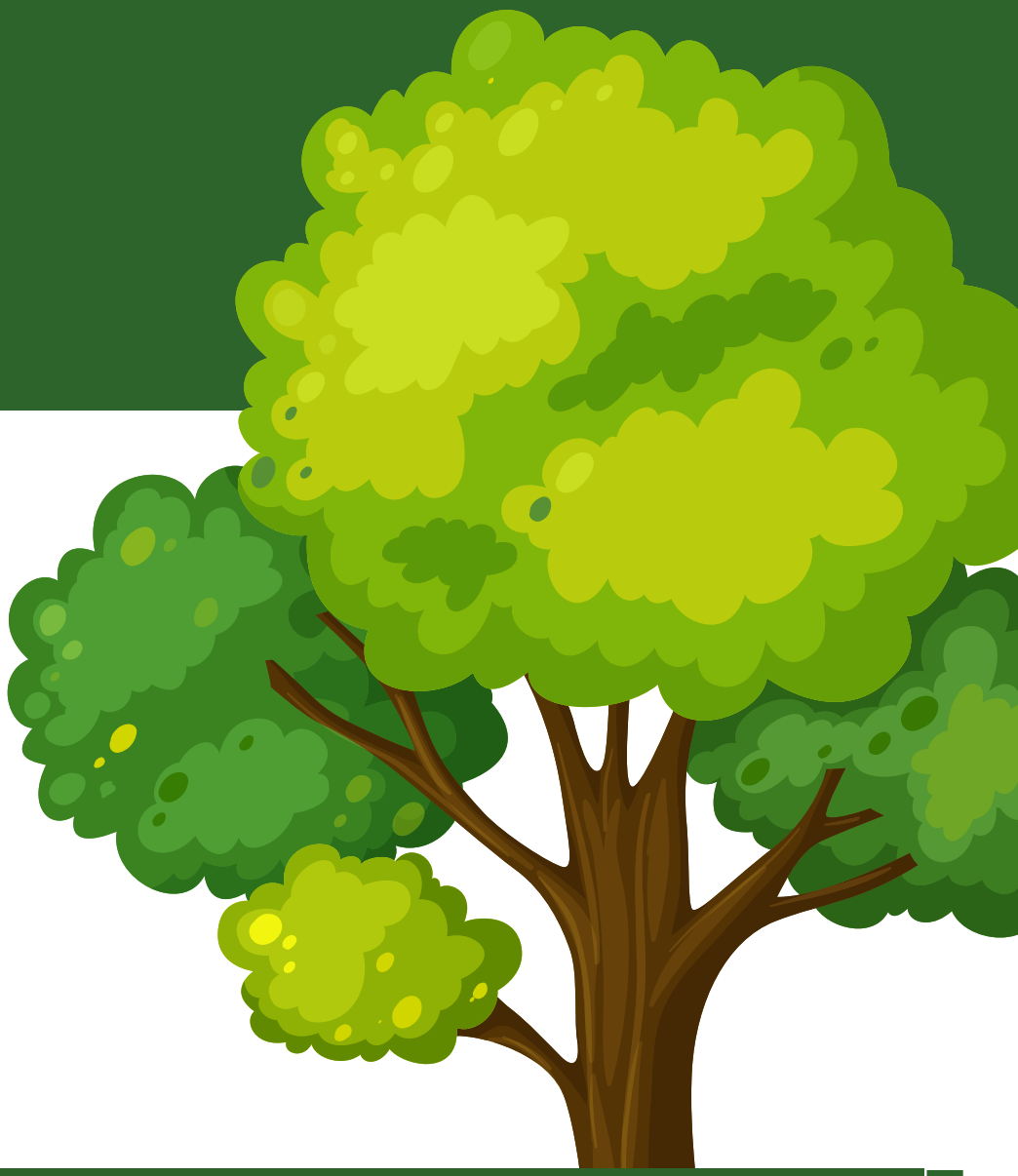
HARVESTING HOPE

Managing expectations for food foresters



TEAM

Lev Crusio
Fleur Denissen
Ynze Kamstra
Álvaro S. Micheletti
Martijn Righolt
Anna Vreeburg

COMMISSIONER Jeroen Kruit
COACH Beatrix Horvath
ACADEMIC ADVISOR Kees van Veluw

PROJECT 3.110

CONTACT COMMISSIONER

Jeroen Kruit
Phone: +31317481682
Email: Jeroen.kruit@wur.nl
Organization: Wageningen Environmental Research

CONTACT INFORMATION

Fleur Denissen (secretary)
Phone: 06-83583807
Email: fleur.denissen@wur.nl

DATE

20-10-2023

DISCLAIMER

"IN THE END WE'RE ALL WORKING FOR THE SAME THING"

MARENTE LOKIN

EXECUTIVE SUMMARY

Food forests are complex agroforestry systems focusing on natural mimicry. In a global context that calls for increased sustainability in production, food forests have been receiving growing interest in the Netherlands as alternative food production systems that bridge nature and agriculture. Our research investigated the diversity of food forestry practices and outcomes existing in the country, with the goal of offering resources for more informed expectations on the part of (aspiring) food forest pioneers. Seven practitioners with consolidated food forests were interviewed to determine the practices, outcomes and history of their systems. Our results showed a great heterogeneity in the sector, with notably different design and management practices, particularly regarding varying degrees of intervention in the system. Such differences are evaluated in their ecological, food production, and economical aspects, showing different trade-offs and synergies that farmers can choose when managing their systems. The core conclusion of this report is that food foresters should ask themselves what their expectations are and what resources they have, so that they can make management and design decisions that fit their needs.

ACKNOWLEDGEMENT

First of all, we would like to express our deepest gratitude to our coach Beatrix Horvath for her guidance and feedback during this project, to our commissioner Jeroen Kruit for his entrustment and flexibility, and to our academic advisor Kees van Veluw for providing his knowledge and expertise on the topic.

Major thanks to all the interviewees; Hetty Adams, Leon Schepens, Madelon Oostwoud, Marente Lokin, Martijn Aalbrecht, Nicolaas Geijer, Sjef van Dongen, Wouter van Eck and the proprietor of De Appelhof who were willing to share their story and insights in the food forest community. Their contribution was invaluable to better understand and analyse the narratives surrounding Dutch food forestry.

Finally, we want to show our appreciation towards Auke Westerterp who helped us to improve our group dynamics, to Anna-Minke Roodhof which gave us advice and workable insides from the start, and to Jarl Kampen who helped us refine our research questions and methodology.

TABLE OF CONTENTS

THE TEAM

TEAM QUALITIES

Our consultancy team has expertise in ecology, international development, permaculture, and qualitative research methods. Therefore, approaching the problem both fit our expertise as well as our interests, since they cover the multiple aspects of food forests. It enabled us to interact with and learn from the food forest community. Furthermore, this approach gives room to the variety of expertise our group possesses ranging from very ecological oriented competences to more socially oriented competences.

MISSION

In our personal life we are very conscious of our current climate situation. Since we were little, we are faced with the fact that our planet is struggling because of humankind and as students at the Wageningen University it is quite hard not to worry about climate change and all its implications. We chose this ACT project to assist food foresters with their current struggles so food forestry can become a reliable food production alternative. We as a group really believe that change is possible, it just needs a little push in the right direction. We are hoping we can contribute to that.

OUR GOAL

We believe that what we can provide the community narratives that offer more insight into the diversity and the real-life food production of food forest initiatives in the Netherlands. To this end, we have conducted case studies with a focus on established food forest systems in the country, with an eye on their background, design and management practices, challenges, discovered solutions, and different outputs from their system, chiefly food production. This way we expect to provide narratives regarding food forests that are more contextualized and consider the real practices and challenges present in the field, thus allowing for more fitting expectations to be formed about food production and necessary investments. This advice would support our commissioner's goal to address the unrealistic expectations on food yield currently present among several actors of the food forest sector by providing real-life narratives that highlight practical trade-offs, techniques and potentials of different food forest types.

WHO ARE WE?

Álvaro S. Micheletti graduated in Economics at the State University of Campinas (Brazil), with a bachelor's thesis on economic anthropology and ecological economics. Currently following the MSc International Development Studies (Sociology of Development track), with a thesis under the Rural Sociology chair group. Experience with qualitative research methods, and interest in food forests as prefigurative spaces of more sustainable social and environmental practices.

Anna Vreeburg studied Biology at the University of Amsterdam, majoring in Ecology and is currently doing the masters Forest and Nature Conservation at Wageningen University. She has an interest in sustainable food systems in combination with nature conservation aspects of food forests.

Fleur Denissen did a bachelors in International Development Studies at Wageningen University and is now currently studying the master Resilient Farming and Food Systems. Has great affinity with designing and researching permaculture and food forests. Hopes to have an own food forest/ permaculture one day. Has gained a lot of knowledge on these topics, so has been assigned

Lev Crusio studied Applied Psychology for two years at HAN University of Applied Sciences. Afterwards he finished his bachelor in Biology with a major in cell biology at Wageningen University. He is currently studying his masters in Plant Sciences with a focus on plant breeding and genetic resources. A personal and professional interest in sustainable food systems and their social aspects drive him.

Martijn Righolt has finished his bachelor in Biology with a major in ecology at Wageningen University. He is currently doing his masters in Biology. He is focusing on ecology and organismal development for his masters. He has an interest in making academic communication accessible and understandable.

Ynze Kamstra finished his bachelor Biology at Wageningen University with a major in Ecology. He is currently studying the masters Biology with a major in aquatic and behavioral ecology. Has an interest in ecological dynamics within the food forest.

COMMISSIONER JEROEN KRUIT

The commissioner of this project, Jeroen Kruit, is a landscape architect, and currently employed by Wageningen Environmental Research. Besides his position as researcher, Jeroen has been involved with the Green Deal Voedselbossen project since its inception in 2017. He coordinates with the Wageningen University (henceforth referred to as WUR) on the research agenda of Green Deal Voedselbossen, thus facilitating the collaboration between students, researchers and the university. As a network coordinator, he also stimulates and organises cooperation between the WUR and its partners. Besides working with Green Deal Voedselbossen, Jeroen Kruit is part of the working group "Kennis, onderzoek & onderwijs" of Agroforestry Network Nederland.

By being a connector between scientists, organizations and food foresters, Jeroen gets a broad overview of the different food forest perspectives. He has been contacted by different food forest pioneers that are disappointed in their yield. It is important to view and analyse these disappointments. By investigating where the disappointment comes from, Jeroen can help future farmers by preventing the same mistakes. Since Jeroen has a lot of relations within the food forest community and the WUR he can use this knowledge to bridge the gap between alternative food systems and the current food system. His long term goal is to increase the prevalence of food forest within the Netherlands. This project provides extra narratives that are useful for Jeroen to show the realistic potential of food forests. Because the commissioner is a node in the web of the food forest community, he sees the problem from multiple perspectives and is intricately involved in the food forest community.

PREFACE

The current Dutch food system is suffering from shocks and stresses. We are discovering that large scale, high input conventional farming is an unsustainable way of producing food. Greenhouse gas emissions are rising, and soil life is heavily depleted by continuous tilling, spraying and heavy equipment (Beach et al., 2008; Chen et al., 2002,). The typical Dutch diet is structured around annual plants that are high maintenance and often produced on a large scale. Within these monocultural fields biodiversity is severely lacking (Dudley & Alexander, 2017). To solve this complicated problem there is a need for an alternative system, but there is no one-size-fits-all solution.

What we do know, is that there is a need for alternative ways of producing food. Food production methods focussed on improving circularity can ensure that precious resources are not wasted, that biodiversity is enhanced instead of depleting it, and that nutrients are returned to the soil. Finally, shortening the supply chain creates more resilient food systems. Events such as the Covid-19 epidemic and the Ukrainian war have had a large impact on our daily food supply, and has shown the urgency for less intensive, locally produced food (Hassen & Bilali, 2022).

FOOD FORESTS IN THE NETHERLANDS

One way of tackling these wide range of problems is by growing a food forest. Food forests are perennial systems that produces food, which are considered to be more resilient than conventional agricultural practices[1] (Martin Crawford, 2010). One of the reasons for this is that a food forest creates minimal disturbance of the soil. Instead of decreasing soil organic matter with conventional agriculture, a food forest focusses on building soil organic matter. By planting different species the chances of harvest losses diminish, which makes farming a more resilient practice. A food forest is seen as self-sustaining system that creates a resilient output. A food forest is a more resilient way of farming than arable production systems. As Martin Crawford (2010) states, a food forest is a more resilient way of farming than arable production systems. By mimicking the characteristics of a forest the system becomes self-reliant. Figure 1 shows this increase in different aspects of resilience as food producing systems become more comparable to a natural perennial system. These benefits of increased resilience and a more stable final system have created an interest in food forests in the Netherlands (Van Dooren, 2018).

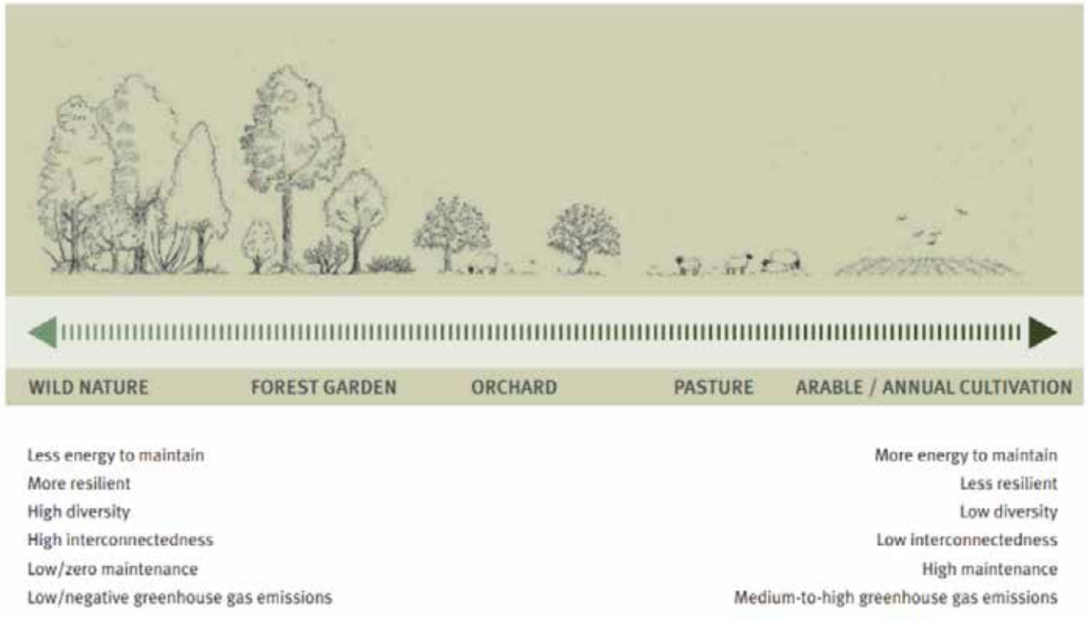


Figure 1. An overview of different food producing systems (Martin Crawford, 2010), with a forest garden being comparable to a Dutch food forest. Human interference increases from left to right, with the associated benefits and downsides list underneath the image.

CURRENT STATE

Though the interest in food forestry is rising, the related scientific and agronomical knowledge and practical experience in temperate climates is limited. Instead, most reports on the function of food forests consider only tropical systems and not temperate climates (Kumar and Nair, 2004). The relatively young age of food forests within the Netherlands makes long term data largely absent (Roodhof, 2023). A survey on Dutch food forests has shown that the majority of food forest projects in Netherlands are young and small-scale (Anna Roodhof, WUR, personal communication). Only 25.7% of projects are above the meagre acreage of 2.5 hectares, and just above 10% of the initiatives started before 2015 (see figure 2). Because of this, the past years have not been enough time for FFs to reach highly productive systems, making it difficult to collect comparable datasets about their productivity (Geijer, 2023).
native to transition towards. Furthermore, food foresters are stigmatized by a majority of critics as being 'dreamers' with big ideals that are not able to deliver on those ideals and on actual, reliable yields.

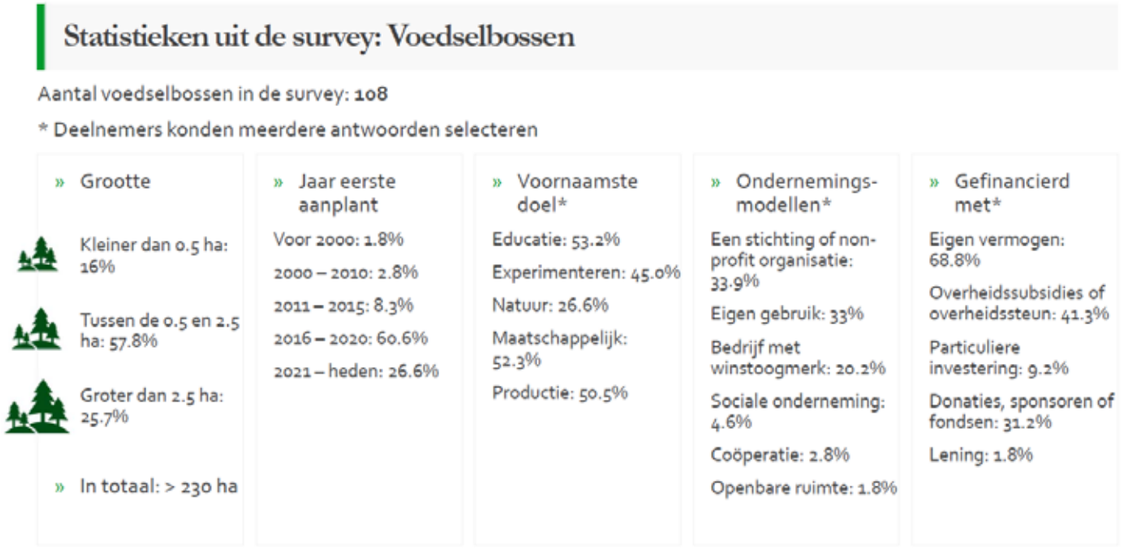


Figure 2. Statistics showing the age of food forest initiatives and their goals in the Netherlands (Roodhof, n.d.)

The lack of strong evidence in the Netherlands makes it difficult for food forestry to be taken seriously by the conventional farming industry as a reliable alternative to transition towards more sustainable agriculture. Besides of this scepticism, food foresters are stigmatised as being 'dreamers' that are not able to deliver on their big ideals with actual, reliable yields.

[1] We found the description of Martin Crawford's forest garden to be comparable to a Dutch food forest. In fact, food forest designs of at least one consultant in the Netherlands, de Voedselboss, are influenced by Martin Crawford's design principles (see page 35). As such, we have used Crawford's work to research food forest qualities.

Food forest definitions

In 2017, policymakers, food forest pioneers and other supportive parties came together under the Green Deal Voedselbossen initiative with the goal of increasing the overall prevalence of food forests within the Netherlands (Green Deal Voedselbossen, 2017). Green Deal Voedselbossen facilitates the transfer of knowledge and experience of food forest pioneers. Moreover, it also aims to build lines of communication between stakeholders within Dutch society. The cooperation of policymakers and food forests allows for a better navigation, analysis, and potential revision of the current laws and regulations within the Netherlands.

There is currently no consensus on the definition of a food forest within the food forest community. One of the most prevalent definitions[2] of food forests in the Netherlands is given by 'Green Deal Voedselbossen' (2023):

> *a. a productive ecosystem designed by people to the example of a natural forest, with a high diversity of perennial and/or woody species, of which parts (fruits, seeds, leaves, shoots and such) serve asfood for humans;*
>
> *b. presence of a canopy layer of tall trees;*
>
> *c. presence of at least 3 other niches or vegetation layers of respectively lower trees, shrubs, herbs, groundcovers, root/tuber crops and climbers;*
>
> *d. presence of a rich soil life;*
>
> *e. a robust size, as in an area of at least 0.5 hectares3 in an ecologically rich environment; in a seriously impoverished environment a minimal area of 20 hectares is necessary."*

(Geijer, 2023, p. 11)

However, there is no consensus on the definition of a food forest in the Netherlands. There is an informal notion that food forest should exclude annual crops and animal husbandry. This idea strongly correlates with Wouter van Eck's view on food forestry, who is one of the pioneers within the food forestry community in the Netherlands (Geijer, 2023). Foundation Voedselbosbouw Nederland, a prevalent foundation that aids in setting up food forest initiatives that was founded by Wouter van Eck, has added these criteria of excluding animal husbandry and annual crops to their definition of a food forest (Buiter, 2022). Another important actor, The Dutch Ministry (RVO, 2023), specifically states that the use of manure, artificial fertilizer and pesticides is not allowed within a food forest.

[2]Original definition of a food forest is from the RVO (2017) Green deal Voedselbossen. This version is in Dutch so within this report the translation by Geijer (2023) is used.

SPECIFIC PROBLEM

The discussion on what constitutes a food forest has created a difficulty in determining the best practices for Dutch food forestry. In addition, the lack of data on Dutch food forests does not only cause scepticism in the conventional farming industry and the overall food system debate, but also within the food forestry community itself. Assumptions on long-term yield are made on the basis of gray literature and personal experiences, which may lead to inaccurate expectations regarding longer term yields (Geijer, 2023). Forecasting on yield is particularly difficult in the context of food forests, as it takes years before the newly planted trees grow to the age before they begin to produce food. These inaccurate expectations cause disappointment among food foresters, because they get less produce in reality than expected (see our approach). This feeds the aforementioned scepticism and critiques stating that food forests are not a reliable alternative to our current unsustainable food system. In addition, conventional farmers are not willing to shift towards an alternative production system when there is no clear evidence on making an stable income (Volkskrant, 2019).
We aim to highlight the wide array of narratives about food forest initiatives, which we believe to be an asset for the community. Stories about food forestry can help pioneering actors to see the reality of food forest projects with different goals and backgrounds, as well as the diversity of practices used during their development. We elaborate on this further in our approach and our goals.

PROBLEM DESCRIPTION

The evolution of the problem description and formulation of the research direction is explained here.

FORMULATING THE PROBLEM

We started with creating an understanding of the problem through discussing the problem with our commissioner. Through extensive discussion we came to understand that the problem is complex, while including and influenced by several issues mentioned by the commissioner:

- Overly positive messaging on social platforms regarding harvests
- A lack of scientific data on food forest production
- Unrealistic expectations about the labour required to manage a food forest

Before deciding what to focus on during the 5-weeks consultancy period, we carefully analysed the main limitations to determine our priorities:

- As our team has hardly any expertise in conducting studies that delve deep into communicati on, such as the use of social media platforms, we decided to ignore this aspect of the initially raised question.
- Similarly, we considered that it would be hard for us to contribute relevant scientific data and analyse them within our timeframe.

Conversely, we expected that the last issue mentioned by our commissioner, labour, is linked directly to the production of a food forest. As the crux of the commissioner's main interest was the production, we decided to concentrate on this issue as our focal point. Specifically, we investigate the expectations farmers had for their food forest's production compared to their actual production. Discussing with experts and based on a preliminary literature search, we included aspects such as ecology and commercialisation, in the context of food production. We also decided to conduct our research through interviews to ensure that we would get in-depth results (for a more complete discussion on our methodology, see our discussion). Finally, we made the following research questions[3]:

APPROACH ADJUSTMENT

Throughout our research, our approach has adjusted slightly. We noticed that the topics of ecology and finances were hard to compare only in the context of food production. These, in several ways, are also linked to things like management intensity, the goals of the food forest, and other aspects. The realisation that these problems are complex and inexorably linked together made us adjust the focus of our interviews and gave us a strong direction. However, we have used the ideas outlined here to determine our approach for the rest of this report, and have always maintained the goal of providing a more complete narrative on the expectations of Dutch food forestry. In particular, we have used these ideas to create our theoretical framework, which forms the basis for discussing our research.

[3] For a more complete explanation of the research questions, see appendix 3.

RESEARCH QUESTIONS

What are the expectations and realities of food production in different established Dutch food forests?

SUBQUESTIONS

What are the histories of the selected Dutch food forests?

What were the expectations regarding food production for the selected Dutch food forests?

What factors made it difficult for the selected food forests to meet the expectations for food production?

What are the management and design practices that could effectively promote food production in the selected food forests?

THEORETICAL FRAMEWORK

Here, we describe and identify our key terms and concepts to create a structural manner for our research and discuss our ideas. To do this, we have defined three pillars and describe here how we use these as our theoretical framework.

The goal of our study is to investigate the diversity of food forest practices in the Netherlands, aiming at highlighting the core differences between different projects and approaches.

According to Geijer (2023, p.32):

"The food forest farmer mediates between ecology and economics and can be understood as bridging both worlds. . . . While distinguishable as categories, the elements of a [food forest] design are both part of ecology and economics."

Based on this insight, our working hypothesis is that design and management practices embody different strategies of coordination between these different practices. We expect these different designs and management practices to lead to varying synergies and trade-offs, and consequently to different results. Deeper understanding of the existing variety of strategies and, even more so, their outcomes, is currently lacking in the Dutch food forest landscape. More clarity in this regard would be crucial to better align expectations with reality in the food forest sector.

Based on previous literature on food forestry, we have developed a theoretical framework to understand the underlying diversity, analysing the multiple choices that food forest farmers must make in managing their projects. For this, we analysed and compared the design and management practices of different food forests by looking at them from the ecological, food production and economic aspects, emphasizing the trade-offs and synergies between these three pillars. In the next sub-section, we describe the pillars in greater depth, and illustrate some examples of synergies and trade-offs.

ECOLOGY

Mimicry of a natural forest is a core tenet of food forests according to essentially every definition (Geijer, 2023). All systems are based on a (greater or lesser) complexification of the agricultural ecosystem, to increase its ecological functions. This means that they go through the different succession phases that would occur in the process of natural forest formation, including:

the formation of multiple layers of vegetation

increase in soil life, quality, nutrients, and organic matter levels;

Increase in water retention and redistribution;

Increase in biodiversity

Martin Crawford (2010) describes a key insight on why food forestry uses succession phases to develop their system:

"In a moist temperate climate, the climax vegetation is woodland or forest – i.e. (. . .) the further your agricultural or horticultural system is from woodland, the more energy it takes to maintain and the more disturbed and distant the system is from a long-term sustainable biological state." (Crawford, 2010, p. 19)

Therefore, one of the concerns of food foresters is successfully achieving some degree of natural succession and increase ecological functions in their plot, so that the system becomes more stable and requires less input.

FOOD PRODUCTION[4]

Food forests are agricultural systems and are thus subject to considerations of the same type as any such systems. The increased biomass productivity coming from ecological development comes through a second lens, where this productivity is scrutinised through human criteria of usefulness: farmers want to maximize the yield and quality of those plant products that are useful for humans. This is an important consideration that drives many decisions such as the choice of varieties, the frequency of certain species in the system, pruning and other management practices and fertilising among other things.

ECONOMIC DIMENSION

The economic dimension subjects the previous pillars to yet another set of criteria. Food forests exist in a social and economic context, which subjects them to a series of goals. Every project has its own set of economic needs, stemming from its context of funding, personal motivations, rent prices, income expectations, investments undertaken. Moreover, when subject to market pressures, food production has to come under a series of other considerations, such as the volume of each product, harvest streamlining, value chains, labour amounts and prices, and market demand for different products.

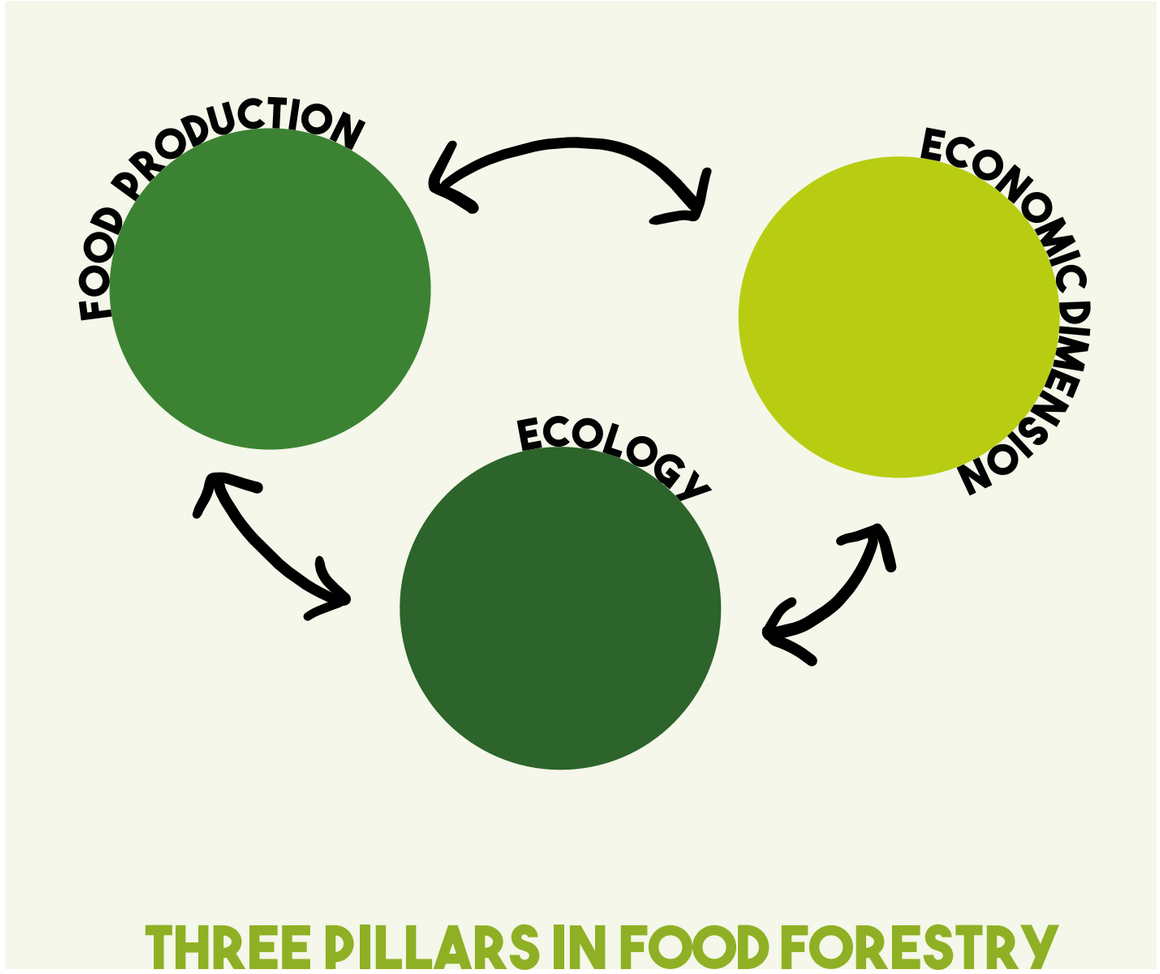


Figure 3. Visualisation of the three pillars in food forestry

[4]Food here is a simplification of useful plant products (for humans). Although the main ones are usually foodstuffs, there may also be species that yield useful materials for different uses.

SYNERGIES

These three pillars are described separately because they have a certain degree of autonomy: they suggest specific criteria for analysing the system and can, to a certain extent, be analysed in isolation. Importantly, they are also inter-related, and the outcomes in different pillars may constitute synergies or trade-offs with one another.

The general concept of food forestry is that the increased natural productivity present in systems further-on in ecological succession can be translated into food production. The presence of multiple productive layers and the increased soil fertility of a complex system thus represent a synergy between the two first pillars of ecological functioning and food production. Increased nutrient accessibility, biomass production, and water retention are also among the factors that stem from ecological development, but also have crucial impacts on increased productivity and reduced costs with external inputs (e.g., fertilizers and irrigation). Nevertheless, an increased focus on food production vis-à-vis ecological succession may lead a farmer to sacrifice biodiversity for fewer, more productive species.

Another issue that could represent a trade-off between ecological and productivity concerns are the inclusion of annual cultures in the system. They allow for a more productive use of the land in the earlier years before perennial species become productive, as well as for the cultivation of foods that are in demand in our society. On the other hand, their cultivation may be detrimental to the development of soil life and fertility, to the extent that certain definitions of food forestry exclude systems that cultivate annuals altogether (Geijer, 2023).

Another field in which these interactions between pillars become particularly evident is labour. Reduced management may support the natural development of certain ecological features (like the development of pioneer species and the development of soil life), increasing productivity in some regards and reducing labour inputs, thus contributing to a financially viable system. Similarly, syntropic practices (Götsch, 1994) may accelerate certain aspects of the succession process, increasing soil quality and plant development faster, but also incurs in large amounts of labour, that may or may not be compensated by proportional financial gains.

These are some examples of the complex inter-relations between the three pillars. We will use these three pillars to characterize our seven case studies and study how their approaches produce different synergies and trade-offs, thus illuminating the diverse outcomes of different practices in the Dutch food forest environment.

LITERATURE

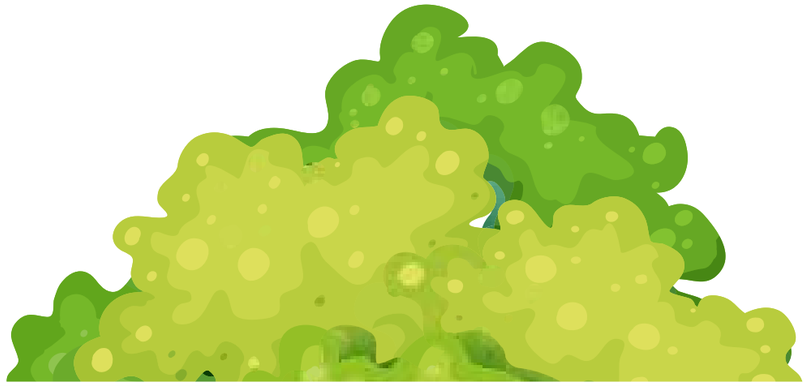
Considering the age of the concept of 'food forestry' in the Netherlands, research on the topic remains rather scarce, especially on their socio-ecological functioning. One of the few longer-term researches on food forestry in temperate regions is that of Albrecht and Wiek. They have published various papers on the socio-ecological functioning of food forests, conducting cross-case comparisons of case studies (Albrecht & Wiek 2021a, Albrecht & Wiek 2021b). These case studies are all food forests, with a difference in age and in the main services offered. They asses these case studies on their sustainability performance in combination with mapping their success factors and barriers to gain a clear picture of the whole functioning of these food forest systems, both on environmental, socio-cultural and economic grounds.

Geijer (2023) conducted a literature review establishing the state of the art on the economic and environmental aspects of food forestry. His emphasis lies on the functionality of food forests functioning as productive entities in the world of agriculture. He mainly looks into the economics of food forestry, with an emphasis on the mediation between ecology and economics. Furthermore, he addresses the knowledge gap that exists on the economic viability of Dutch food forests by means of their food production. His thesis contains a lot of valuable empirical data on the current state of pioneering agricultural food forests in the Netherlands.

In the book Narrative and social control: critical perspectives, Dennis K. Mumby (1993, p.3) states:

> *"Narrative is examined not as a fixed and stable communication phenomenon but rather as part of the complex and shifting terrain of meaning that makes up the social world."*

This touches upon an interesting element of our research, because the world of food forestry in the context of the Netherlands, one could argue, has not been encapsulated in a set foundation, based on years and years of scientific data and analyses, for it is a fairly new and upcoming phenomenon. Meaning, that a consensus on a variety of elements or practices within food forestry in this climatic zone is starting to be established, but does not exist yet. This links to the focus of this research to the term 'expectation', meaning a strong belief that something will happen or be the case. Beliefs and expectations are based on experience and stories, and in the world of science, on evidence-based data. This is exactly the crux here, that long-term evidence-based data on how to run a pioneering food forest in the Netherlands is simply not extensive enough. There is only still a handful of people that are now entering a phase in which they could aid pioneers in sharing their lived knowledge. This increases the need to analyse narratives, as they are what farmers concretely have to orient their actions, and the elements that could be studied in a context lacking the necessary long-term data.



CONCLUSION

To conclude, this research will use a theoretical framework comprised of a combination of different theories. We, firstly, use an adaptation of the three pillars of Albrecht and Wiek how they assess food forest based on the services they offer. As mentioned before, the three pillars they use are social-cultural, economic, and environmental services. Because this report has a focus on the food production part and implications for economic viability of a food forest, we, secondly, choose to combine this framework with the work of Geijer who incorporates the pillar of economics intertwined with food production. Hence, our 'unique' combination of pillars for comparison of the case studies conducted here, will comprise of: food production, economical functioning and ecological functioning. Thirdly, the element of narrative in the expectation management will be taken into account whilst conducting our data analysis. This will emphasize the importance of the narratives 'being lived' by the food foresters.

Altogether we aim to paint a picture of the differences in lived experiences between a variety of food forests. We will look into their food forests trade-offs and synergies as well as the view from the food foresters themselves on the topics concerning ecological functioning, food production, and economical functioning. By combining the bridging of pillars and listening to the stories of food foresters with their challenges and accomplishments we can offer insights in managing expectations in the process of starting, or managing, food forests. Overall, we have used the theoretical framework to structure the rest of our research and make informed decisions on structuring our methodology.

METHODOLOGY

Our methodology comprises of a comparative analysis of seven case studies on the basis of the three pillars of ecological functioning, food production, and economical functioning. We will highlight synergies and trade-offs as well as similarities and dissimilarities of these case studies to illustrate how they manoeuvre through the interrelated landscape of food forestry.

SELECTION OF CASE STUDIES

The data for the comparative analysis was generated from in-depth interviews with the managers or initiators of the seven case studies. The interviews were conducted on the basis of a questionnaire covering a variety of topics concerning food, ecology and economics as well as general information on the food forests themselves. Furthermore, with one exception[5], all interviews took place in the food forests and involved a tour through the plot.

Our main source of contacts for the research was Anna Roodhof's survey on Dutch food forests, which was based on a survey which people could answer on a voluntary basis. Given our goal of contributing to more reasonable expectations in the field, we chose to focus on projects with at least 10 years of age, so as to obtain as much data as possible on the long-term potential of food forests. This already narrowed down our list from 248 contacts to 10. Out of these ten, five were responsive, and two other young food forests with already promising results and recommended by our commissioner and initial interviewees were selected (Baarle-Nassau and Den Food Bosch). Afterwards, we found out that one of the respondents' food forest, namely Kattenbergsebroek, was younger than we expected from the survey, meaning that we ended up with 4 food forests that were at least 10 years old, and three younger ones.

As previously discussed, the definition of food forest is far from unanimous, and these differences in conceptualization cause or reflect crucial differences in practical approaches to this system.

Considering our goal to map the diverging expectations and results in food forest projects, we have decided to not select projects based on any particular definition, which has led us to encounter systems with very different characteristics. The definition of food forestry with which they comply in practice is taken to be a variable that influences the expectations and real-life results of the projects

DATA COLLECTION

An interview guide was designed to capture the history and context of each food forest, highlighting the design and management practices adopted and the results obtained through the duration of the project. Semi-structured interviews were chosen to allow for greater investigation of the context and complexity of field realities. In addition to our interview data, we also considered the notes on the observations conducted in loco. The full interview guide can be consulted in Appendix 1.

The choice of gathering qualitative data by means of conducting interviews was a rather straightforward choice considering the timeframe of the project, the complexity and uniqueness of the different food forests, and the logistics. A discussion point for this project, however, was whether the questions could be answered through interviews only or by conducting a survey. Interviews would allow us to go more in-depth for each studied food forest but would limit us in the number of food forests we study, and consequently make our data fairly anecdotal. Surveys, on the other hand, would allow us to correlate data of food forests throughout the Netherlands. We decided interviews as the most reliable option for our research, since few survey results would give us the same limitation of anecdotal data that interviews would.

DATA PROCESSING

The data from the interviews was transcribed and coded using ATLAS.ti, with a blended coding approach. The coding started out as a pure deductive process, with codes derived from the coding framework (Appendix 2). The utilized codes are based on the three pillars laid out in the theoretical framework: ecological functioning, food production, and economical functioning. If important information in the interviews did not fit existing codes several codes were added using an inductive process. Additionally, several supporting codes such as a time specification were used to aid in the analysis of the coded quotes.

The coded interviews were used to construct descriptions of each food forest, which can be found in appendix 4. The descriptions were further used to construct the comparisons based on our theoretical framework between each food forest, and eventually form the basis of our conclusions and recommendations.

ETHICAL IMPLICATIONS

We made sure that our conducted interviews met certain ethical standards. We made sure to get consent from the interviewees on the information they share with us and aim to accurately depict the participants to minimalize ethical dilemmas. Moreover, we made sure that the interviewees privacy met the appropriate standards. Sharing contact information and sensitive personal data was avoided as much as possible. This will be done in consultation with the interviewees.

[5]Due to time constraints, we were not able to visit Fruithof de Brand. We did, however, make sure to have an in person interview with Sjef van Dongen, who is the co-owner of Fruithof de Brand.

RESULTS

CASE STUDIES

Locations and general information per Food Forest

Owner
Location
Starting year
Hectares
Soil type
Managment style

5. DEN FOOD BOSCH

Co-management
Sint-Michielsgestel
2016
0.8 Ha
Sandy
Intensive

4. DE VOEDSELBOSS

Martijn Aalbrecht
Hengelo
2011 & 2020
0.4 Ha
Sandy
Mixed[6]

6. KATTENBERGSEBROEK

Leon & Petra
Oirschot
2018
2.5 Ha
Sandy
Extensive

1. DE APPELHOF

Yvonne
Joppe
2008
0.4 Ha
Sandy
Extensive

7. VOEDSELBOS BAARLE-NASSAU

Nicolaas Geijer
Baarle - Nassau
2021
4+ Ha
Sandy
Extensive

2. KETELBROEK

Wouter van Eck
Groesbeek
2009
2.4 Ha
Clay
Extensive

3. FRUITHOF DE BRAND

Sjef van Dongen
Zeeland (Gld)
2010
1.1 Ha
Sandy
Intensive

[6]Martijn manages two food forest, both in an extensive and intensive way, but he promotes an intensive system

GENERAL OVERVIEW

Every food forest unique. Figure 4. shows the relevant characteristics per food forest to give a general overview. An elaborate description per food forest is found in the appendix 4. There the characteristics, motivation, management intensity and biodiversity per food forest are highlighted in more detail. We made the deliberate choice not to include them in the results to prevent overlap of information with the comparison.

	Owner	*Age*	*Size*	*Soil*	*Management intensity*	*Motivation*[7]	*Outputs*
De Appelhof	Yvonne	15 years	0.5 Ha	Sandy	Low intensity	Recreational	Ecological
Ketelbroek	Wouter van Eck	14 years	2.4 Ha	Clay	Low intensity	Educational	Ecological & food production
Fruithof de Brand	Sjef & Wilma van Dongen	13 years	1.1 Ha	Sandy	Low intensity & High intensity	Food production	Ecological & food production
De Voedselboss	Martijn Aalbrecht	12 years 3 year	0.4 Ha 0.3 Ha	Sandy	Low intensity & High intensity	Food production, community-engagement & education	Community-engagement, education, ecological & food production
Den Food Bosch	Co-management	7 years	0.8 Ha	Sandy	High intensity	Food production & community engagement	Food production
Kattenbergsebroek	Leon & Petra Schepens	5 years	2.5 Ha	Sandy	Low intensity	Food production & community engagement	Recreational
Voedselbos Baarle-Nassau	Nicolaas Geijer	2 years	4+ Ha	Sandy	Low intensity	Food production, community engagement	Ecological & food production

[7] All interviewed food forest farmers start a food forest with the aim of producing food and gaining biodiversity, but some are more oriented towards education and community engagement. So note that the motivations and outputs are complex than portrayed here

Figure 4. General overview of the interviewed food forests.

COMPARISONS

In this chapter, we give an overall analysis of the visited food forests taking into account the narratives of the interviewees. We summarise our findings focusing on the common characteristics and discuss the differences and similarities between the seven case studies, covering their ecological, production related and economic aspects.

ECOLOGICAL PILLAR

From an ecological point of view, the concept and existing practices of food forests are great improvements compared to the current agricultural practices (Breidenbach et al., 2017). Transition from monocultural practices, which harbours only a few species, to a diverse food producing system with several layers of vegetation is the best alternative to deal with the current biodiversity and climate crises. However, this transition takes longer than just a few years and requires succession over time to improve soil quality, provide protection for young trees and shrubs from later succession phases to grow.

In the following paragraphs, we will discuss the ecological aspects of the seven case studies. In the three subheadings: Soil quality, Biodiversity and Planting, we highlight the differences and similarities food forests and illustrate them with examples.

SOIL QUALITY

Each ecosystem relies on the quality of the soil. Nutrient rich soils allow plants to grow fast; fast growing species easily outcompete their neighbours, as they take up the available nutrients faster. Thus outcompete others with a consequence on biodiversity, resulting in a narrow range of species. In contrast to nutrient poor soils, which permit high competition and thus biodiversity with a wide range of species. For this reason, taking soil quality in to account is essential when planting a food forest, as it determines the development and thus the quality of the forest from the start.

Most food forests in the Netherlands are built on sandy soils, which are fairly nutrient poor and have a low water holding capacity in our investigated food forests. Both of these characteristics could cause a problem from the start. Some of the visited food forest started on a land which was formerly used for agricultural purposes and practices using fertilizers and pesticides on monocultures, exhausting the land (Geiger, et al., 2010). Turning such a land into a food forest requires succession, which in turn requires time. Starting off with planting fruit trees and perennials will eventually lead to a low producing forest, if ever it develops. We saw this happening at De Appelhof, from which the owner wants to stay anonymous so we call her by the name Yvonne. She built her food forest on sandy soil, which was used as agricultural land before. Yvonne saw trees that barely grow with irregular harvestable low quantity products. When there was any harvestable produce, birds or squirrels often found it before Yvonne did, because her land is like a small oasis within a bigger forest and agricultural area. She thinks her forest is lacking mainly due to the poor sandy soils, therefore, to improve nutrient content she uses cow manure from a local farmer together with composted plant material that comes from pruning and mowing.

Planting pioneer species and nitrogen fixers creates a suitable habitat for soil life to develop. When pioneer species die or lose leaves in the fall, mycorrhiza can re-establish and form a symbiotic relationship with the fruit trees. In Den Food Bosch, where we interviewed Marente Lokin, this principle was integrated in the design. Pioneer species are planted between the fruit trees and shrubs, to provide shade and function as windbreakers. Regularly pruning the fast-growing pioneers and mowing the weeds prevents them from overgrowing the perennials, leaving the leftovers in the system to decompose and boost soil life. Marente says that the input determines the output of the system and because of that they embrace the syntropic farming method. This method was developed by Ernst Götsch, a pioneer Austrian farmer working in Brazil since the 1980s (Götsch, 1994). He emphasises the benefits of constant pruning for the accumulation of organic matter in the soil and plant growth. This is based on the idea that, as a tree undergoes stress from pruning (which mimics herbivory) they send out signals to other plants nearby through their root system. This should result in a growth response, through which they are convinced that they improve their yield. The leftover cuttings will be spread out near the base of the plants to provide them with nutrients after decomposition, it prevents the weeds from outcompeting young trees and helps to keep moist during droughts. For the same purpose wood chips can be used, in Voedselbos Baarle-Nassau, developed by Nicolaas Geijer, this technique used. He sees that this improves water retention around the trees; even during dry summers when rain was absent for a long period of time, the wood chips still contained moisture.

Planting pioneers can not only improve the soil quality, but also the establishment of suitable micro-climates by providing shade and providing a break wind for the trees and shrubs for the subsequent succession phases. However, growing the pioneer species generally takes two to three years before planting the next succession phase, a method Wouter van Eck prefers, which could be too long for some starters

Martijn Aalbrecht from the Voedselboss, is an experienced food forester and consultant. He too sees that people don't want to wait for the succession, however, years of experience taught Martijn that you could also jump through this process by analysing the soil quality and adding lacking nutrients or minerals before planting the food forest. To enrich the soil quality and enhance the plants survival, he dips the roots of the seedlings in a mycorrhiza-nutrient solution before planting them. This gives the plants and soil-life a kick-start which will benefit the later health and production of the food forest. He thinks that planting a food forest is not at all a natural process and it therefore needs help at initial steps. Preparing the ground, extensively observing and interfering the first couple years really improves the food production on the long term he says. According to him, a lot of food forests don't support their starting material, and are thus missing their potentials while having expectations too high for their poor sandy soils to match. According to Martijn: ***"They believe that after a few years they can walk through this abundant field of Garden of Eden type of project, where there is so much harvest that they don't know what to do with it. But the reality is that they are struggling to get those places going"***. Martijn is convinced that planting a tree that comes from a nursery where it was grown with fertilizer and then putting it in an exhausted soil with no microbiome to support its needs and expecting it to flourish is just nonsense and one of the biggest mistakes made.

Establishing a food forest in, or close to an existing forest requires a different approach. Forest grounds can be too acidic for annuals, perennials or young trees to grow on, as Leon Schepens from Kattenbergsebroek experiences this in his food forest. He developed his food forest within an existing forest, which was already in its climax stage. Acidic dry sandy grounds make it hard for the small fruit producing trees and shrubs to grow, since nutrients are lacking, competition is high and the ground is very dry. To counteract this Leon uses fertilizer around the stems and chalk to neutralize the soils pH. Though applying both chalk and fertilizer helps at this moment, as he says it takes time before the trees can take care of themselves. By then, in the future he wants to stop using chalk and fertilizer.

In contrast, Wouter van Eck from Ketelbroek, has built his food forest on a very fertile soil, as it is located on the glacial border from the last ice age, coming from the north and stopping around what is currently Nijmegen, leaving fertile land. Wouter selected the land with soil fertility in mind, and made some adjustments to further improve water drainage since the water level was relatively high in this area. Wouter raised the land by 1.5 meter to make sure his trees would survive wet periods, together with extra ditches to allow excess water to flow away more easily. To improve soil organic matter in his land he makes use of pioneers species but due to the richness of the soil he does not apply fertilizer, opposite to those food foresters who started their projects on nutrient poor grounds.

BIODIVERSITY

Systems with higher levels of diversity tend to be more resilient against natural stressors, diseases and have a bigger carbon storing capacity (Wendel et al., 2023). Therefore, compared to most agricultural systems, food forests are more resilient systems related to food reliability and provide sustainable solutions on environmental issues like CO2 uptake from the atmosphere. In this section we describe how biodiversity is implemented in the food forest design, how it has been developed so far and how it can enrich the food forest in the future.

The number of starting species strongly varies between the food forests. While Ketelbroek or Den Food Bosch started with planting almost four hundred species. Nicolaas chose to plant only fifty commercial species, he decided to go for less species to increase harvestable volume of every species.

This trade-off, we noticed amongst the visited food foresters, with some doubts and uncertainty. On one hand, higher numbers of one species means less space for others and could have larger impacts positive and negative in good and bad years, respectively and on the other hand producing larger volumes of product to sell on the market is easier due to uniformity. Obviously, this means that to have significant amounts of sellable produce, the trees need years and years to grow with unpredictable changes in the circumstances and the market. As both Nicolaas and Sjef van Dongen, owner of Fruitzforlife and Fruithof de Brand, mentioned, you have to plant a variety of species since no-one can predict what the market demands are over ten or twenty years from now. Due to the uncertainty and unpredictability Sjef noted that planting a variety of species at the start gives you more flexibility and resilience in the future: ***"When the demands are shifting towards chestnuts for instance, I can take more care of my chestnuts to improve productivity vice versa"***.

When planting the food forest, biodiversity restoration was not the main motivation of most food foresters we interviewed. Yvonne and Martijn for example wanted to be self-sustaining in terms of food consumption and nutritional value. However, Yvonne has after fourteen years still no reliable produce, but sees the enormous change her land had biodiversity wise, especially compared to the neighbouring forest and agricultural land. Bird, insect, reptile and mammal populations are growing every year within her land she says, making it a thriving ecosystem which is full of life. ***"I would strongly recommend letting someone study the biodiversity within this forest, then we could see the actual worth of it. I strongly believe this is a solution for the biodiversity issues we are facing"*** Yvonne states. Martijn has the same situation, his land is also surrounded by older forest and agricultural land which only supports a limited amount of life. When asked Martijn what his view is on the ecological outputs of his system, he enthusiastically reacted: "***Enormous! I find it amazing how quickly nature can re-connect with the land. I count the insect population every year and they keep increasing year by year, I have European hornets and amazing bird species like owls. I have a tiny plot and I always think; if it is possible here it is possible everywhere. There was an ecologist visiting and he was amazed by all the birds he saw."***

Creating a suitable habitat for species to re-establish themselves also brings returned benefits for the food forest. Wouter experienced this with the beavers, which returned to the area after he planted the food forest. Wouter dug ditches on the borders of his land to promote water run-off during wet periods. These ditches attracted beavers, who settled and built a dam across the ditches creating a small wet area within the food forest which helps to trap water during droughts. It was a welcome surprise! Once in a while, Wouter takes off the top of the dam to prevent the water level raising to high and overflowing his entire forest. In his design, Wouter implemented a buffer zone where non-producing trees are growing, this way the beavers only take wood from that part of the forest and not the valuable fruit or nut trees.

PLANTING

Planting plays an essential role in the design, determined by the aim and its function and has consequences for management and production. In this section we discuss in what way plants are intergraded within the design of the food forest, what functions they can have and how spontaneous species create unexpected benefits, in a chronological order, from design to production.

A trade-off food foresters have to make is harvestability and diversity in the system. Planting trees in rows for a more "production" based-design makes harvesting less labour-intensive and easier compared to a "romantic" food forest where trees, shrubs and herbs are placed between one and another. Planting in rows makes harvesting easier, but this practice might have a negative influence on biodiversity. Additionally, it may decrease the resilience against pests and diseases, as multiple trees of the same species placed in the same row close to each other could makes them more vulnerable. Martijn has built a production designed food forest where he divided the rows in months, so for each month he has a row which contains plants with harvestable produce in that specific month. Moreover, each row is planted in such a way that there are never two plants of the same species next to each other, thus e.g. after an apple tree there comes a pear and took care that after three producing plants he planted a shading tree. He also incorporated perennials in this system so he makes it harvestable whole season and ensuring a certain level of biodiversity as well. Similar system is also applied in Den Food Bosch; here with extra attention they planted rows curved North to optimise food production. After every row of trees, where they planted pioneers, shading and fruit producing trees next to each other, they have lower vegetation like annuals, perennials or shrubs. This row-system makes harvesting easy, but it is also complex. ***"It is easy since everything is in rows and accessible, but you really have to know the place. I cannot tell my sister to go over here and harvest two boxes of raspberries, she would need a map."*** as Marente says.

A thought through planting design choosing the "right" species, can reduce market-related uncertainties as we saw in Nicolaas' food forest. He aimed to plant as little as possible species to maximize the volume of each species; with a risk in mind, as having only twenty species is a risk if there is no market for half of it. Although the market cannot be predicted he planted species where he is certain of that will sell, like cider apples. The apples are easy to harvest, they fall on the ground when they are ripe. This way it makes harvest less costly and brings yeast in a natural way, assuring of at least some profits from his land.
Supporting your plants competing against weeds has a notable benefit as well. Martijn showed a clear example; two trees of the same species were planted in the same year with the only difference was that one was planted between grasses and one was planted and then the ground around it was covered in tarp to prevent the weeds from overgrowing during the first couple of years. Overgrowing indeed happened and the tree planted between the weeds was barely alive, while the tree which was covered in tarp was already producing some fruit. Sjef van Dongen uses a similar technique but puts white clover (Trifolium repens) to function as natural tarp. "***It works perfectly, especially when you start with a barren ground. The roots are very shallow so they do not compete with you trees and in the morning they catch dew and trap the moist in the soil. It saves you a lot of work since it keeps out the weeds so they won't compete with your trees and there are more nutrients available for them to grow, and it only costs 50 euro per hectare."*** Sjef says.

Through the years, species might enter the food forest spontaneously and settle. This doesn't have to be a bad thing necessarily. As happened to Yvonne her forest, she planted some flowering species herself to boost the insect population and help attract pollinators for her fruits. But in the meantime some species popped up spontaneously like Digitalis, Impatiens & Glechoma. Yvonne is happy with these since they also have a positive effect on the insect population and even attract insect species she did not see before. Marente says that even species that settled spontaneously can be sold. ***"One day we were walking with the chef Martin through the forest selecting all the plants he wanted to buy and out of the sudden he stopped at this very ordinary weed, Aegopodium podagraria, that we did not plant and asked if he could buy it."*** Once the food forest is producing and wildlife is attracted design can minimise harvest losses due to animals. During his project, Martijn studied his own food forest a lot and saw which fruits were taken by birds and which they would leave behind. He incorporated this into his design: ***"I know the birds like cherries a lot, but at the same time the multiflora has fruits. When I place them close to each other, I know the birds will take the cherries and the multiflora is for me. I also work with colours, I always place red fruit next to yellow fruit. So the red ones are for the birds, and I can harvest the yellow fruit."*** This way Martijn makes use of plant colour and bird preference to maximise his harvest without interfering too much.

FOOD PILLAR

Food production is one of the key goals why food foresters start their food forests. It is seen as a very sustainable, promising and alternative way of producing food, while at the same time obtaining other favourable outcomes like generating biodiversity, restoring soils and offering space to the local community to explore these types of systems. However, food production is also a contested topic within the Dutch food forest community. Some questions still have to be answered, like what can actually be produced by these types of agroecosystems? And how much of this produce can be harvested and possibly sold?

Under this pillar we will compare the different points of view on the topic of 'food production' that we have heard from the field. There are four topics discussed under this pillar comparing the trade-offs and synergies of the different practices and views from the food foresters we interviewed:

Importance of generating food production

Gain 'sufficient' production

Food Loss

Yield expectations & time

IMPORTANCE OF GENERATING FOOD PRODUCTION

When considering the importance of the food production, there was a variety of different takes on the importance of food production: Yvonne's ideas on the subject were very different form Nicolaas. Food production for Yvonne is more intended for small-scale self-sufficiency with a potential excess of production that then could be sold or traded with neighbours or local selling points. Nicolaas, on the other hand, has designed his food forest with the intention of producing and selling to local restaurants and consumers with the aim to sustain himself financially from this. This illustrates that food production can mean a variety of things to different people. Multiple ideas about the importance of generating food exists: food production for Martijn, for instance, can be observed in his romantic food forest in that, with this piece of land, he intended to feed solely his family on – and maybe donate the excess to friends and family. On the other hand, his 'production' type of food forest aims to showcase the neighbourhood that you can feed many mouths: ***"Every week we had around twenty families coming to harvest already, for the fruits. So already on this this piece of property [of 0.5 hectares], after three years, there is twenty families I can feed from. From May until September. With fruits, and veggies are coming."*** Sjef has a rather similar stance, however, his food forest produces not only for himself, as he sells to the local school as well. He sells them nuts, grapes, honey and eggs from his forest-system. For Leon the food forest is a place where he would like to sell out of in the future, but mainly as a community-engagement place where people can come and pick as an addition to the bed and breakfast on his land.

However, it is important to emphasise the different perceptions of what a food forest actually is. Several systems studied do not follow the standards set forth in the Green Deal Voedselbossen. Whether that means completely writing off their practices in the world of food forestry, is up for debate. Marente, from Den Food Bosch nuances this by shedding light on the implications of using annuals in food forestry: ***"When you want to have an income from the first year onwards, [annuals are] a great way of starting your business and starting to have productivity from the land from the beginning onwards. I think the combination of perennials and annuals is a great solution for the challenges that we're facing in food forestry now, which is the delayed timeline of production."***

When looking at Marente's point of view on the importance of production of the food forest, her emphasis lies on the community engagement aspect. Meaning, that this aspect outweighs, for her, the importance of the production aspect of Den Food Bosch. The volunteers that are 'running and managing' Den Food Bosch put in substantial amounts of labour, that can be understood when she points out that a group of around six to eight people work every Friday morning from around 9 until 12.

GAIN SUFFICIENT PRODUCTION

Another element Marente touches has to do with yield optimization. Because Den Food Bosch manages their food forest in a syntropic manner, with lots of pruning and interference to feed soil life and induce stress reactions in the trees to enhance their growth, the input they have to put in is relatively higher than for a less intensively managed food forest. The idea behind this, according to Marente is: ***"If you talk about expectation management, loads of people start a forest besides a job or just for fun, and they don't realise that what you put into it is what you get out of it. That's what we see here... We can also choose to not maintain the place, but we will not harvest as many brambles or blackberries as we do when we properly prune the stuff... in the Netherlands, we think that nature can do a better job than humans, so we don't do anything at all. Which is the case when you talk about nature, but which is maybe not really the case when you talk about food production."***

Yield optimization can be seen as a contested subject in the field of food forestry. The conceptions of how much a food forest should be interfered with in order for humans to benefit of, are not all on the same line. For example, according to Nicolaas yield optimization can be seen as a trade-off: ***"It's the idea that what you need to do in the food forest is always ask yourself, what am I putting in? What am I getting out? So it could be that pruning, say it has an advantage, but then you still need to calculate that advantage over having to prune it [in terms of labour costs]. If I don't prune and I sometimes have branch breaks, I get more diseases. But that also means I don't have any costs. So that's the way you need to calculate whether you want to prune or do other things."*** When comparing Den Food Bosch and Baarle-Nassau in terms of management, say for instance high or low input, they make different choices based on their capacity to put in labour hours in combination with a broader idea of how Marente and Nicolaas want to run their food forests.

When talking about yield optimization, however, another broader 'problem' arises which most of the food forest encounter: lack of yield data. Almost no food forest, except for Den Food Bosch, has long term data on how much these food forests produce. Den Food Bosch, however, only recently started collecting this type of data. This makes it, for comparison purposes, quite difficult to compare on the basis of hard data.

FOOD LOSS

Another notion concerning the topic of food production is food 'loss'. A food forest is highly attractive to different kinds of fauna, especially because of this high productivity. Yvonne notices this in her food forest: ***"I see here that the squirrels and woodpeckers take everything out of the trees and that is something I did not expect. I expected a harvest of walnuts, but I did not get any. I'm very willing to share fifty-fifty, some for the birds and squirrels, and some for me."*** The food that is lost can be, in terms of food production, quite a big dent in the yields that are actually being sold. Wouter acknowledges this as well: ***"the birds now live in a landscape which is bringing them starvation, so they are hungry and thirsty, and then then [the food forest] is an oasis where things are growing. Many people with smaller projects and a small garden see this and compare to [Wouter's] food forest. They have one apple tree and everything is picked, one cherry tree and everything is picked."*** This is an interesting notion, because a trade-off can be observed between food production and ecological output. However, Wouter adds to that, that size matters too. Likewise, nature areas that can offer animals refuge besides only the food forest, like the strips of land with non-producible he calls buffer zones.

YIELD EXPECTATIONS & TIME

Hence, this combination of uncertain yield expectations, based on no available data and potential loss of food production can play a role in the difficulty in estimating how much food these food forest can actually generate for production purposes. When looking at the initial expectations for food production almost all of the interviewees said they would have expected more food production, on a shorter term. The narrative on this, however, changed when discussing this with the older food foresters who had already passed the initial stages of their food forests and had older systems that established themselves over time already. Sjef mentions this about his food forest: ***"I think just after seven or eight years, the harvest became quite well. And then now I have every year a harvest."*** However, he also mentions that most of his production comes from the 'bosrand', better said, the zone in between his purely romantic food forest and his predominantly-annual vegetable garden. Furthermore, Martijn adds on this by mentioning the speed with what his production-oriented food forest is generating harvest already: ***"The romantic [food forest] is also doing fine and it's also producing a lot. But, I think I found it interesting that after two and a half, three years in the new commercial [production oriented food forest] site we already have abundance of harvest."***

Both Sjef and Martijn elaborate on the fact that the more romantic food forests take within the range of six to eight years to start generating substantial amounts of harvest. This is something Leon has seen in his food forest as well. He argues it has to do with the type of soil that the young trees have to survive in. Emphasise on the importance of soil quality is heard back in many of the interviews too, and mentioned above in the ecological pillar.

Another important nuance has to be made in relation to the timespan of the projected management interventions. Multiple interviewees, in favour of the more intensely managed food forest systems, stated that management is especially important in the first years after initiation of the food forest. After these first years of intensive management, the intensity may drop and the system equilibrises towards favourable succession phases wherein less management might be preferred or deemed less necessary over more management. This element of time (and succession) is hence an important emphasis that needs to be taken into consideration when addressing the topic of management interventions.

OVERALL

To summarise, the expectation of food production in the initial stages of a food forest in comparison to the later stages were often heard to be slightly disappointing. In the later succession phases of the food forest, higher produce than expected was often the narrative. Older food forests that still did not have sufficient production output could very well vocalise where the trade-offs were found which made, according to them, the production lower. These included impractical designs, status of the soils, and competition from weeds, grasses, and animals eating the produce. Furthermore, the narrative of 'high input makes for high output' was heard in multiple of the interviews as well. In these interviews the opposite became evident too: 'low input makes for low output'. Meaning, intervention in the food forest, whether for example nurturing the soil or pruning the trees, could be named as important aspects of higher productivity outputs according to multiple interviewees.

ECONOMIC PILLAR

The economic dimension concerns the placing of food forest systems into the broader socioeconomic arrangements around them. As in the previous pillars, the recent nature of these systems (especially those that aim towards rational, profitable production) make several assumptions and approaches adopted by food foresters be speculative exercises. Clearer evaluation of strategies and trade-offs will probably emerge as more food forests reach their full productive maturity and more data is available on (Dutch) temperate food forests. Nevertheless, our field research showed some trends and patterns on the economic dimension of food forests, which will be discussed below. This section has five sub-sections, dealing with designing for profits, intensity of intervention in the system, the place food forests occupy in the economic dynamic of a property, resilience considerations, and markets and value chains.

DESIGNING FOR PROFITS AND FOOD PRODUCTION

It is important to highlight to what extent each project is designed for profit purposes. Food forests can have high ecological development and food yields, but not be organised in a way that favours their insertion into markets. Moreover, the profit expectations farmers have of their food forests can vary substantially per project. Important factors for economic performance include planting trees in rows and/or clustering trees of the same species together for easier harvest, planting larger volumes of some commercially valuable crops, and selecting commercially better varieties.

Among the systems studied in this project, Voedselbos Baarle-Nassau is the one that fits these criteria the most, due to its larger size (6.5 ha) and focus on a smaller number of productive species; however, it has not entered its productive phase yet, with only a handful of harvests of anything. Den Food Bosch is organised in rows but has around four hundred species and multiples varieties of each desirable product, making it hard to harvest and to sell large volumes of anything. Ketelbroek is similar in this regard, with only a part of the plot with some trees planted in rows, and the largest plant variety of all projects, which makes harvesting complicated. This is a crucial factor in making these two projects sub-optimal for commercial purposes, while at the same time having an important educational and advocacy function, showing what the possibilities are for other systems and serving as experimental grounds.
The part Sjef calls a food forest in his project is similarly not planted in rows, but it is adjacent to a more commercially designed system with annuals and perennials that is more commercially oriented. Although this system would not fit the food forest definition from Stichting Voedselbosbouw and Sjef himself does not refer to it as a food forest, it is very similar to Martijn's more commercial food forest, another system alternating perennial and annual rows, as mentioned under the Food pillar.

Food forests may still offer relevant economic benefits even when they are not aiming at market sales. Martijn reports that his backyard garden, greenhouse and his 0.3 hectare 'romantic' (not optimised for commercial production) food forest supply virtually all the food for the four people in his household, as well as generous donations to family, friends and neighbours. Wouter stated in his interview that while he believes 10 hectares are necessary to financially support a regular-sized family, a single hectare of food forestry would be able to produce most of the food necessary for six people.

DIFFERENT APPROACHES REGARDING INTERVENTION IN THE SYSTEM

Our research revealed a wide variety of views on intervention in the food forest, which have substantial impacts in the economic sustainability of the projects. The approach developed by Wouter in Ketelbroek is very influential in the Dutch landscape, being the main influence behind the definition established by the Green Deal Voedselbossen. His approach suggests minimal interference in the system as a way of optimising both its ecological and economic outputs. A core aspect of the economic strategy is relying as much as possible on natural processes and minimizing all types of inputs, therefore drastically cutting costs, even if that means losing some productivity. Examples of this are: not using fertilisers, reducing pruning and management to a minimal, and reducing harvesting efforts, even if that means sub-optimal harvests. Emphasis is placed on the design and natural succession, compensating eventual losses through the long-term resilience of an organically developed system and low work and capital inputs. Voedselbos Baarle-Nassau is another example of a food forest following this broad management strategy.
On the other end of the spectrum regarding management intensity we have syntropic farming. Den Food Bosch is one of the few Dutch projects systematically following these practices. The state of ecological succession observed in their food forest was indeed surprising, as it was only 5 years old but completely the opposite of what we could see in Voedselbos Baarle-Nassau or what other farmers had reported about the first years of their projects. Marente attributed this special development mainly to syntropic pruning practices.

Nevertheless, these practices are very labour-intensive; something that is not a problem for Den Food Bosch, as it is chiefly a showcase/experimental project, and relies on a team of eight volunteers working there once a week.

Martijn also proposes an approach with greater intervention, giving priority to production earlier on. He stated the importance of soil analysis and remediation, and initial fertilization in poorer soils, while also emphasizing controlling the development of grasses (using a plastic tarp) to maximise the growth of productive trees. Sjef also emphasised the importance of labour input in the system, with practices like pruning, planting ground covers, and creating space for productive species ***"So with more inputs you can have higher production, for example, pruning, doing these syntropic farming methods. You need inputs, right? You have to do it. You need chop and drop, you need chainsaws. So you need to think about it. It needs a caretaker who is there every day, and then you can optimise production."***

At this moment, it is difficult to thoroughly analyse the trade-offs that these different practices imply. The impacts of practices like fertilization and control of grass growth on soil life and forest ecological dynamics have not properly been studied to understand what exactly would be lost ecologically when choosing to accelerate and emphasise certain processes. Moreover, it is also virtually impossible to ascertain the long-term economic impacts of these different strategies. Nevertheless, some narratives suggest that it is possible to accelerate the first harvests through certain management practices conducted in some of the projects. The extent to which this is desirable is probably highly dependent on the economic and ecological conditions of each project, such as the amount of time and capital available, and the amount and the speed one expects for the monetary incomes of the project. It also depends on the function the food forest has in relation to other parts of the property they are in, as will be discussed in the sub-section below.

FOODS FORESTS WITHIN AN AGRICULTURAL SYSTEM

The economic goals and expectations of food forests may change depending on the position they occupy within the broader context of the property they are in. Food forest approaches with greater intervention (like the ones of Sjef and Martijn) might be adopted in isolation or together with "less-interventionist" systems when there is greater need for their produce and/or the money one can obtain for it. This bit of dialogue from the interview with Sjef illustrates well his approach to the subject:

> *Álvaro There's this area of the plot where you are mixing the annuals, the edge. The fact that you have it, I imagine that changes the way you manage the food forest. I'm curious if you would manage it differently if you didn't have the edge.*
>
> *Sjef Yeah, then I would manage probably the food forest more intensely. Then I would become more dependable on the food forest. Now I can get the products from the edge, that I would otherwise have to get from the food forest. Since I can get them from the edge, that keeps the food forest a bit more quiet, you know?*

As discussed above, there are also economic advantages to a reduction in labour inputs. Nicolaas used to live in Den Haag when he started his food forest, later moving closer by, to Tilburg. Nevertheless, he is still a reasonable drive away from his project, which would not be possible if he had a more interventionist approach to his food forest. In a similar line, Leon also sees his food forest as an area that will probably give yields on a longer-term and with reduced labour inputs, since his farm's core economic activities are renting out accommodations and selling produce from the annual garden.

UNCERTAINTY AND RESILIENCE

Resilience against multiple sources of uncertainty are a core benefit of food forestry. In addition to the ecological resilience discussed above, the diversity of species and produce in a food forest also allows for significant economic resilience. A well-known advantage of systems with greater emphasis in polyculture is their inferior susceptibility to weather and market fluctuations, since the diversity of crops produced are likely to be differentially affected by such changes, thus spreading risks and income sources. On the other hand, this greater diversity can also pose problems regarding the production of greater volumes of produce, which are key for accessing certain markets. As in other systems, the variety of species should be chosen to balance out the risks and benefits of specialization and diversification. In food forestry, however, this choice comes with some other more specific factors. Firstly, this choice for specialization is at odds with the diversity implied in natural mimicry, which can have a negative effect on the ecological processes of the system and compromise its progress and productivity. Secondly, the markets for several key food forest products are not yet developed or clearly understood, particularly in the Netherlands. Therefore, food forest designers must work with assumptions on how certain perennial species will fare decades from now, assuming that products like chestnuts, currants, and perennial Asian legumes will be profitable at the large volumes that food forests can produce of them. Nicolaas stated that his choice to plant around fifty productive species in his system is determined by this structural uncertainty: while he would prefer to focus on around twenty cultures to maximise selling potential, the uncertain nature of future markets for these products led him to spread out the risks.

VALUE CHAINS AND ALTERNATIVE ECONOMIC CIRCUITS

All interviewees were unanimous on the importance of alternative value chains that can better pay for food forest produce, stating the virtual impossibility of competing with large-scale industrial production. The diversity of produce (and the irregular harvests it implies), demands specific types of customers that can adapt and benefit from that.

All the systems that were currently selling at least a part of their produce (Den Food Bosch, Fruithof de Brandt, and Ketelbroek) did so through alternative/shorter circuits. The main client of Sjef is the local Steiner school that his children attend; Den Food Bosch's main costumer is a chef; and Ketelbroek sells to four clients: a craft brewery that makes apple cider, a catering service, a local restaurant called De Nieuwe Winkel, and an EkoPlaza grocery store.

These types of clients have certain key advantages for food foresters. Restaurants usually have demand for a large variety of products and need a steady supply of fresh ingredients, while usually not demanding as large volumes as a supermarket chain. Moreover, they have the capacity of creating markets for certain non-conventional produce coming from food forests by utilizing it in their recipes. Regarding cider breweries, Wouter and Nicolaas stated it was advantageous that they were interested in apples regardless of their shape and accepted those that had already fallen from the trees (preferring them, as a matter of fact, due to the yeast present in them), which facilitates harvesting processes and allows for the sales of products that would not be desired by direct clients.

DISCUSSION

In this final section, we outline the common points and the differences we observed between systems in the field. These findings are contextualised in terms of trade-offs and synergies between our three analytical pillars. Finally, we summarise them in an infographic showing the varying degrees and types of intervention in the systems.

KEY FINDINGS AND CONCLUSION

Our research shows that there is a variety of different practices currently being used under the name of 'food forestry' in the Netherlands. This is mirrored in the lack of consensus on food forestry definitions we could find in the field. All food forests rely on an increase in soil fertility through nature mimicry. As compared to conventional agriculture, all systems also relied on greater biodiversity for increased resilience and income diversification. However, diversity in the system may be at odds with food production and income generation. While greater diversity makes for a diverse income, it may also compromise production of the volumes necessary to access markets. Moreover, greater diversity also increases the relative losses per food product from animal predation. The trade-off between increased biodiversity or a more production-oriented design is also an important consideration for food forest farmers; less species and spatial diversity increases the harvestability of the system, while also making the system more susceptible to pests and diseases.

As discussed above, these different approaches result in different trade-offs and synergies between the ecological, productive and economical pillars. The core conclusion of this report is that (aspiring) food foresters should **ask themselves what their expectations are and what resources they have, so that they can make management and design decisions that fit their needs.**

INTERPRETATION OF KEY FINDINGS

There are different ways to achieve this greater soil fertility. Ecological succession can occur naturally, with little intervention and costs, but also taking longer and offering little yields in the process. Conversely, it is also possible to accelerate soil development by pruning intensely and leaving organic materials on the soil.

How early in the process produce can be generated from a food forest also depends on the amount of intervention one desires to have. Some approaches argue that irrigation, fertilization, inclusion of annual crops, and the control of naturally-occurring grasses and shrubs compromise the long-term fertility and resilience of the forest system. On the other hand, focusing on the development of productive species early-on leads to greater and faster income potentials. The cost-benefit analysis of low input/low output and high input/high output approaches has to be studied contextually by each farmer.

Even for the same farmer, these varying degrees of interference may vary in time and within different areas of a food forest. When explaining his reasoning for higher intervention in the beginning of projects, Martijn Albrecht states:

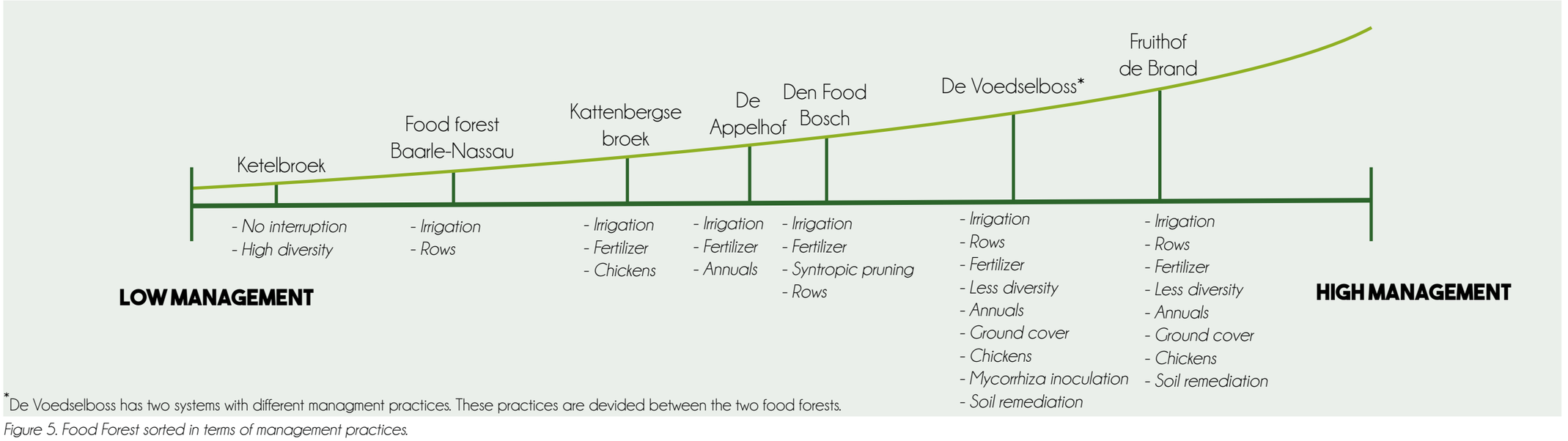
> *'People have this image in their heads that in a food forest everything goes by itself. Since you mimic nature, the system can take care of itself, and the only thing you have to do is harvest. I would say that is too black and white, but most of people who I talk to have this image in their heads. And that's true. After a year, or six, or seven, but the first years in the development of the system are really, really important for the vitality of the years in the future.'*

Even for systems that do not envision this as a practice in the long term, cultivating annuals may be a way of generating food or income in the first years, when shade from perennial species is still negligible. Nevertheless, this may also be argued to slow down the build-up of soil fertility (Geijer, 2023).

Levels of interference may also vary depending on the part of the food forest. Ketelbroek has an area Wouter calls the "deep dark forest", where succession has been allowed to progress all the way to something akin to a climax forest, thus having space for fully developed climax species like chestnuts and walnuts, but only allowing for crops that can handle strong shading in the lower strata. Conversely, he also keeps areas where pruning and design are used to keep the system at mid-succession levels, allowing for the cultivation of berries and mid-succession trees like apples or pears. In a similar fashion, Sjef has the area he calls a "food forest", where succession goes further and management is lower; and an area where perennials are paired with annuals, constituting an initial to mid-succession system. Martijn also had a system like Sjef's "bosrand" in the initial years of the system, before further succession is achieved.

While the economic trade-offs of higher intervention are easier to see and account for, the ecological impacts of intervention are harder to estimate clearly and demand further scientific research to ascertain what (if anything) is lost in ecological terms with different interventions.

Below is an infographic (Figure 5.) with the different systems studied in this report organised in terms of the type and degree of intervention described above:



*De Voedselboss has two systems with different managment practices. These practices are devided between the two food forests.

Figure 5. Food Forest sorted in terms of management practices.

IMPLICATIONS & SOCIETAL RELEVANCE

Another important point of discussion in terms of societal relevance is the financial possibilities of food forests. All interviewees were unanimous in stating that the agricultural system as a whole is unsustainable within the current economic system. Martijn Albrecht describes this well when reporting a conversation he had with another food forester, who also has a restaurant:

> *"The system is so crooked. [...] it's cheaper to go on the website of Albert Heijn and order a sack of apples than to ask their employee to go and harvest the apples, because of the price of labour. I think that's fundamentally what's happened. If you if you try to have a produce that will be sold at the supermarkets, then you will lose the game, because you can never compete. But when you say: 'I have a unique product", because I have different things, or they are better flavour-wise or nutrition-wise; or when I can make some stuff out of things myself and sell it for a better price, then I really believe in food forests. Also, everybody says that our model of producing food is broken. So, nobody knows in 10, 20 or 30 years' time, if that model is not only broken, but it has collapsed, what will the value of food forest be? So, looking it with the eyes of today's market, you have to make something special out of your product to get a good price from it. But I think it will be increasingly interesting through the years when food prices get higher and higher."*

In this sense, especially for alternative farming systems, it is crucial to find markets that monetarily value ecologically friendly systems, with as few intermediaries as possible. In the case of food forests, the high diversity and seasonality of yields, as well as the often exotic produce, demand specific customers to be viable. Building connections with restaurants, alternative catering and supermarket chains, breweries and other suitable clients is thus crucial and should be a core consideration for any aspiring food forest farmer.

This research also highlights the importance of trans-disciplinarity in the study of food forests. The lack of data on these systems is partly due to the complex entanglement of agronomic and ecological knowledge involved in their management and design. In this study, food forests were observed in the complex inter-relation of their ecological, productive and economic aspects, and this should be the norm in studying such projects.

LIMITATIONS

Our research consists of a collection of case studies and was conducted in limited timeframe. Seven case studies, unfortunately, cannot provide a true representation for the whole of the Dutch food forest community. We did, however, find some overlap in expectations and disappointments on yield within the case studies. Although the sample size was small, we do believe these case studies portray a reliable narrative. However, to be able to extrapolate this to the whole Dutch food forest community, more case studies are required.

RECOMMENDATIONS

Following, there are a total of seven recommendations formulated by our group based on this research in this final section of the report.

> *"I feel like sometimes we're lacking the discussion a little bit. So we're not really talking about these things because we're like: "annuals? That's not what food forests are about." Or when talking about the Green Deal definition, the use of manure: "No, we shouldn't go there because it's not good!" We're not leaving space and time for new insights, for other ideas, ideas from other cultures, from other parts of the world. I think we should be much more open than we currently are. And not pretend that we know what's going to happen."*
>
> Marente, Den Foodbosch

1. *Food forest definitions should contemplate the diversity present in the field*

This quote above captures very well the essence of our first and main recommendation. The main definition of food forestry present in the Dutch landscape is that of the Green Deal Voedselbossen. Contrary to most other definitions, it has the advantage of being very objective and explicit about what qualifies and does not qualify as this type of system (Geijer, 2023). Nevertheless, it still leaves space for interpretation regarding specific practices. The statement "a productive ecosystem designed by people to the example of a natural forest" is particularly open for interpretation, being seen by many practitioners as barring the inclusion of annual crops and livestock, the use of fertilisers, or even suggesting the reduction/elimination of irrigation[8].

Nevertheless, our research showed several practitioners conducting experiments with more intervention, in ways that can probably still be argued to support core principles of food forestry, like natural mimicry and ecological succession.

Different definitions within the food forestry world make it hard for the outside world to deal with these systems, particularly when it comes to legislation and zoning.

As the interest in food forests develops, definitions are bound to become increasingly important, as these definitions are being tied to subsidies and spatial planning rules.

Our observations suggest the importance of keeping space open for experimentation within the definitions and the debate between practitioners. That is because a greater diversity in food forestry is probably important for the practice to be suitable for a wider array of farms and circumstances. Moreover, as stated above by Marente, the highly complex and still pioneering dimension of food forestry can probably benefit substantially from intense experimentation and exchange of information.

2. *The power of food forests is diversity: we need to embrace it*

Kees van Veluw emphasised this very beautifully to us: we must start embracing diversity. As each food forest is unique with special values, we urge to promote more debate and discussions within the community as well as with the broader public on informing people on the potential that food forestry has to offer. We found how enormous and complementary the existing knowledge on the ground already even when this means that is often not (yet) translated onto paper. Various ways of doing food forestry should be a richness and not a battle between the different strategies.

3. *Knowledge exchange based on lived experience*

This recommendation is a combination of the previous ones and our conclusion. Better expectation management in the food forest community would come from sharing knowledge acquired through lived experience, whether in person or in other food forests. We have spoken to many food foresters that turned towards consulting that have a lot of experimental knowledge that can fill the current gap of lack of data in Dutch food forestry practices. We feel that this could be beneficial for managing unrealistic expectations in the best way possible.

4. *Be aware of what the aims are before you start.*

Different design and management practices discussed in this report lead to different results regarding, among other issues,

i. How much work and financial input a food forest needs;
ii. How early it will yield produce;
iii. How much produce it will yield;
iv. How much of it will be marketable;

It is therefore crucial to have a clear idea about the possibilities and expectations in each circumstances to have realistic goals and make optimal choices.

5. *Adapt and be flexible in the evolving food forest world*

Most of the oldest food forests in the country are not older than 10 years, and most of the large-scale projects are not even 5 years old. In this context, there is still enormous space for experimentation and new practices are being invented on the field. Any (aspiring) food forester will greatly benefit from observing and being open to trying approaches that seem to be succesful and/or fit their conditions and objectives.

6. *Generate evidence-based data for a longer period of time*

There is great need for long-term evidence-based data on the functioning of food forests. The generation of this data is crucial in the progression of adoption of food forestry in our current society. Most projects still fail to do this systematically, which reduces the possibilities of studying food forests.

7. *Studies on long term ecological-agronomical outputs*

The complex inter-relations and trade-offs involved in a system of natural mimicry like food forests are still severely understudied. While there is great practical knowledge accumulated and being generated on them, the development and legitimization of the field will greatly benefit from scientific and long-term research on its functioning.

8 "There exists an unofficial conception of FFs as excluding annual crops and animal husbandry. This is likely in part due to the prominence of VBNL and W. van Eck in the food forestry world. Van Eck and VBNL tend to make the case clearly that a FF excludes annual crops and animal husbandry because these practices contradict the GDV first condition: that a food forest mimics a natural forest ecosystem. An example of this unofficial conception comes from the RVO. Without citing the GDV or another source, the RVO stated that fertilisers (animal or artificial) and pesticides are forbidden according to their definition (RVO, 2023). That there exists this unofficial conception of FFs in line with the GDVe is ironically supported by cases of academics misquoting the GDV. For example Khan (2021) and Nabisubi et al. (2020) misquote the GDV as excluding annual crops and animal husbandry."
(Geijer, 2023, p. 81)

CLOSING REMARKS

Food forestry as analysed by us in this report has a great potential for current problems our society is facing. It considers including elements of nature in food production, it addresses food production in a way where the soils are nurtured instead of depleted, it engages people to take a step closer to the way food is produced in a holistic way, and most of all it inspires. This is our main take-away from this ACT project. To all of the experts, food foresters, and people that we interviewed and talked to, few had the exact same idea on how to 'do' food forestry. They, furthermore, encountered different challenges in their process of starting (and keeping) their food forests But, what they all had in common was the optimism about food forestry as a working system. Even if the production was very low in some cases, at least there was a burst of biodiversity. Even if many seedlings died the first year, the volunteers learned and grew from that. Even if it the expectations were not in line with the reality, it was all worth it. And to the question if they would do it all over again, everyone said: YES!

REFERENCE LIST

Albrecht, S., & Wiek, A. (2021a). Food forests: Their services and sustainability. The Journal of Agriculture, Food Systems, and Community Development, 1–15. https://doi.org/10.5304/jafscd.2021.103.014

Albrecht, S., & Wiek, A. (2021b). Implementing sustainable food forests: Extracting success factors through a cross-case comparison. The Journal of Agriculture, Food Systems, and Community Development, 1–18. https://doi.org/10.5304/jafscd.2021.111.019

Beach, R., DeAngelo, B., Rose, S. K., Li, C., Salas, W., & DelGrosso, S. (2008). Mitigation potential and costs for global agricultural greenhouse gas emissions. Agricultural Economics, 38(2), 109–115. https://doi.org/10.1111/j.1574-0862.2008.00286.x

Breidenbach, J., E. Dijkgraaf, B. Rooduijn, R. Nijpels-Cieremans, & A. Strijkstra, 2017. Voedselbossen van belang voor biodiversiteit. De Levende Natuur 118: 90-93. https://natuurtijdschriften.nl/pub/1010567

Buiter, M. (2022). Wat is een voedselbos? https://www.voedselbosbouw.org/media/documents/Artikel_Wat_is_een_voedselbos_FmUQeEN.pdf

Chen, J., Jing-Zhang, C., Tan, M., & Gong, Z. (2002). Soil degradation: a global problem endangering sustainable development. Journal of Geographical Sciences, 12(2), 243–252. https://doi.org/10.1007/bf02837480

Crawford, M. (2010). Creating a Forest Garden: Working with Nature to Grow Edible Crops. Green Books.

Dudley, N., & Alexander, S. (2017). Agriculture and biodiversity: a review. Biodiversity, 18(2–3), 45–49. https://doi.org/10.1080/14888386.2017.1351892

Geiger, F., Bengtsson, J., Berendse, F., Weisser, W. W., Emmerson, M., Morales, M. B., Ceryngier, P., Liira, J., Tscharntke, T., Winqvist, C., Eggers, S., Bommarco, R., Pärt, T., Bretagnolle, V., Plantegenest, M., Clement, L. W., Dennis, C., Palmer, C. M., Oñate, J. J., . . . Inchausti, P. (2010). Persistent negative effects of pesticides on biodiversity and biological control potential on European farmland. Basic and Applied Ecology, 11(2), 97–105. https://doi.org/10.1016/j.baae.2009.12.001

Geijer, N. J. (2023). Agricultural food forestry: A state of the art [MSc Thesis]. Universiteit Utrecht.

Götsch, E. (1994). Break-through in agriculture. Rio de Janeiro: AS-PTA.

Green Deal Voedselbossen. (2017). C-219 Green Deal Voedselbossen. https://www.greendeals.nl/sites/default/files/downloads/GD219-dealtekst-Voedselbossen.pdf

Green Deal Voedselbossen. (2023). Gewascode "Voedselbos" benutten voor agrarische bedrijven. Green Deal Voedselbossen. https://greendealvoedselbossen.nl/gewascode-voedselbos-benutten-voor-agrarische-bedrijven/

Hassen, T. B., & Bilali, H. E. (2022). Impacts of the Russia-Ukraine war on global food security: Towards more sustainable and resilient food systems? Foods, 11(15), 2301. https://doi.org/10.3390/foods11152301

Kumar, B. M., & Nair, P. K. R. (2004). The enigma of tropical homegardens. Agroforestry Systems, 61–62(1–3), 135–152. https://doi.org/10.1023/b:agfo.0000028995.13227.ca

Mumby, D. K. (1993). Narrative and Social control: Critical Perspectives. SAGE Publications, Incorporated.

Roodhof, A. (2023). Voedselbossen in Nederland [Samenvatting eerste onderzoeksresultaten van het promotieonderzoek 'Sociale en Economische Mogelijkheden voor Voedselbossen in Nederland']. Wageningen University.

RVO, (Rijksdienst voor Ondernemend Nederland). (2017). Green Deal Voedselbossen. 1–13. http://www.greendeals.nl/wpcontent/uploads/2017/11/GD219-dealtekst-Voedselbossen.pdf

RVO. (2023). Agroforestry GLB 2023. https://www.rvo.nl/onderwerpen/basispremie-en-extra-betaling/agroforestry

Van Dooren, N. (2018). The emerging practice of food forest-a promise for a sustainable urban food system?. In European Agroforestry Conference-Agroforestry as Sustainable Land Use, 4th. EURAF.

Volkskrant. (2019). https://www.volkskrant.nl/kijkverder/v/2019/plantenvoorlater/

Wendel, B., Rooduijn, B. & Disselhorst, E. (2023). Food forests: Soil, Biodiversity, Biomass, Business & Movement. National Monitoring Program food forests (NMVB). Ministerie van Landbouw, Natuur en Voedselkwaliteit.

APPENDIXES

APPENDIX 1: INTERVIEW GUIDE

GENERAL

What did you do before starting a food forest?
- Personal life
- What makes a food forest a food forest?

Start with story / personal motivation
- Why did you start a food forest?
- What is the goal of this food forest?

What is the history of this food forest?
- When was this food forest founded?
- How did you obtain the land?
- What was the land used for before starting the food forest?
- What is the soil like?
- What are the water levels?
- How big is the food forest in terms of hectares?
- Is it divided in different sections?

In your perception, what is the potential of food forests?
- Food production wise
- Conservation wise?
- Money wise?
- Otherwise?

FOOD

What was the food yield?
- Do you have food yield data?
- How would you estimate your food yield (in kg or money)?
  - In each succession phase?

MONEY

What were the main investments in:
- Equipment
- Land
- Landscaping
- Plant material
- Fertilizers
- Education

MANAGEMENT

How much work did you put in?
- What tasks did you do?
- In each succession phase

How much time/people did it take you to do them?
- In each succession phase

MARKET

Do you sell your products?
- To whom are you selling to?

ECOLOGICAL

Plant species
- What species do you have?
  - Species in each succession phase
    - Introduced vs. Spontaneous species
- Biodiversity
  - Did biodiversity/ecosystem services increase over time?

How do you incorporate succession phases into your design?

COMPARISON/CONCLUSION

And what where your expectation regarding your food forest?
- How much did you expect in terms of yields?

How did your expectation change over time?

Concerning food, money and ecological outputs
- Was this difference between different species, were there more important ones in mind when planning?
- Did you expect any other benefits?
  - If yes, which?
  - Did they actually happen?

APPENDIX 2: CODING FRAMEWORK

ECOLOGY
- Biodiversity
- Plant species
    - Introduced
    - Spontaneous
- Soil life
- Water

ECONOMY
- Cost
    - Education
    - Equipment
    - Fertilizer
    - Land
    - Landscaping
    - Other
    - Plant material
- Labour
    - Tasks
    - Time
- Other inputs
    - Fertilizer
    - Soil remediation
- Sales
    - Profit
    - Value chains

EXPECTATIONS
- Ecology
- Economy
- Food production
- General

FOOD PRODUCTION
- Estimates
- General
- Harvest
- Pests and diseases

GENERAL INFORMATION FOOD FOREST
- Age of food forest
- Design
- Legislation
- Prior land use
- Size
- Soil type
- Subsidies
- Water levels
- Zoning plan

GENERAL INFORMATION FOOD FORESTER
- Personal definition of a food forest
- Employment prior to starting food forest
- Goal
- Motivation

OTHER OUTPUTS

TIME
- Before starting food forest
- Beginning
- Intermediate stage
- Now

APPENDIX 3: ELEBORATION ON RESEACH QUESTIONS

What are the expectations and realities of food production in different established Dutch food forests?

This encompasses the following sub questions:

What are the histories of the selected Dutch food forests?

For the histories, we will look into aspects directly related to our main research question. More specifically, we will research the acreage, design and food production since the inception of the food forest. We also research the age and the environment in which the food forest was created.

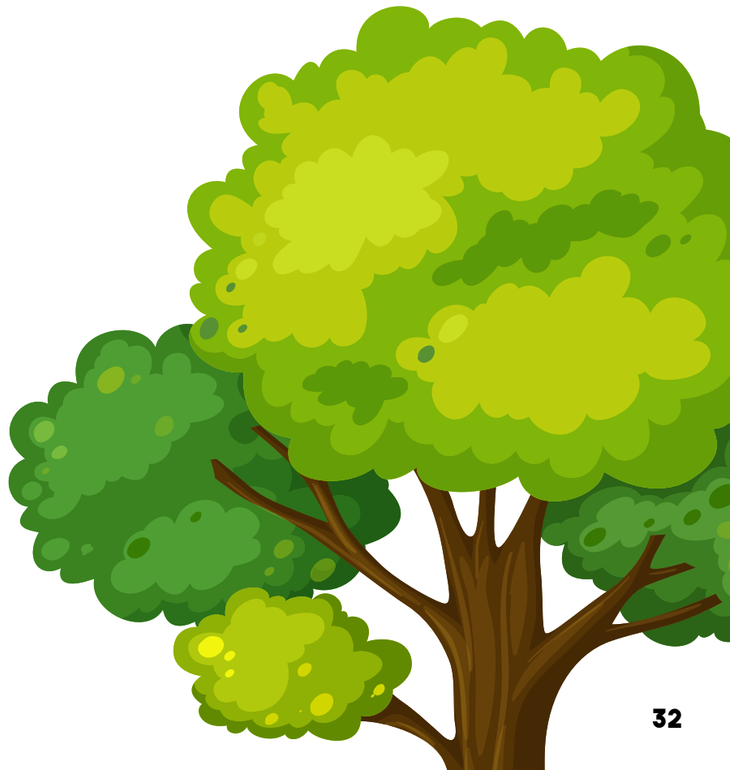
What were the expectations regarding food production since the inception of the selected food forests?

What factors made it difficult to meet expectations for food production in the selected food forests?

What are the management and design practices that could effectively promote food production in the selected food forests?

We define management practices as the intentional human interference in the food forest system. The design of the forest is the process for landscape planning, the choice of plants, and the planting scheme. Since these terms are interdependent, some processes may overlap between management and design. For this study, environmental factors will be any interference into the food forest that was not incorporated into its design or part of its management.

APPENDIX 4: GENERAL DESCRIPTIONS



DE APPELHOF

A 15 year old food forest of 0.5 hectares growing on sandy soil. Owner Yvonne manages the forest with low intensity. The food forests outputs are mainly ecological.

CHARACTERISTICS

De Appelhof is a 0.6 ha food forest, created on a sandy soil, situated on the boundary of Gelderland and Overijssel. The land is enclosed by agricultural land and forest that consist of mainly birch and pines. The land was bought in 2006 and had been left fallow for two years. Before the land was bought, it was used as agricultural land, most recently for maize production.

MOTIVATION

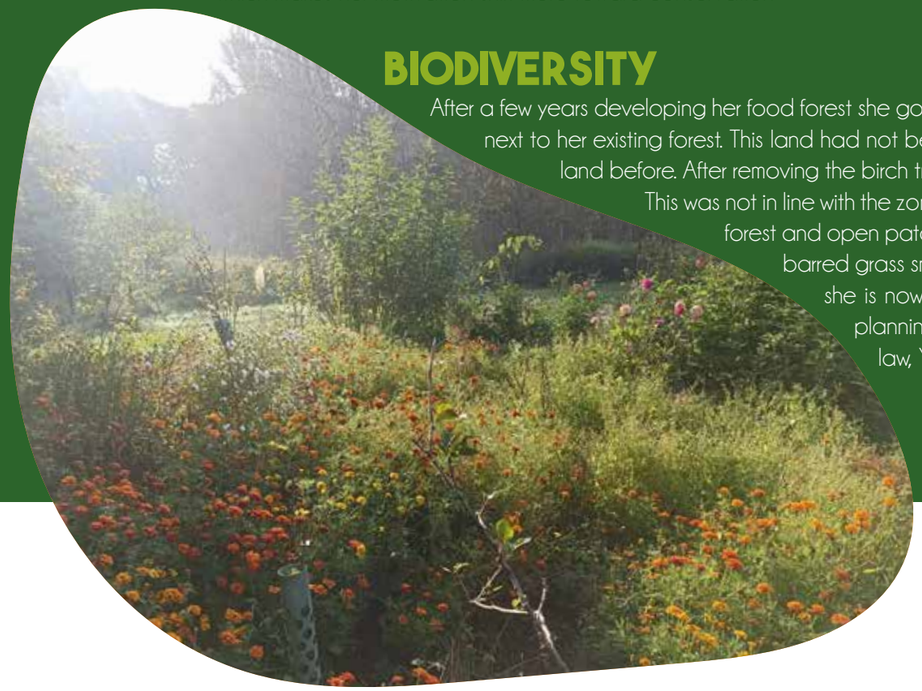
The owner of De Appelhof, who prefers to remain anonymous, will be referred to from now as Yvonne, started off using the land for the production of carrots and green beans in that same year. The following year, too many weeds started taking over the land and Yvonne decided to stop using the land solely for crop cultivation. She decided to turn her land into a food forest, with the idea that the system could maintain itself and Yvonne in her nutritional needs.

MANAGEMENT

She started her journey with no clear design but developed her view and land through the years. Starting off with cutting down trees surrounding her land to provide her new plants with the needed sunlight. However, there are still some large trees which intercept the sunlight from the lower vegetation inside Yvonne's food forest. During the first few years she received subsidies via a local agricultural nature association, 't Onderholt. "It was not much but it created possibilities" she stated. With the subsidies she planted the first trees, which happened in 2009, and created a pond. But after six years this subsidy stopped, and she had to pay all the remaining costs by herself. Yvonne expected the food forest maintenance to not require as much labour as it turned out. Time is the main limiting factor in her project and a lot of maintenance has to be done. In the beginning and during drought some plants need to be watered. To make this happen she installed a pump to get the water out of the ground. For other management practices like pruning and mowing she needs equipment, which she unfortunately cannot store on her land. The municipality does not allow her to build a shed to store her belongings, which results in equipment getting stolen or vandalized.

YIELD & PROFIT

Through the years her expectations around food production changed, Yvonne saw that her forest was not thriving as much as she expected. Overall productivity stayed low and if fruit could be harvested birds would get to it before she could. Being self-sustaining did no workout so far, calorie wise but also in the diversity of food. On the other hand, biodiversity is thriving in and around the 0.6 ha food forest, which makes her motivation shift more toward conservation



BIODIVERSITY

After a few years developing her food forest she got notified that the neighbouring land, which was owned by a friend, was for sale. She decided to buy this land that was next to her existing forest. This land had not been touched in years and was full of birch trees. This was used, like the strip of land she already possessed, as farming land before. After removing the birch trees, she got in conflict with the municipality, they saw on satellite images that a substantial part of forest was cut down. This was not in line with the zoning plan and the nature-conservation law. The law states that existing forest needs to be preserved, although her food forest and open patch attracts red list species such as the barred grass snake, several butterfly and frog species. that are on the red list like, barred grass snake, several butterfly and frog species. Which will disappear once she starts to replant the birch trees again. However, she is now obligated to replant the forest since the zoning plan was changed from agricultural land to forest. This change of planning happened without notifying her. Since fruit trees are not considered as forest according to the nature-conservation law, Yvonne is obligated to replant birch, oak or pine trees.

KETELBROEK

A 14 year old food forest of 2.4 hectares growing on clayish soil. Owner Wouter van Eck manages the forest with low intensity. The food forests outputs involve next to ecological, economical outputs and food production also educational purposes.

CHARACTERISTICS

Ketelbroek is a 2.4 ha food forest that was started in 2009 by Wouter van Eck and Pieter Jansen. Before this, the land was used for maize production. Ketelbroek is located in a valley created by glaciers during the last ice age, creating relatively fertile soil. Before starting the food forest, the location was chosen fairly carefully. The soil quality was considered, and, though Wouter admits that they didn't think of a business model beforehand, they did pick a location close to Nijmegen so that there might be a market for the food produced.

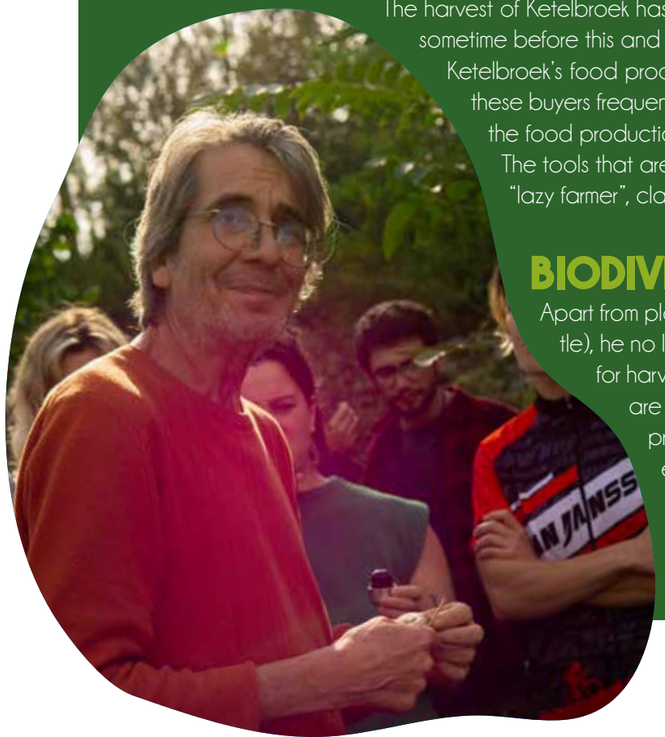
MOTIVATION

The ideas behind Ketelbroek mostly started through a project Wouter did in Kenya, where he was supposed to discover whether a more classical Western European agriculture approach would work. Instead, he was inspired by the existing systems that people used there, where people could harvest several different food varieties, such as bananas, in forest-like environments.

MANAGEMENT

In Ketelbroek, poplar and willows were used as the main pioneer species. A fairly dense row of alders was used as a windbreak in the early stages for both parts and is still present. Pioneer species were also planted to increase the soil organic matter in the food forest. These pioneers are sometimes grounded to make space for plants that are expected to produce in the future now that the forest is older. The food forest can be roughly divided in two areas, the first is maintained in such a way that it includes different succession phases in a gradient, increasing from the South-East to North-West. In this part, there is little organisation and an intense diversity of species, containing the majority of over four hunderd species present at Ketelbroek. The other part of Ketelbroek is a little smaller and has trees planted in more orderly rows. The whole of Ketelbroek is surrounded by buffer zones; these are the edges of the food forest that are not harvested and contain species that were not planted by people. The water table is relatively high throughout the food forest. Some measures were taken to lower the water table because of concerns about tap root plants (such as Diospyros kaki and Castanea sativa) getting enough oxygen underground. One of these measures was raising the land by 1,5 meters before planting to make the water table lower in relation to the trees in the main body of the food forest. In addition, ditches have been made around the food forest to improve water run-off. However, beavers have settled around the food forest and created two dams, increasing the water level. The dam's height is monitored by the owners and lowered every once in a while to maintain the water table, though Wouter mentioned that the dam has helped during recent warm and dry summers and that he has never had to water the food forest.

YIELD & PROFIT



The harvest of Ketelbroek has increased over time. When the food forest started, Wouter and Pieter didn't expect any harvests within fifteen years, but it turned out that it was possible to harvest sometime before this and after the first five years. Wouter also expressed that he is getting more harvest from his food forest then he expected when he started out. Though there is no data on Ketelbroek's food production, the harvest is sold to four parties: restaurant De Nieuwe Winkel, supermarket Ekoplaza, a craft brewery, and a catering business. Wouter communicates with these buyers frequently about harvests and they are aware of the diversity it brings. He also thought about processing the food himself when he started out, but found it better to focus on the food production because others are already specialised in processing the food. In regards to cost, Wouter and Pieter bought the land and don't have many constant expenses. The tools that are used to maintain the food forest are kept at home, close by. Even for time, Wouter says they only have half a day of work in the week. Thus, he describes himself as a "lazy farmer", claiming that they would be able to get even more harvests if they put in more work, but that this wouldn't be worth it.

BIODIVERSITY

Apart from planted species, there are also plant species that spontaneously appeared. Though Wouter mentions that they did manage some species, such as Urtica (stinging nettle), he no longer does so because they play a role in the food forest system. The paths are fairly small and people are only allowed to walk outside of the path when necessary for harvesting or the little maintenance that is still done, to avoid soil compaction. There are no measures taken to keep animals out of the food forest; birds and other animals are expected to take a part of the harvest. This was a problem in the early stages of the food forest, when most of the harvest would be lost to them. As the forest started producing more, however, the production of food increased enough to have a big enough harvest while allowing animals to eat from the forest as well. Wouter also explained that he keeps certain spontaneous plants for the animals to eat, since if he would remove them, they potentially could eat the harvest instead.

FRUITHOF DE BRAND

A 13 years old food forest of 1.1 hectares on sandy soil. Owner Sjef (and Wilma) manage the food forest part of their agroforestry system with low intensity, their boundary/annual-oriented part with higher intensity. The food forests ouputs are ecological, economical and food production.

CHARACTERISTICS

Note that the description of Fruithof de Brand is somewhat shorter than the others because we were not able to go there in person and the interview was somewhat limited in time. Fruithof de Brand is a 1.1 ha system that uses different principles of permaculture and has a relatively small food forest. It was started in 2010 by Sjef and Wilma van Dongen, the owners of the company Fruitzforlife.

MOTIVATION

The Fruithof was started because Sjef wants to use personal experience on more resilient systems like permaculture to help promote this way of farming in the Netherlands. In addition, producing his own food aligns with his view that it's beneficial to be more self-sufficient.

MANAGEMENT

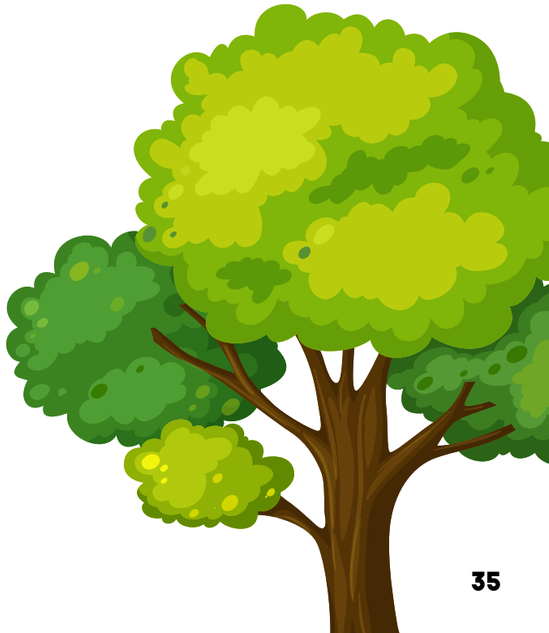
The couple is currently maintaining Fruithof de Brand with the help of family. Their company sells tree species for planting in food forests and other agroforestry projects, as well as volcanic dust and compost for soils. Sjef also mentions that he stays in touch with clients and gives advice to make sure their products are used well.
To improve plant growth from the start they added rockdust to the soil. Pioneer species and food producing trees were both planted at the start of the project, which Sjef believes is the right call in general because there is a sense of urgency to produce more sustainable food. Pioneer trees are pruned or killed off to make space for food producing trees.

YIELD & PROFIT

The most common producing tree in the food forest are chestnut trees. He sells the produced food to the other parents at the school that his children go to. Though the food does not have an organic label, he says this is not necessary because the buyers there know that he produces them in an organic manner, so he can sell them for the appropriate price. However, he does mention that the produce from the food forest is not the focus of the Fruithof, and that he gets his main produce from the systems at the edges of the food forest.

BIODIVERSITY

In regards to biodiversity, Sjef mentions that he saw both an increase in biodiversity in the food forest and the systems at its edges. When asked how biodiversity changed over time in his systems, he said that the biodiversity comes back naturally, and that it's really the food and money that require the effort.



DE VOEDSELBOSS

A romantic 12 year old food forest of 0.4 hectares growing on sandy soil. Owner Martijn manages this forest with low intensity. The food forests outputs are ecological and food production for his household. And he has a 3 year old production-oriented food forest of 0.3 hectares on sandy soil. He manages this with high intensity. These main outputs are educational, ecological and food production.

MOTIVATION

Martijn Aalbrecht's food forest journey started with the birth of his two daughters. The main motivation behind producing his own food started with the values he wanted to raise his children with. He wants to show them where our food comes from, how it is produced, and that food is not simply bought in the supermarket. Beside that he also wanted to produce food and get nutritional values that normally cannot be bought in the supermarket.

CHARACTERISTICS

With this idea he placed an advertisement online saying he was in search for a patch of land. At the end of 2011 he bought a plot of land, spanning 0.4 hectares. Martijn started developing right away but had little experience with creating or designing a food forest.

MANAGEMENT

He decided to follow different courses from various experienced food foresters through the years, but all outside the Netherlands since there were no experienced practitioners here. Martin Crawford, an English food forester, helped him with the design of his forest. Martijn had to start from the beginning, saying that he had to learn how nature works and how the processes in an ecosystem are linked to each other. This came with making a lot of mistakes in his project, but he also learned from it and now uses this in his advantage by teaching new food foresters on how to make a better start. Martijn says he is a bit unlucky with his soil since the first two meters are sandy soils, after that a seventy-meter-deep clay layer makes sure the water stays trapped in winter when it rains a lot. But during summer when the water sinks through the clay, a water shortage appears since most of the plant roots are in the sand. To counter the water problem in winter he made a drainage and planted the nut trees on a small slope. Organic matter in the soil improved over time, so during summer more water stays trapped and that helps the plants against drought.

Martijn's vision is very clear, planting a food forest is not a natural process and because of that management is crucial. Especially in the beginning when young trees are vulnerable and lacking reserves for growth. At the start he therefore helps the plants in the first few years. When planting the new trees, shrubs and perennials he soaks their roots in a mycorrhiza-nutrient solution, to give them a boosted start in their new soil. Beside that he also uses basalt to provide the soil with the needed minerals. These two things are important since most lands that are bought for planting a food forest don't have the microbiome and nutrients in the soil to support a forest. This is why he thinks it is necessary the first few years to speed up the process. Establishing such a microbiome, sufficient organic matter and nutrients is also possible by planting pioneer species, but most people do not have time for this he says. Once the forest went through that starting phase Martijn also thinks that in the end a food forest is a system that regulates itself and fulfils different functions.

During the start of his food forest, he had the advantage that we had some wet summers here in the Netherlands, so he didn't have to put any effort into irrigation. Most labour went into designing, preparing and planting the forest. After that, he spent most of his time in the forest removing weeds, observing and asking himself questions on why certain plants did better than others or if his plants are being pollinated or not. After planting the perennial herb layer, he had to put in more time maintaining the plants, since he saw that they got overgrown by other plants very fast. During this time Martijn still had his job, so the time spent in the forest was limited.

YIELD & PROFIT

The first seven years were the worst, Martijn was even thinking about quitting since his food forest was not thriving or producing. But after those seven years his food forest slowly started to flourish and he can now almost sustain his family with fruit and vegetables year-round. The positive development of his food forest resulted in him making his job out of his hobby. He consults and gives courses to new food foresters with all the lessons he has learned and is still learning. This makes him financially independent so he quit his job and can now fully focus on the food forest. Three years ago, he established an 0,3-ha food forest with a commercial setup. His motivation on this was that he wants to teach and consult people on how to start and maintain a commercial forest. "How do I teach people about a commercial forest, if I don't have one myself" Martijn says.

DEN FOOD BOSCH

A 6 years old food forest of 0.8 hectares growing on sandy soil. Co-manager Marente & volunteers manage the food forest with high intensity. The food forests outputs are community-engagement, ecological, economical, and food production.

CHARACTERISTICS

The food forest, which is 0.8 ha, is established on sandy soils. The piece of land, on which Den Food Bosch is built, is owned by the local waterboard, Waterschap de Dommel. The first five years were free of charge, as it was seen as an ecosystem service. They are interested how the water holding capacity changed during the project.

MOTIVATION

The idea of starting the food forest was developed by two students of the HAS as a graduation project in 2016. However, these two students are graduated and moved back to their home country. The food forest is now maintained by six to eight volunteers on a weekly basis.

MANAGEMENT

The volunteers work every Friday morning three to four hours to keep the forest in shape, harvest what can be harvested and talk with a chef who buys their products. But they also get a lot of attention from students who want to interview them and other people that just want to know about the place and take pictures. Marente has been a volunteer for two years now, and was eager to tell us everything about the food forest. At the start they received subsidies from the AgriFood capital, this was used for planting the trees, shrubs and annuals. The first two years annuals were planted in the system to have harvest and generate an income from the start while waiting for the perennials and trees to grow.
Marente says that compared to other food forests a lot of labour is put in this particular forest because a syntropic method is used. Pruning happens on a regular basis to improve the growth and productivity of the plants and the organic matter in the soil, since all the cuttings will be left in the forest. This also benefits the surrounding plants since they are able to catch more light once bigger scrubs and trees are pruned.

YIELD & PROFIT

Now, after six years, they sell a lot of products to a chef, Martin, which generates a small income for the forest. The money is used to pay the rent, since the five year agreement with the waterboard is over, for maintenance, to buy tools and provide courses for the volunteers, to further develop the knowledge and skills. In short, they re-invest the money into the forest.

BIODIVERSITY

The forest also has an educational purpose, they work closely with the national monitoring program. These collaborations give them also data on what is happening in the soil. Each month they organise a tour through the forest which are popularly visited and fully booked every time. People get to know what processes are going on in the forest and what outputs there are.
The food forest started out with twelve rows of food producing plants, while the design that was made for the food forest twenty years later just exist of six rows. They designed it in such a way to account for the fully grown nut trees, therefore the other plants needs to make space for them. But in practice it is not sure if the trees will grow that big.
Further, we don't know how the labour improves the system, since there is no real data or study on in this climate. We cannot say for sure if we experience a positive or negative trade-off with ecological drivers. The processes are there but are just speed up since you plant the species and regulate the succession phases instead of waiting for them to naturally occur. But Marente and the volunteers are convinced that it is fun, and they are really engaged with the forest. Their motto is what you put into it, is what you get out of it.

A 5 year old food forest of 2.5 hectares growing on sandy soil. Owner Leon manages the forest with low intensity. The food forests outputs are community-engagement and ecological. In the future this will hopefully become economical and food production too.

KATTENBERGSEBROEK

CHARACTERISTICS

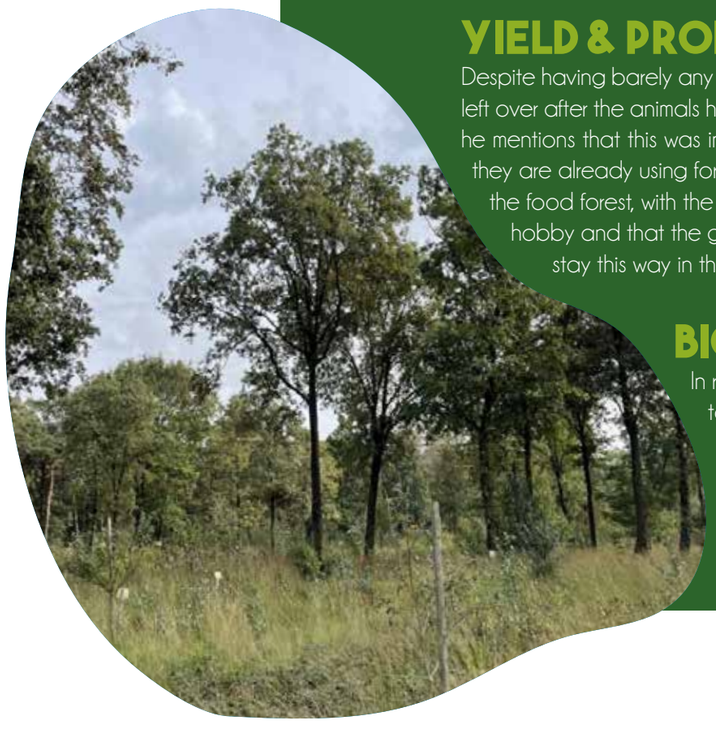
The food forest of Kattenbergsebroek is 2.5 ha large and used to be a mixed forest. It's the property of Leon and Petra, who were dairy farmers until 2011. After selling their dairy farm, they started focusing more on sustainable agriculture.

MOTIVATION

We interviewed Leon, he told us they were inspired by Ketelbroek and wanted to find a similar way to give more room to nature, and the same time get nutritional value from it. In the end they are sure that they would make some money out of it, but at this point they are not sure in which way yet.

MANAGEMENT

The first planting of food production trees was done in 2018, according to the design of Jan de Vries, which makes it the second youngest food forest that we investigated. Kattenbergsebroek has broad paths that are mowed with tall grasses and herbs covering the rest of the forest floor. A chicken coup is placed in the food forest, from which the chickens can roam freely. Most of the area is shaded by oak trees that were already present in the old mixed forest. The soil is fairly acidic because of the trees, Leon says. To combat this, they add calcium to the soil. They also add fertiliser every year to promote the growth of the trees as well. Leon mentions that he has no intention of creating further succession phases in his food forest because he already started with an older forest. This means that he has not had to plant any pioneer species and has focused on planting food producing species. He has planted these throughout the years since 2018 and tries to plant a large variety. However, a lot of trees were lost due to damage by deer. This has made them put a fence around the food forest to keep the deer out. Still, he acknowledges that he expects animals to take part of the harvest as well.



YIELD & PROFIT

Despite having barely any food production yet, Leon says that he expected this to be the case. He predicts that once the food forest produces larger quantities that there will be more food left over after the animals have taken their share. Leon acknowledges that he would have planted the trees more orderly if he would have created it for commercial food production. However, he mentions that this was indeed not his goal and doesn't plan to harvest the food by himself. Instead, in the future people will be able to come by for a fee and pick food, a system that they are already using for their allotment garden. This way, he doesn't expect to invest time in harvesting and still use his food production effectively. They also rent accommodations next to the food forest, with the food forest being accessible by those people and used as a large selling point, which does generate sizeable income. However, Leon says it mostly started as a hobby and that the goal of the food forest was never to generate a large profit, and that the food production from the forest is the least profitable revenue for now. He expects this to stay this way in the future.

BIODIVERSITY

In regards to biodiversity, Leon mentions that he expected to see animals appear when he started out this food forest. He says he notices the increase of biodiversity too in the number of birds and insects that visit Kattenbergsebroek, and that his guests are very appreciative of the nature as well.

VOEDSELBOS BAARLE-NASSAU

A 2 year old food forest of 4+ hectares growing on sandy soil. Owner Nicolaas manages the forest with low intensity. The food forest outputs will in the future hopefully comprise of ecological, economical outputs and food production.

CHARACTERISTICS

Before being designated for food forestry, the land of 6.3 ha was used by a farmer as organic cow pasture. Currently, about 3 to 4 ha have been planted, with the rest being planned for planting in the coming years. These were saved for later to also learn from the previous plantings. The area has roughly thirty to forty centimetres of black soil and is quite rich in nutrients. Now, the land has been divided into different sections with broad paths running through it. The water table is quite high, but droughts still impact the growth of the food forest. Nicolaas thinks that about three years ago few food foresters would have watered their land, but that the recent droughts have changed this mindset and more people have started watering during droughts.

MOTIVATION

The food forest is an initiative by Nicolaas Geijer, and he maintains it together with biologist and partner Marcia Arredondo, and family members. The design was made by Nicolaas, Jan Hein Ruijgrok, and Peter van Oort. Nicolaas has also done a thesis project on food forestry (Geijer, 2023), although these are not linked to each other. Baarle-Nassau is the youngest food forest system that we have included in our case studies; the first planting took place in 2021. Nicolaas started this project to show that food forests are commercially viable because they believe food forests are a good option to produce food while leaving room for nature.

MANAGEMENT

About four thousand pioneer plants were planted throughout the food forest, with some forming a fairly thick windbreak in the middle of the land to make sure that a large part of his food forest is sheltered from the wind. The food producing trees are mostly planted in rows to enable easier harvesting when they start producing. The growth of the trees is aided by spreading wood chips around the base, which holds some moisture during droughts and keeps grasses at bay a little. Most food producing trees are also protected with a simple tree guard that can be removed later. These help somewhat against the deer that are prevalent in the area, though does not completely prevent them from biting the young trees. This has killed a few trees already, mostly when deer have eaten the buds. However, others are still surviving with the damage.

YIELD & PROFIT

Nicolaas mentioned they had some harvests already, but described it as handfuls. When he saw his first harvest in 2022, he figured there might be a significant increase this year, in 2023. However, it seems that both harvests are pretty comparable to one another, and expressed that he figured he needed to be more patient. Currently, he expects to have a sizeable harvest in about nine to fourteen years time. Although he is not selling any harvest yet, he has thought about potential value chains. A large number of his trees are planted that he expects there to be a market for, such as cider apples and chestnuts. They also planted some trees that Nicolaas figures might be harder to sell the harvest of, but he says is worth the investment because of the low cost of planting them.

In regards to other costs, he mentioned that there was a large investment to get started, but that there are few continuous costs. The trees appear to be the largest continuous investment, since there is still quite a bit of planting required. As for the land, he has a long term lease contract with the province that costs him nothing for the moment. The project was also subsidized by Stichting Voedselbosbouw Nederland and a CO_2 compensation fund.

BIODIVERSITY

As for biodiversity, Nicolaas mentions that he expects that to increase and that he can already notice animals being attracted to his plot. Plants that were already present or started appearing spontaneously since buying the land are kept. Grasses in particular are expected to slowly become less prominent as the food forest establishes itself, with herbs taking over more and more.