surface such as a rug before running the first rounds out in the field. Knowing your tools makes farming easier!



Klara Hansson, eight months pregnant, demonstrating how to broadfork and shape a bed to then direct seed or transplant seedlings.

9.1.2 Transplanting

Prepare the bed surface with a rake and then use the row markers to draw shallow lines at equidistance from each other. Draw a grid by adding more lines at a 90-degree angle.

Use the push out plate to loosen the transplants from the plug tray and place one transplant at each cross in the grid. With your fingers or a spade, work your way down the line and plant all the transplants. Making sure that the transplants are spaced evenly allows for quick and easy passes with a hoe or other weeding tools further along the season. While planting, speed is of the essence so don't fiddle too much with the plants – they are sturdier than you think!

Make sure to water in the transplants well, especially if it is a dry or windy day. Place drip tape in between the rows and peg it down with anchoring pins. If needed, place hoops and fiber cloth or insect netting over the transplants.

9.2 Weeding

To grow strong, healthy and tasty crops it is important to stay one step ahead of the weeds, especially during the first half of the season. As the plants grow bigger

they are better equipped to compete with the weeds, but when they are first direct seeded or transplanted they will need some help. There are many ways to go about weeding, but the main key is to get it done before the weeds have established themselves. Passing over a bed with a weeder or a cultivator before you can even see any weeds or just as they are germinating is a great strategy. This will lessen the time spent on weeding later on by at least 50 percent since the effort to kill of these plants increases with their growth.

In terms of tools and equipment to rely on, there are a number of hoes, wire weeders, flame weeders, tarps etc to help the farmer with this task. At the Model farm, the main tools have been a stirrup hoe, a Lucko wire weeder, a Terrateck double wheel hoe and a sturdy knife or Hori-hori to dig up the occasional weeds with tap roots which have managed to establish themselves. The use of silage tarps is also one of the main tools in keeping the weeds down. Keeping the beds covered either in living plant material or with a tarp reduces the amount of time where the bed surface is naked, giving ample space for weeds to germinate and grow.



Green and black kale ready to harvest, week after week.

9.3 Harvesting

In the crop plan, an estimated harvesting window is given for each crop and bed. These dates provide a first listing of what will be ready to harvest each week through the season. Hopefully, it is spot on, but most seasons will have a warmer, cooler, wetter or drier period shifting the harvesting dates for a bunch of crops. The beauty of running a CSA is that the farmer can more easily maneuver these seasonal shifts and adapt the harvest to the weather and growth rate of the crops.

A weekly walkabout will generate an updated version of the planned harvest list in accordance with what and how much than can and/or needs to be harvested. Do your best to stay agile: If the salad is beginning to bolt, if the spring onions are starting to yellow or if the frost is about to take out the fennel, it all needs to be on that list to get harvested now. With this information at hand, write your list specifying when, what and preferably how much to harvest. If you are solo-farming, don't skip out on this. Having a set list to follow helps bring you up to speed and to not stray into other tasks during harvest. The hours spent harvesting can become very long and daunting if you're not moving swiftly, so stay on track!

When planning the harvesting order you should factor in the temperature in the field. Harvesting a lettuce at two in the afternoon a hot day in July is not the best if you want it to keep well for a long time. A good way to go about it is to start the day bright and early with all "fragile" crops such as lettuce, leafy greens, spinach, herbs, chard and kale, in the order from thinner to fatter leaves. If you are bunching beets, carrots etc and leave the tops on, put them next on the list. Then move on to harvesting crops less affected by the field heat, such as beans, zucchini and tomatoes.

Make sure that you have everything you need in order before you start the harvesting: A clean washing- and-packing area, bins or boxes, garden cart or wheelbarrow, scissor, knives, secateur, rubber bands, quick cut greens harvester with charged power drill, scales, whiteboard with a list of crops to harvest. As you start your harvest, get into the groove and just DO IT! Remember to drink water, to stretch every now and then and to enjoy the fact that you're now harvesting delicious vegetables which you have brought up from seed!



Keeping the harvested vegetables in a shady spot or in a cooler is essential to keep the quality high before delivery.

9.4 Washing and packing

To be able to handle the harvested vegetables in an efficient way, a washing and packing area is needed. It can be indoors or outdoors, but preferably under a roof to give shade during sunny days and shelter during rainy days. An easy start-up option is to build a simple setup with a workbench or table, a netted table and an elevated bathtub. This can be done at low cost from mostly second hand and recycled materials and will allow the farmer to build a wash-and-pack station according to her/his own needs and measurements. At the Model Farm, the washing station is outdoors under no roof, while the packing station is in a barn just next to the field.

If you choose to wash or not to wash your produce is both up to you and your customers. Delivering vegetables to public kitchens, it has been important to wash them with water from a tested and approved water source and to thoroughly remove all dirt. Some kitchens have the capacity to handle dirt, others do not. To maintain a good flow during a harvest day everything harvested gets the same treatment when it comes to washing regardless of which kitchen it will go to.

At the start of the harvest day, fill the bathtub with cool and clean water. When you've started harvesting and bring back a container full of for example salad or kale, dunk it all in the water and put a couple of boxes on top of the veggies so that they stay under the surface.

Leave them in the tub and go harvest the next crop. When you come back five or ten min later, the leaves have cooled off. Swirl or move them around to rinse of any soil particles or insects, pull them out and (if possible) shake them off before letting them drip dry on the netted table. If you have the possibility, mount a fan above the net to help with the drying. You can also dry for example baby kale, rucola and spinach in a salad spinner, either a homemade one or a store-bought version. For heads such as lettuce or broccoli, remember to leave them dripping with the bottom pointing upwards to avoid collecting the water inside the head.

Put your next load of vegetables in the bathtub and go harvest another crop. When you come back, move the semidry leaves from the netted table into boxes and into a cooler or a shaded area, then swirl and shake off what's in the tub, put that load on the netted table and dunk the next variety of veggies



Swiss chard getting rinsed and cooled off in a bathtub filled with cold, clean water.

in the bathtub. In this way, your harvesting set up becomes a mini-assembly line with different stations, allowing you to harvest according to your list and to have fun while doing it with a variation of tasks at hand. If you'd harvest everything at once and then move on to wash it all, harvesting easily becomes a tedious task.

Not all vegetables need to get washed in the bathtub. Some might just need a thorough spray, such as carrots, beets and parsnips, but if they have their tops on, they might first need a spray down, then a dunk in the water to rinse out any dirt etc from the leaves.

Others are delivered un-washed, such as tomatoes, cucumbers and zucchinis. These vegetables tend to spoil faster if they are washed but not thoroughly dried, and drying can be hard to achieve on a budget set up.

When it's time to bring a container to the shaded area or the cooler, first use a scale to measure the weight of the crop and note this down, for example on a white board where you have written your full list of crops to be harvested. If you are bunching crops, you might also want to add the number of bunches. At the end of the day, transfer this harvest

record to your digital one. The harvest record will serve you well in understanding how much a certain bed has produced, how much has been produced per week and in total and at what point during the season you have been harvesting different crops. It will feed straight into the planning for the next season, and it allows you to present your customers with an estimated delivery schedule while maintaining detailed and updated knowledge of what and how much the farm is actually producing.

“Your harvesting set up becomes a mini-assembly line with different stations, allowing you to harvest according to your list and to have fun while doing it with a variation of tasks at hand.”



Carrots with their tops on together with fennel, beets, onion and garlic, served in the school kitchen.

9.5 Transport and delivery

In order for the deliveries to function well in relation to the season and the receiving kitchens, deliveries are made once a week from early June to mid-August, and twice a week from mid-August to early November. During the early summer months, there are less crops ready to harvest both in terms of volume and weight, and the demand is not as high since most schools are closed. The crop planning is tweaked in accordance with this, pushing bumper crops such as zucchini and beans to start delivering higher yields from mid-August onwards.

The vegetables are packed and delivered in standardized plastic boxes which are part of a reusing system commonly used by wholesale dealers. This makes it easy for the kitchens, they can pop the boxes straight into their fridges and send back the same number of boxes from an empty stack.

With the customer base being larger public kitchens with a high turnover rate, the crops are typically prepared and served in the canteens within ten days. Most of the crops are not meant for storage, though they will still last a long time if stored correctly. For example, a bag of salad can sit in a fridge for over twenty days and still be delicious, and a kohlrabi stores well for more than two months at four degrees Celsius.

Most of the vegetables are used in the salad bar, with kids happily chomping away at raw beans and purple carrots, and the elderly tasting tomatoes and salads which bring back memories from their childhood.

The feedback is very consistent: The crops from the Model Farm have a richer taste, smell better and look fresher than what can be bought wholesale. The vegetables last longer and most importantly – the children like to eat them!

10

Farm infrastructure

The soil is the foundation for a farm, but to be able to manage the farm efficiently, you need to invest in proper infrastructure. It doesn't need to be high tech or fancy, it just needs to leverage your efficiency. Don't spend your time watering with 10 liter water cans, or keep all your seedlings in the windowsills at home. It is well worth the time and money to build or buy a few pieces of material to set you up for a smoother run during the full farm season, especially in regards to a nursery, a caterpillar tunnel and an irrigation system.



A simple shelf made from scrap wood, with LED-light as a light source and fiber cloth as a curtain to keep the heat trapped.

10.1 Nursery

The growing season starts indoors in a plant nursery. Depending on your site location and what crops you are planning for, this can be as early as January or as late as April. The nursery can be located on or off the farm, and it can be split into different sections. If you live off site, it is often more convenient to set up a nursery at home for the first few months, and then move the plants to a nursery at the farm once the farming season is kicking off. By doing so, you can focus on planning your season, add a few hours of nursery work per week at home and not waste time on transport to and from the farm.

A basic set up requires an empty space with temperatures from 18 to 22 degrees C, shelves, lights with suspension, a timer, cover materials such as transparent plastic and fiber cloth and potentially a back-up heater.

Before you sketch up and start building your system, do a calculation of how much shelf surface area you will need. Checking your seeding plan to calculate how many trays you are planning to have in the nursery at any given point of time, then multiply this with the measurements of your plug trays.

If possible, prepare a modular design that can be easily expanded by building more shelves as your needs will likely be higher in future seasons.

Many growers start their first nursery at home in a walk-in closet, a garage or a basement. There's no need for a fancy set up when you start, but make sure you have enough space for all the trays you're planning to seed. The potential migration of plug trays into other areas of your home can take a toll on your personal and relational sustainability. Not everyone wants to have seedlings in the living room constantly reminding of work to be done, though of course for others the opposite is true.

When the weather permits and the seedlings are big enough to head outdoors, a simple way of hardening them off is to move them to a second stage nursery inside a caterpillar tunnel. Use pallets to create a level surface, put plastic tubes up as hoops and put fiber cloth over them as a finish.

If you have the option, an insulated and heated greenhouse is the next step up the ladder.



A caterpillar tunnel planted with tomatoes in the two middle rows, and lower growing crops on the sides.

10.2 Caterpillar tunnels

A caterpillar tunnel is a greenhouse construction designed to provide a mobile, cost-effective alternative to a permanent greenhouse. The name stems from the shape of the segmented tunnel, which from the side looks like a caterpillar. In comparison to a permanent greenhouse or a hoop house, a caterpillar tunnel can be mounted or dismantled in a couple of hours, allowing the farmer to move the tunnel around the farm to where it is best needed. The tunnel can be integrated into the crop rotation to accommodate heat loving crops and to allow for season extension, and it can easily be stored away over winter to prolong the life span of its materials.

A caterpillar tunnel can be ordered or made in different sizes with these main components: Hoops, rebar stakes, anchor plates, carabiners, purlin strap, transparent greenhouse plastic, anti-billowing poly rope and wire hooks.

A caterpillar tunnel has its hoops spaced evenly at roughly 120-180 centimeters, the tighter the spacing, the stronger the construction. When planning to invest in a caterpillar tunnel, the farmer should take local weather conditions into consideration and make sure to wind- and rainproof the construction. Additional wind braising at tunnel ends and a rigid purlin are basic add-ons to create a sturdier construction.

Advantages:

- » Mobile
- » Low-cost alternative
- » Can be upgraded to a hoop house
- » Can be installed on uneven ground

Disadvantages:

- » Sensitive to high winds and heavy rainfall
- » Access problems at the ends of the tunnel, requiring the farmer to bend over and slide under the plastic

Assembling a caterpillar tunnel is pretty straight forward. The rebar stakes are pounded into the ground at an even spacing, often around 1,5 m apart, creating two long rows which will form the sides of the tunnel. The anchoring plates with carabiners attached are threaded over the stakes before the hoops are slid over. Now the end of each hoop is resting on an anchoring plate, hindering it from making its way further into the ground. At each end of the tunnel, rebar or a fencing post is pounded into the ground about 1,5 metres away from the outer hoop. The purlin strap is fastened to the rebar at one end and is then looped around the center point of each hoop before being attached to the rebar at the other end. The purlin strap is then tightened of at each end to create a rigidity in the hoop structure, making the structure look a bit like an accordion, and each hoop is readjusted so it stands vertically.



Drip lines is the back bone of the irrigation system, but an ordinary spray nozzle always comes in handy as a back up.

The greenhouse plastic is rolled out alongside the hoops on one side and is then pulled over the hoops from one end to the other. Make sure to have enough plastic sticking out at each end, then pull it tightly together into a cone shape and fasten it with a piece of poly rope to the rebar. To finish of the set-up, a spool of poly rope is used to tighten down the plastic. Fasten one end of the rope to the carabiner at an end-hoop. Toss a loop of rope over the tunnel and click it through the carabiner one hoop further along. In this zigzag fashion, keep clicking in the rope along the tunnel at each second hoop, then turn around at the other end of the tunnel and fasten the rope to the remaining carabiners in the same zigzag pattern. Tighten down the structure by pulling at the rope at each second hoop along the full length of the tunnel, then do the same at the way back. The job of attaching and fastening down the poly rope is most easily done by two people working together on each side of the tunnel. Tie of the poly rope at the last end hoop and fasten the end of the rope where you can easily find it, since you will need to readjust and tighten down slack during the season. Lastly, install the wire hooks at each hoop to enable ventilation through raising the plastic along the sides of the tunnel, letting it rest on the wire hooks at an appropriate height. Always roll the plastic inwards and upwards, to avoid rainwater collecting in the rolled-up part.

Voilà, now you have a protected growing space!

10.3 Irrigation system

As mentioned in the section about finding the right piece of land, if you don't have access to water you shouldn't start a farm at the site. The second part of this advice is to make sure you have the budget for installing an irrigation system, which will save you many hours of hard labor and mental stress. Make sure that the irrigation can be controlled for each separate bed if it's a drip line, and for each separate main line if it's a sprinkler system.

At the Model Farm there are two blocks with 24 permanent beds each. There's a separate master line running along the edge of each area, and from each master line there are two drip lines connected for each bed. Each master line and each drip line can be turned off and on. It's a sturdy but fully manually operated system, with no way of turning on the drip via an app on your phone, so it can only be activated when the farmer is on site. There's also a third main line which can be connected to a line of sprinklers. These can be moved around the farm in correlation with the crop plan, to use sprinklers when for example germinating small seeds such as carrots, which might not get a sufficient water flow from the drip lines.

11

Preparing permanent beds - a detailed account

The two-wheel tractor allows a farmer to start building beds either from a plowed or non-plowed starting point. If the land is plowed, the usage of the two-wheel tractor is very straight forward. If the land is currently a pasture, the farmer will need to work the tractor and the soil a bit more.



Permanent, raised beds, made with a two-wheel tractor and shaped with a rake.

11.1 Starting from scratch with a two-wheel tractor

The first step in preparing the beds is to mark their placement. Bring the farm design, a 50 metre tape measure, a carpenter's rule and marking poles. In accordance with the farm design and in-field permanent elements such as trees, fence posts, buildings, identify one corner of the bed system and mark it with a pole. From this corner measure up a square of for example ten beds. Mark the other corners of the square with poles and then cross measure to ensure straight angles. [drawing], Make sure to be in line with the field design and the surrounding permanent elements, and adjust if needed. Remember, once these beds are put into place, they will be permanent. Use more poles to mark the end of each bed and pathway along the edge of the square, measuring with the carpenters' rule and putting down a pole at the alternating distance of 75 cm per bed and 45 cm per pathway.

Bring the two-wheel tractor with a rotary plow attached. The screw of the plow pushes the soil to the right, creating a slanted bed side, so it often makes sense to start plowing the field from left to right. Most tractors don't have a specific sight mounted to the machine, so instead figure out what feature to use to align your tractor with the length of the bed about to be plowed. This might be the wheel, the air filter or a wingnut. This feature shall line up with the poles at the start and at the end of the bed.

Imagine a string in between the two poles (but don't use one, it tends to move too much to actually help), then remove the starting pole to avoid driving over it. Run the tractor slightly forward so that the rotary plow is at the edge of the bed, engage the PTO and start plowing, following the imaginary string and aiming at the pole by the end of the bed.

The plow will form a slanted side, digging into the soil of the pathway and pushing it up to the right-hand side creating the first side of a raised bed. Nearing the end of the bed, put the machine in idle, remove the pole in the finishing corner, plow the last few meters and then disengage the PTO. With a quick 180-degree lift-and-turn, run the tractor in position with the next set of poles. Repeat the lining up using for example the wing nut sight, move into position and plow the second side. You will now have formed the base of a bed, 75 cm wide at the top. [sketch] Seen as a cross section, the slanted sides and a lower untouched middle section now gives the bed a U-shape. This shape will be flattened and leveled further on, using the power harrow.

As you turn the tractor 180 degrees to start a third run, again use the poles and wing nut to align the tractor but also make use of the half-made pathway, positioning the tractors left wheel in the pathway. This will help guiding the tractor in plowing in a parallel, straight line. From now on, every second turn with the tractor you will have the pathway as a guide, thus speeding up the process of bed forming.



Tractor maintenance with the help from instructional videos on Youtube. Don't think you need to know it all yourself.

Using the poles as directional marks, keep plowing beds. It is useful to plow a minimum of four beds each time you bring out the tractor, to ensure a smooth workflow with a minimum of interruption.

While plowing the tractor often tends to steer of to the left because of the turning and pushing motion of the plow, creating a bend in the supposed-to-be straight side of the bed. To oppose this bananalike shape, make sure to keep eying the sight line both back and forth while plowing, adjusting the trajectory when needed. If a bend has been created, disengage the PTO, back up at least a few meters and realign the tractor, engage the PTO and reshape the side as needed, moving material either from the pathway and into the bed, or slicing of a bit more soil from the side of the bed [drawing].

Depending on soil type and conditions, a small ridgeline might form in the middle of the path. This can easily be removed with the plow, making an extra pass right down the middle of the path to level the surface.

Strive to form beds with the tractor when the soil is in good condition moisture wise, since this will make the work easier and lighter. If the soil is too wet, the

plow tends to get sucked down, and if the soil is too dry, the plow tends to bounce on the surface.

When operating the tractor in non-perfect conditions, it is useful to counter these movements with your own body weight. If you cross into a dry area, push down on the handles and lean into the machine with your weight to help the plow push deeper. If you cross into a wet area where the plow gets sucked down, simply help lifting it a bit by pushing upwards with your legs (making sure to spare your back). Tuck your arms and elbows along your upper body as you hold on to the handles with a light grip. Be mindful about your posture. The less physical strain you put on yourself to operate the tractor, the more hours you can keep on working. This in turn means less time spent on moving the two-wheel tractor back and forth to the storage shed due to short stints of work as a result of physical fatigue.

Initial time investment, plowing: 15-20 minutes per 20 metres bed.

Maintenance, plowing: 5-10 minutes per 20 metres bed.



Shaping the very first beds using the two wheel tractor and rotary plow.

The next step is to swap the rotary plow for a power harrow. This is a tool which is bulkier to maneuver on uneven land due to its weight and large surface area in contact with the ground. Getting stuck takes time and energy away from the field work, so keep in mind what problematic, uneven areas to avoid driving over as you come into the field. If there is a ditch at the start of the bed, make sure to level it out with some soil or a board, otherwise the nose of the tractor will most likely get stuck in the ditch.

Center the tractor and harrow at the edge of the bed, with the width of the harrow covering the full 75 cm. Lower the teeth of the harrow fully by turning the handle above the mesh roller counterclockwise, approximately 15 turns from the highest possible position. This will bring the teeth down to a harrowing depth of about 10-12 cm. Engage the PTO and harrow the bed back and forth, allowing the teeth and the mesh roller to break up clumps and root mass in the soil and to level the surface.

If creating beds directly in a non-plowed pasture, most likely there will be a lot of root mass to work through both while plowing and harrowing. In this scenario it is advisable to first run down the U-shaped middle of the bed with the rotary plow

to break up the root mass before using the power harrow to break up the last roots and level the bed. If the root mass is very dense, you might not be able to use the harrow at all at this point. Skip this step and jump straight into broadforking and weeding.

Initial time investment: 10 minutes per 20 metres bed.

Maintenance: 5-10 minutes per 20 metres bed.

11.2 Finalizing the beds with manual tools

Now it is time to park the tractor and get back to manual labor. Using a broadfork as wide as the bed surface, start forking through each bed at a 10-15 cm interval. The aim is not to turn the soil over but simply to aerate it by creating many new cracks and porous spaces. The first time a bed gets broadforked is also an excellent time to remove perennial weeds, large stones and any other odd findings that may lay resting in the soil.

Align the tines of the fork with the end of the bed. Step onto the horizontal steel bar, finding your balance by holding on to the handles and using your



Broadforking a bed which has been covered with silage and silage plastic during the winter.

body as a balancing weight. Wiggle the broadfork and your body back and forth in the lengthwise direction of the bed to make the tines slide into the ground. Depending on soil conditions, this will require more or less of an effort. Best practice is to use the wiggling motion and not to jump or stomp on the bar to force the tines into the ground. Jumping will require more strength and is more tiring, while wiggling turns the job into a fitness exercise and allows for a longer duration of work.

Continue to wiggle the tines at least halfway into the soil, then step backwards and pull back heavily at the handles to leverage the soil in front of the tines upwards. This will create a first cracking of the soil. Move the broadfork handles into a vertical position again and step back onto the steel bar to keep wiggling the full length of the tines into the ground. Step backwards and pull back hard at the handles to break up and reveal the deeper layers of the soil. If perennial weeds or stones are present, make use of this exposure of the soil to remove roots etc. This may be time consuming but is a good investment to erase future problems. As you move the handles into an upright position again, the soil will resettle but it now has a fluffier texture.

Take one step backwards and move the tines 10-15 cm towards you by pulling the broadfork along. Avoid lifting the fork each time since this will add up to a substantial extra work load if repeated again and again. For example, a 10 cm forking interval amounts to 200 repetitions in a 20 metres long bed. Lifting a fork each time would amount to $200 \times 5 \text{ kg} = 1,000 \text{ kg}$. Spare your body! Instead repeat the wiggling and cracking, remove weeds etc, move the broadfork another 10-15 cm, and keep repeating this motion the full length of the bed.

The surface of the bed will now be significantly higher than before, as the soil is less compacted. The more porous texture of the soil will allow for easier transport of both gas and fluids, which helps the microbiota in the soil to thrive due to enhanced living conditions.

Broadforking each bed is done at least once a season, commonly at the start of the season, and depending on what crops have grown in the bed it can be worth the time to broadfork in between successions as well. It is also an excellent way of monitoring the soil quality in different beds and sections of the field, since it provides a rather detailed sensory understanding of the soil. Is it a compacted, fluffy, dry,



Checking for weeds after taking of the silage plastic which has protected the beds during winter.

wet, sandy, clayey or humus rich soil under feet? This allows the farmer to make better informed choices regarding what amendments such as manure or compost to add or where to plant crops with specific needs in relation to for example root space.

Initial time investment: 40-60 minutes per 20 metres bed.

Maintenance: 20-30 minutes per 20 metres bed.

To finalize the shaping of the bed, use a 75 cm broad aluminum bed preparation rake. The standardized size helps you to easily form the correct width of the bed while working. If the soil is heavy, it is convenient to use a slightly narrower and heavier steel rake or another sturdier tool to start the job. Walking in the pathway on one side, rake the soil from the opposite path onto the top of the bed. Use the weight of the rake to break up clumps into finer soil congregates. By dragging the soil from the path on to the bed you are both preparing a smoother pathway and raising the bed even further, while also stabilizing the slanted sides of the bed. Especially if you are growing in clay soil in a colder, wetter climate, a raised bed will prolong your season by creating a heating effect during the shoulder seasons and it will also help to keep the soil drained.

As you rake your way down the length of the bed, keep dragging soil from the pathway onto the surface and push the material back and forth on the top of the bed to break up clumps and even out the surface. Strive to create a smooth, level bed surface. Using the broad bed preparation rake makes it easy to work the bed into the correct width of 75 cm since you are bringing along a constant measure. When you finish down the first side, step into the opposite pathway and continue with raking soil from the path of the second side.

Make sure to keep an eye on the straightness of the bed. If there is an obvious banana shape when you look at the bed from one end, use the rake to correct the bed by dragging soil from the bulging side to the skinny side. It is definitely worth the time investment to finalize your bed shaping with this step, since this will be a permanent bed and the efficiency of planting, weeding etc relies on straight beds and straight lines.

Initial time investment: 30-40 minutes per 20 metres bed.

Maintenance: 10-20 minutes per 20 metres bed.



Covering the area for future permanent beds with silage plastic, to help smother the grasses and weeds.

Before seeding or transplanting a crop into the bed, adding a thick layer of compost is the final step. This should be a well-blended garden compost or mulch. The compost can be brought in with a wheelbarrow or with a garden cart, or even with a small machine and trailer if the width of the wheelbase matches the pathways. Scoop out the compost with a shovel or spade. For a 20 metres bed, roughly 500 liters of compost will be needed. Use the bed preparation rake and form a five cm thick layer covering the full bed surface, but not the sides. Compost sliding into the pathway can be raked back up on top of the bed to not add unnecessary organic matter and nutrients to the pathway. Make sure to smash up any larger clumps and to remove twigs and sticks. Strive to create an even, smooth surface where a seeding machine can be used without problems.

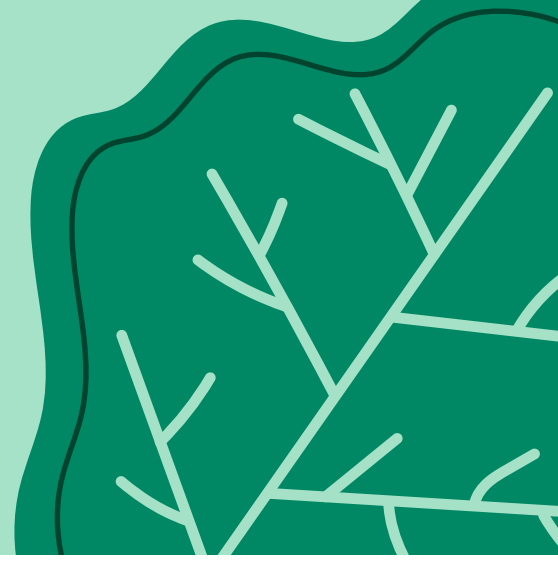
The aim is not to integrate the compost with the original soil, but rather to keep it as a dark cover on top of the surface. This will help with subduing the growth of annual weeds, creates a perfect seeding or transplanting surface, retains heat due to the dark color, reduces the forming of a hard surface and cracks in a clay soil and reduces the amount of transpiration in a sandy soil. The soil biota and plant roots will help to slowly integrate the compost into the deeper layers of the soil, which means that an annual refill is often needed, especially for the first 3-5 years.

Initial time investment: 30-40 minutes per 20 metres bed.

Maintenance: 30-40 minutes per 20 metres bed.

While the beds are being prepared it is valuable to have a cover to pull over them before they are fully formed and ready to get planted. This helps keeping the moisture in the ground on sunny days and smothers the growth of perennial and annual weeds, working as a passive weeding strategy. For this purpose, most farms use black or black-and-white silage plastic cut into pieces of a convenient size, covering for example four beds. The same sheets of plastic will be used at the end of the season to cover up the field during the winter months. The plastic should be thick, at least 120 μm , to last for many seasons. The plastic can be weighed down with for example sandbags or pallets. Any sharp edges can create rips in the plastic in windy conditions so make sure to only use heavy material with rounded edges that won't bite into the plastic. When not in use, fold the plastic (preferably in a dry condition) and store it in a dark space to prolong its lifetime. Make sure to fold all the pieces in the same way to make it easy to also unfold them, even for a solo farmer on a windy day.

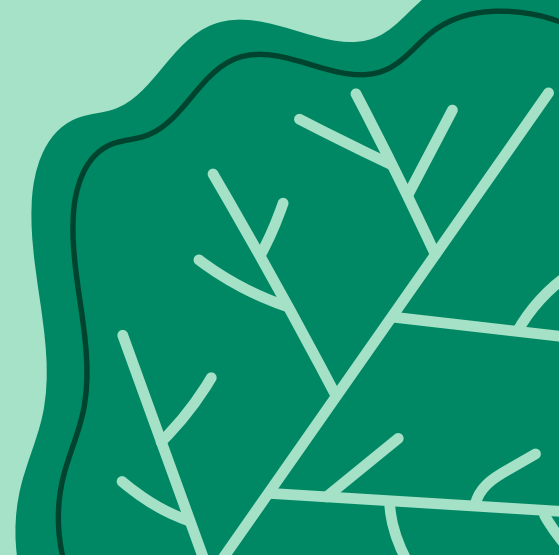
12



Closing words: A great farmer needs a great set of skills!

It seems appropriate to end rather abruptly with something so trivial as a note on how to fold a piece of silage plastic. One of the most meaningful parts of being a Market Gardener is that the job involves everything that you as a person are and all the knowledge and skills you have gathered. Any given day you might end up using a two-wheel tractor, guide a group of gardening students, send off a batch of vegetables, enter data in an excel sheet and troubleshoot a section of drip irrigation. Its high and low, hiccups and flow, brutal force and finicky fiddling, slow observations and harvesting frenzies. Every day I'm a farmer I'm also tapping into the realms of agroecology, engineering, logistics, geology and so on. It's a never-ending learning process lined with hard work and delicious harvest bounty, and if that is your cup of tea, you should be a farmer too.

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Appendix

13.1 Budget

	Unit	Quantity	Cost, total ex VAT	Supplier	Specification
Sum total 2020			31983		
Various disposable materials and tools			2948	Hallarnas trädgård	Seeds, hand tools, potting soil, single flame wood burner tool etc
Various disposable materials			590	Magrudsens O Fritj AB	Material for harvesting, plastic bags, hand disinfectant, gloves, tape etc.
Gas burner accessories	pcs	2	280	Bräcke Åkeri	Hose clips, back pressure valve
Seeds			2160	Lindbloms frö	See crop plan for details
Propane bottle	kg	5	1268	Linde gas AB	Propane plus composite bottle
Irrigation system			6218	Aquadrip	Additional valves and connections
Farming accessories			3237	Hallarnas trädgård	Algomin fertilizer, slug repellent, net, tomato hooks, carrier trays
Soil/compost	M ³ T	12,3	9653	Hässelhorn gården AB	Soil/compost in metric tonnes including transport
Fridge	pcs	2	0	TaCe	2 fridges via TaCe, municipality's internal freshshop
Transport, fridge			300	Parke- och naturförvaltningen	Transport of fridges
Soil analysis	pcs	1	1380	Eurofins Agro testing	Analysis package "Fruit and greens 1" with extra lime analysis
Plastic liner bag, 30 kg	pcs	500	890	Procurator Sverige AB	Liner for grey boxes, Chark MD 30 kg 680/470x700mm 23my, blue
Lime	pcs	71 (bags à 15 kg)	2643	Naturmäns foder i Tuve	Animal feed lime from Svenska foder

13.2 Crop plan

Family	Scientific name	Variety	to maturity	maturity	Supplier volume	Planting distance
Mustard green	<i>Brassica Juncea</i>	Golden Frills		25	3,6 L, 25 g	12r @5,7, cc
Mustard green	<i>Brassica Juncea</i>	Purple Frills		25	3,6 L, 25 g	12r @5,7, cc
Asian greens, mix	<i>Brassica rapa</i>	Mix		25	3,6 L, 2000 seeds	12r @5,7, cc
Onion family						
Alliaceae						
Onion sets, yellow	<i>Allium cepa</i>	Husky			5, 5 kg	4r @20, cc 5
Onion sets, red	<i>Allium cepa</i>	Red Baron			5, 5 kg	4r @20, cc 5
Scallions, white	<i>Allium fistulosum</i>	Long White Ishikura	65		9,3 L, 3000	4r @20, cc 12/5 per grupp
Scallions, white	<i>Allium cepa</i>	Ishikura	65		9,3 L, 1000	4r @20, cc 12/5 per grupp
Leek	<i>Allium porrum</i>	Ranslet #1	55		7,9 L, 500 seeds	3r @12, cc 12
Garlic	<i>Allium sativum</i>	Sabidrome			0,0 2020 from farm	3r @25, cc 20
Chives	<i>Allium schoenoprasum</i>	Gonzales	80		11,4 L, 2000 seeds	3r @25, cc 20/10 per plugg
Pea family						
Fabaceae						
French bean, green	<i>Phaseolus vulgaris</i>	Domino	50		7,9 L, 250 g	2r @50, cc 15
Widow bean	<i>Phaseolus vulgaris</i>	Valdor	60		8,9 L, 1000 seeds	2r @50, cc 10
Pole bean	<i>Phaseolus vulgaris</i>	Isabel	60		8,6 L, 100 seeds	2r @50, cc 10
Snap pea	<i>Pisum sativum</i> var. <i>macrocarpon</i>	Cascadia	60		9,3 L, 1000 seeds	3r @25, cc 10
Sugar pea	<i>Pisum sativum</i>	Sweet Horizon	55		7,9 L, 500 g	3r @25, cc 10
Carrot family						

You can download the complete documents for 2019-2021 here: [Budget](#) and [Crop plan](#)

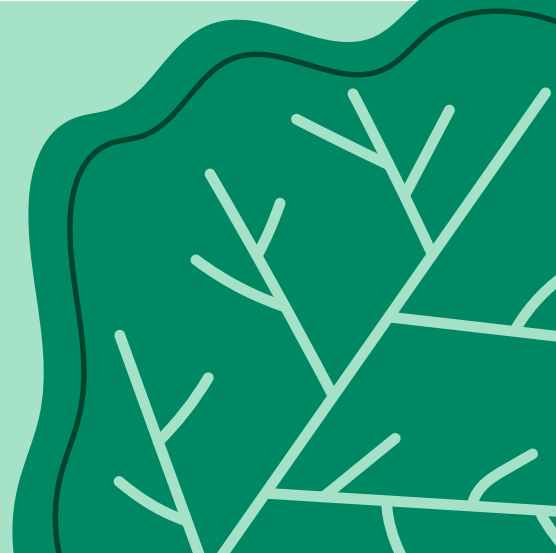


Appendix

14.3 Garden Plan

19	20	21	22	23	24	25	26	27	
10-maj	17-maj	24-maj	31-maj	07-jun	14-jun	21-jun	28-jun	05-jul	
	Last frost		1st harvest						
			1	2	3	4	5	6	
		Green manure							
		Green manure							
		Green manure							
		Green manure							
		5 m Market Gardener education tulips, 10 m Mixed flowers TP							
		5 m Purslane DS, 11 m Bulls blood DS, 2,5 m Red veined sorrel TP							
		1.5 m Purslane TP, 8.5 m Lettuce TP, 10 m Lettuce DH					H	H	H
		Lettuce TP					H	H	H
			French bean green, DS						
			Wax bean DS						
						French bean green, DS			
						18m Wax bean DS, 2m French bean green,			
	Swiss chard TP 50%	H	H	H	H	H	H	H	
						H	H	H	
						H	H	H	
		10 m Red beet, 5m Yellow beet, 5 m Polka beet DS							
								H	
							H	H	
	10 m Celery TP				10 m Fennel TP				

You can download the complete document for 2019-2021 [here!](#)



Appendix

13.4 Time tracking data

Toggle 2020, Ebba Wilhelmsson 15 Apr-13 Nov	No. work days	135		
Task	[h:m:s]			
Preparing permanent beds	63:26:28			
Direct seeding, transplanting	113:24:07			
Management	107:49:04			
Infrastructure, tools	81:11:50			
Harvesting and packing	228:18:51			
Project admin, meetings, presentation, education	218:19:32			
Nedmontering av odling och bäddar	71:25:04			
Total no hours	883:54:56		Total, Klara Hansson	#####
Total no hours, flextime registration	1558:12:00			
No hours, days, Klara	462:30:00	62		
No hours, days, Ebba	1095:42:00	165		
Jan	80:18:00	11	50%	
Feb	77:16:00	10	50%	
Mar	91:46:00	11	50%	
Apr	99:49:00	12	100%	149:53:00 20
May	154:18:00	18	100%	63:17:00 10
Jun	179:25:00	21	100%	
Jul	85:08:00	10	100%	Vacation 10 days, sick leave 3 days
Aug	171:15:00	21	100%	
Sep	165:15:00	22	100%	
Oct	167:03:00	21	100%	
Nov	73:29:00	10	100%	

You can download the complete document for 2019-2021 [here!](#)

Link to our website: <https://stadsnaraodling.goteborg.se/>



13.5 Literature

The Market Gardener, Jean Martin Fortier

Regenerative Agriculture, Richard Perkins

The Permaculture Market Garden, Zach Loeks

The Resilient Farm and Homestead, Ben Falk

Permaculture Design Principles, David Holmgren

New Organic Grower, Elliot Coleman

The Urban Farmer, Curtis Stone

The Lean Farm, Ben Hartman

Building soils for better crops, Fred Magdoff, Harold van Es.

FAO, 2020. *State of knowledge of soil biodiversity - Status, challenges and potentialities.*
<http://www.fao.org/3/cb1928en/cb1928en.pdf>

Swedish literature

Odling till försäljning del 1, del 2, del 3, Ylva Lundin, Sanna Ringqvist, Jonas Ringqvist

Runåbergs fröer, Johnny Andreasson

13.6 Podcasts

Farmer to Farmer, Chris Blanchard

Regenerative agriculture, John Kempf

Real Organic, The Real Organic project

13.7 Organizations

In Sweden:

Jordbruksverket, Ekologisk produktion

Länsstyrelsen i Västra Götaland, Rådgivning ekologisk grönsaksodling samt Andelsjordbruk

Hushållningssällskapet Västra

Småskalig grönsaksproduktion, grupp på Facebook

Andelsjordbruk Sverige



Appendix

13.7.1 Guide to Texture by Feel, USD Natural Resources Conservation Service

