Voedselbossen Zuidoost-Nederland

Food Forest business models

Project report

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Prologue

As students in the 21th century in the area of agriculture, we question our current food production system and its drivers. Due to the degrading effect our current food production system has on our environment, we ask ourselves how food production systems can be made sustainable and resilient for future generations. Agroecological farming systems, which include food forestry, are presented as an option. Agroecology is based on the application of ecology to food and agricultural systems and focusses on climate resilience, an important aspect of environmental sustainability. However, there is hesitance to apply these systems as they are perceived to be less productive and thus, less profitable.

The question whether an agroecological farming system can feed the growing world population, seems to be the wrong question. We should shift our intention towards the values a farming system is producing and the impact it has on, not only on ourselves but also on the environment and the community. If we want to create a sustainable farming system, we need to look behind the value that feeds the market in a broader sense.

Ontology defines two concepts in which humans can look upon nature. The first view on nature is the ´human-centered´ concept, where the human is governing nature and valuing it for its´ resources. This concept is strongly dominating current activities related to food production and our environment and has led to a range of problems such as land degradation, depletion of natural resources, extinction of species and poverty. In contrast, the second concept is defined as the ´life-centered´ concept of nature. This concept considers all life is as equal and recognizes the human as being part of the interconnected web of life.

Profitability should not be a main driver, providing nutrition and health should. However, this does not mean that the profit of a farming system is of less importance, but it means that the social and the natural value must be reconsidered to create a sound food production system that is sustainable on all three fronts; social, environmental and monetarily. It requires reconsideration of the way we look at agriculture: from valuing nature only for the resources it produces, to a life-centered, integrational approach in which people can coexist with nature.

A farming system that sees ecological science and the 'life-centered' concept as an intrinsic part of the food production process seems to have potential for the future. Current agriculture relies on the same processes, but lost connection to them and thus influence. The question arises on how we can shift from our current industrial farming system to a farming system that values nature and the people that coexist with it.

In this line of thought we want to contribute to the development of agroecological farming systems, in which we present a food forest as an alternative business case to current farming systems. During the process of 6 months, we have researched food forests in the Dutch agricultural landscape.

Acknowledgements

While writing this thesis research, we received a great deal of support from several entrepreneurs, teachers and colleagues. First of all, we would like to thank our supervisor Rolf Kerkhof-Mogot for his support and guidance. It was through the discussions in our weekly thesis meetings that we were able to give this research the depth it has. Also, by weekly discussions, we were able to develop a broad understanding of the matter on a conceptual level. Also for this, Rolfs' attitude contributed a lot.

Furthermore, we would like to thank Stichting Phien and Voedselbosbouw Nederland for supplying us with the information needed to form the two case studies. Also, both were very open and it was through their openness that we were able to form two very complete case studies.

Next to them, we would like to thank the countless interviewees that were used in the chapter to describe the potential of food forests in our temperate climate. All of them showed us a unique business and provided us with inspiration to write the research.

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Roy Doomen, Benjamin van Leeuwen, Leonie Puhe

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Executive Summary

A food forest is a food production system that mimics natural ecosystems, which creates a resilient system. Based on ecological values food forests show potential, but in produced capital, the food forest is not more promising than a maize farm on a timeframe of 0-20 years. However, the research has shown that on a longer timeframe, the food forest shows potential to be a successful business case, based on the following arguments:

Firstly, food forests show a higher rentability per hectare per year than a conventional agricultural production system. However, this rentability only reaches stability after 20 years; there is a negative cash flow in the period of 0-20 years. Still, the rentability of a standardized and simplified food forest (€6,300 ha/year) is considerably higher than potatoes (€3885), strawberries (€2723) or maize (€908).

Secondly, attention should be paid to the sales-side. Agricultural price level won't yield a viable business case and steering towards a premium price level is advisable. Attention should be given to short chains, as the quantity and fluctuating supply are undesirable for supermarket chains. Also, communication of added value is easier in short chains.

Furthermore, in a food forest, there is the possibility to diversify revenues streams to an extent where social, nature and produced value can all be a contributing to the farmers' income. The added value created in the social and nature quadrant can be paid for by consumers.

More labor is needed in a food forest (544 hours) than conventional maize cultivation (7.7 hours). However, labor spread is much more even in the food forest. Next to stability, another factor is the knowledge-intensive approach of the food forest and the lack of data negatively correlates to this.

Applicability & scalability

Applicability of the system on the farm level depends on rentability and scalability. Rentability of a food forest system is higher than common agricultural crops. In a sensitivity analysis, it was found that price level is a determining factor. The price level can be managed by establishing a higher margin for the farmer, for example by using a short chain. Design and labor need are also key influencers on the rentability, and a labor-efficient design might even yield higher rentability. The business case might also yield income out of diversification, for example by providing a place for tours or workshops. The food forest is an interesting opportunity for entrepreneurs that have a stable private equity as interest is a factor in the profitability.

Scalability is depending on cash flow, labor- and risk management. The research showed that the cash flow in the first years is considerably negative and demands a loan for which interest is paid. Also, there is currently little mechanization in the food forest and high demand for labor. One food forest farmer was estimated to be able to manage 2 hectares, where a farmer of maize can manage 95 hectares. Risk is managed by improving the rentability, expanding the system step-wise or using alternative ways of financing. Based on these the optimal scale for a productive food forest is 10Ha, however, as diversification of the company it is also promising.

Research methodology

Temperate climate food forestry in the Netherlands is slowly attempting to surpass the pioneering phase. This research seeks to address the financial, but also the social, natural and individual value of the system and to validate claims on the proposed value of food forests. Furthermore, it includes practical examples and possibilities for an entrepreneur considering starting a food forest. The main research question was formulated as follows:

What could be a successful business case for a temperate climate Food Forest in the Netherlands?

The research describes how a food forest can fit into the Dutch future food system and what ongoing trends and possibilities there are for a food forest. After these, two case studies (Food Forest Schijndel and a food forest by Phien) are described and analyzed using the transformative business model, in which the value proposition is placed central. Next to this, the theory of the four environmental capitals (individual, natural, produced and social capital) has been used to capture the performance of a food forest on more than just the economic side. Furthermore, the same theory has been used to compare both case studies to a conventional farming system that will show how a food forest performs in relation to other food production systems. The research is concluded with recommendations and how the principles of food forestry can be applied on the farm level.

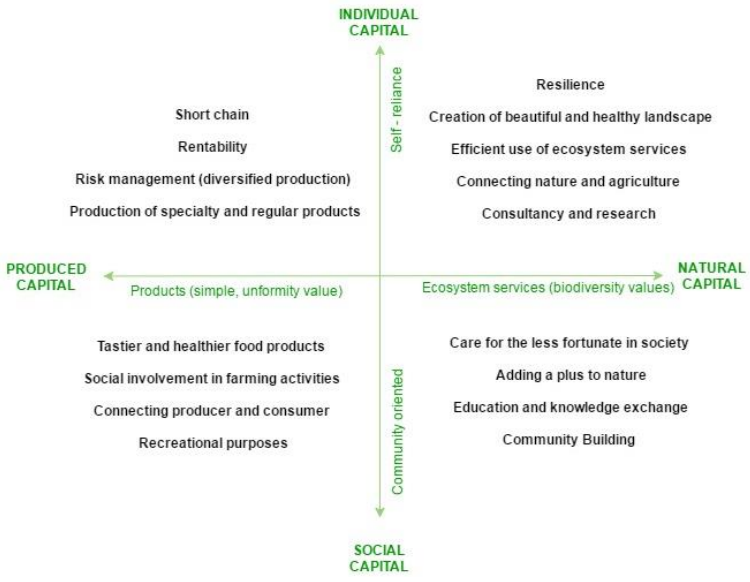
Food forests in the Dutch agri-food sector

The agricultural sector has a total area of 1.7 million hectares, which has seen a decrease of 10% from 2000 to 2018. The average number of hectares of an agricultural company is 32.8, which has seen a 60% increase in the same period. The current agricultural sector is characterized by specialized, highly mechanized cultivation of products on a large scale and cost reduction. Food forests are currently only seen operating on a small scale, with an acreage of labor 150 hectares in the Netherlands. There is not a lot of data available on the economic performance of the system. The current commercial food forests are mainly operating in local markets. Self-sufficiency can also be a goal of the food forest.

There are several trends that are challenging the current agricultural landscape. On a global level, there is climate change and scarcity of resources the most important trends. On a consumer level, the most important trends are increasing consumer awareness and transparency & traceability. The food forest fills the niche of an efficient, inclusive, resilient food production system. In this system, the land is regenerated, biodiversity is created, and new and innovative food products are grown.

The value proposition of a food forest is summarized as a collection of different values. Important values scored on how they act on capitals can be seen in the graph:

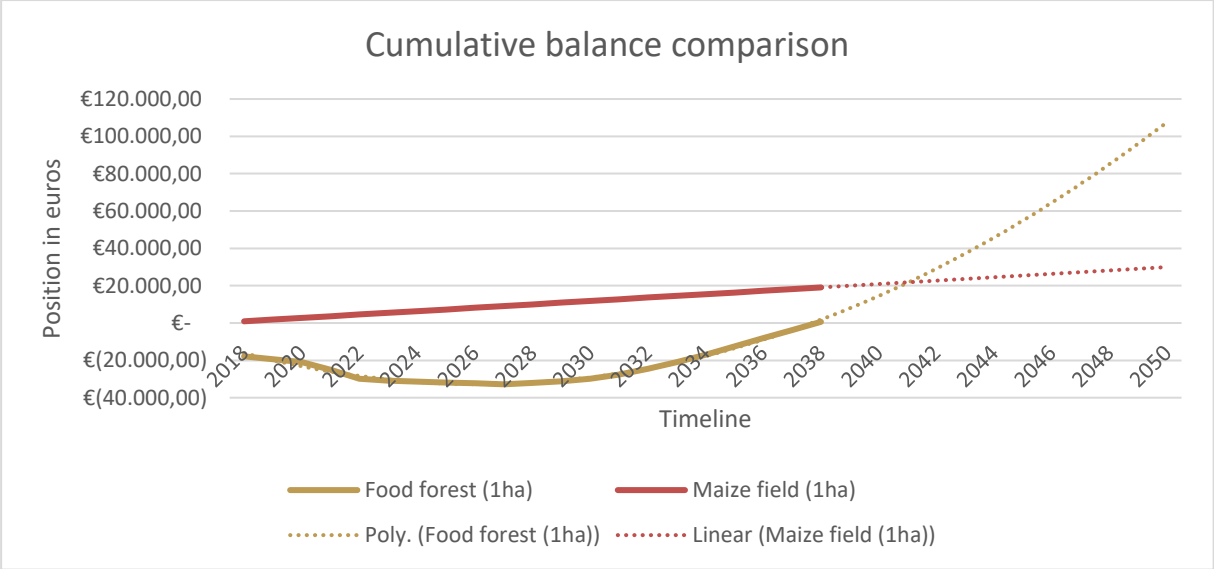
A food forest supply chain should be built on trust and linkage and short chains are considered essential to communicate the added value created in a food forest. Products and services in the food forest depend on the value proposition: when the emphasis is on nature value, the food forest will be most diverse. Self-sufficiency can also be a goal of the food forest.



Regarding the valuation, the highest investments of the food forest are land and labor. A difficulty for many entrepreneurs is the long timespan the food forest takes to reach economic production. When wholesale prices are followed, it will take 20 years until the investment is earned back. However, when a supermarket price is yielded for the products, it will only take 7 years to reach the return of investment. When an agricultural price is calculated, the food forest shows a rentability of €525 ha/year, yet combined more labor needed or higher price for labor, the rentability is negative, respectively -€1915 and -€423.

Comparison

The two examples were compared based on social cost-benefit analysis (SCBA). The balance comparison shows effectively that natural capital is much larger in a food forest. However, on produced capital, the maize farmer has a higher cumulative balance on the timeframe of 0-24 years, as can be seen in the figure.



The applicability on the farm level depends on two factors: rentability and scalability. The rentability in of a standard food forest is higher per hectare than maize or potatoes. The profitability of a food forest can be influenced by short chain application, design and price level. These are all factors a food forest can use to increase the rentability.

Food forestry show potential from the perspective of climate change; this will most likely affect arable farmers. Due to changing stakeholder values, the current agricultural system will see lessening support. The food forest will see more support, as they are acting on global challenges. A system where added value is paid for can be formed where also non-monetary values created by the food forest can be monetized. Also, on the consumer side, values are changing. The food forests respond to this by supplying nutritious sustainably-farmed food from a transparent and traceable chain.

Dutch executive summary

Een voedselbos is een voedselproductiesysteem dat natuurlijke ecosystemen imiteert, waardoor een weerbaar systeem ontstaat. Op basis van natuurwaarde hebben voedselbossen potentie, echter in geproduceerde waarde is het voedselbos niet veelbelovender dan een maïsbedrijf binnen een termijn van 0-20 jaar. Het onderzoek heeft aangetoond dat voedselbosbouw op een langere termijn potentie heeft om een succesvolle businesscase te zijn, gebaseerd op de volgende bevindingen:

Allereest vertonen voedselbossen een hogere rentabiliteit per hectare per jaar dan een conventioneel landbouwproductiesysteem doet. Deze rentabiliteit wordt echter pas na 20 jaar stabiel; een negatieve kasstroom wordt gecreëerd in de periode van 0-20 jaar. Toch is de rentabiliteit van een gestandaardiseerd en vereenvoudigd voedselbos (€6.300 ha/jaar) aanzienlijk hoger dan van aardappelen (€3885), aardbeien (€2723) of maïs (€908).

Ten tweede, aandacht voor de verkoopkant is essentieel. Een agrarisch prijsniveau zal geen levensvatbare businesscase maken, en sturing naar premiumprijzen is wenselijk. Aandacht moet worden gegeven aan korte ketens, omdat de kwantiteit en het fluctuerende aanbod onaantrekkelijk zijn voor supermarktketens. Ook kan toegevoegde waarde gemakkelijker worden gecommuniceerd in een korte keten.

Ook creëert een voedselbos de mogelijkheid om inkomstenstromen te diversifiëren tot een mate waarin sociale, natuurlijke en geproduceerde waarde allemaal bijdragen aan het inkomen van de voedselbosboer. Opbrengst uit nevenactiviteiten zorgt voor een kortere terugverdientijd. De meerwaarde die wordt gecreëerd in het sociale en natuur kwadrant kan door de consument worden betaald als toegevoegde waarde.

Ten slotte, heeft een voedselbos een grotere arbeidsbehoefte (544 uur) dan conventionele maïsteelt (7,7 uur). De arbeidsverspreiding in het voedselbos is echter veel stabieler. Naast stabiliteit is de kennisintensieve benadering van het voedselbos ook een meespelende factor. Het gebrek aan gegevens correleert hier negatief mee.

Toepasbaarheid en opschaalbaarheid

Toepasbaarheid van het systeem op bedrijfsniveau is afhankelijk van rentabiliteit en opschaalbaarheid. De rentabiliteit van een voedselbossysteem is hoger dan bij veelvoorkomende landbouwgewassen. In een gevoeligheidsanalyse werd vastgesteld dat het prijsniveau een bepalende factor is. Prijsniveau kan worden beïnvloed door een hogere marge voor de boer te realiseren, bijvoorbeeld door middel van een korte-keten concept. Ontwerp en arbeidsbehoefte hebben ook een hogere invloed op de winstgevendheid, een arbeidsefficiënt ontwerp kan een hogere rentabiliteit opleveren. De businesscase biedt ook mogelijkheden om inkomsten te genereren door diversificatie, bijvoorbeeld door een plek te bieden voor tours of workshops. Het voedselbos biedt een kans voor ondernemers met een stabiel eigen vermogen. Doordat betaalde rente ook van grote invloed is op de casussen, geven andere financieringsmogelijkheden met een lagere rente grote voordelen.

Opschaalbaarheid is afhankelijk van cashflow, arbeids- en risicobeheer. Uit het onderzoek is gebleken dat de cashflow in de eerste jaren negatief is en het nodig maakt een lening af te sluiten, waarvoor rente moet worden betaald. Door de lage mechanisatiegraad op dit moment, is veel arbeid nodig. Eén voedselbosboer kan ongeveer 2 hectare beheren, waar een maïsboer 95 hectare kan beheren. Risico's worden opgevangen door de winstgevendheid te verbeteren, het systeem stapsgewijs uit te breiden of alternatieve financieringswijzen te gebruiken. Op basis van deze parameters is de optimale schaal voor een productief voedselbos 10 Ha, maar ook als 'verbreding' op het bestaande bedrijf is het veelbelovend.

Onderzoeksmethode

Voedselbosbouw in Nederland komt langzaam uit de pioniersfase te komen. Dit onderzoek tracht de financiële, maar ook sociale, natuurlijke en individuele waarde van het systeem te analyseren. Zo kunnen voorgestelde claims over de waarde worden gevalideerd. Verder bevat het praktische voorbeelden en beschrijft het mogelijkheden voor een ondernemer die overweegt een voedselbos te beginnen. De onderzoeksvraag luidt als volgt:

Hoe ziet een succesvolle businesscase voor voedselbos in een gematigd klimaat in Nederland eruit?

Dit onderzoek beschrijft hoe een voedselbos kan passen in het toekomstige Nederlandse voedselsysteem en welke trends en mogelijkheden ervoor het voedselbos zijn. Hierna zullen twee casussen (Voedselbos Schijndel en een voedselbos van Phien) worden beschreven en worden geanalyseerd met behulp van het trans formatieve bedrijfsmodel en de vier kapitalen (geproduceerde, individuele, natuurlijke en sociale kapitaal) voor leefmilieu. Bovendien zullen beide casussen worden vergeleken met een conventioneel landbouwsysteem dat laat zien hoe beiden presteren in relatie tot andere voedselproductiesystemen. Het onderzoek wordt afgesloten met aanbevelingen hoe de principes van voedselbosbouw op bedrijfsniveau toegepast kunnen worden.

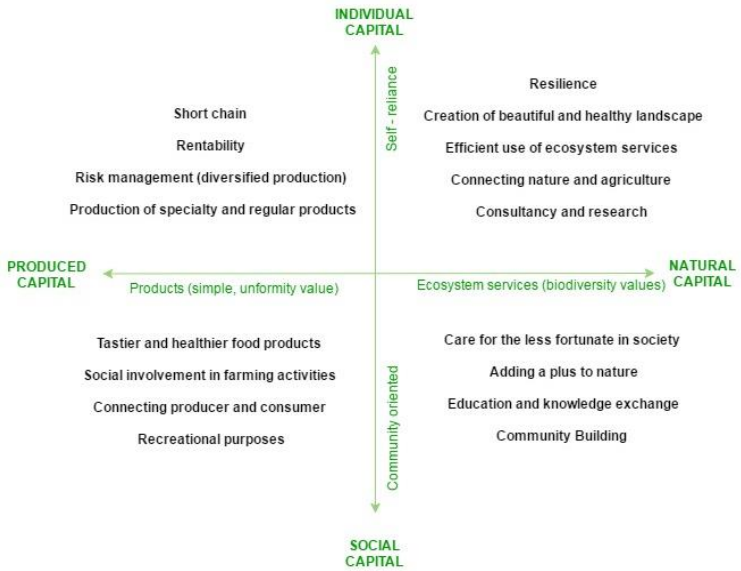
Voedselbossen in Nederland

De landbouwsector heeft een totaal oppervlak van 1,7 miljoen hectare, welke in de periode van 2000 tot 2018 met 10% is gedaald. De gemiddelde grootte van een landbouwbedrijf is 32,8 hectare, een getal wat in dezelfde periode met 60% is gestegen. De huidige agrarische sector wordt gekenmerkt door een gespecialiseerde, sterk gemechaniseerde teelt van producten op grote schaal waar kostenbesparing een belangrijke rol speelt.

Huidige voedselbossen worden gekenmerkt door een kleine schaal, met een oppervlakte van ongeveer 150 hectare in Nederland. Op dit moment ontbreken echter beschikbare gegevens over het economisch functioneren van het systeem. De huidige commerciële voedselbossen zijn voornamelijk actief in lokale markten. Zelfvoorziening kan ook een doel van het voedselbos zijn.

Het huidige agrarische landschap wordt door meerdere trends uitgedaagd. Op mondiale schaal zijn klimaatverandering en schaarste van middelen van het grootste belang. Op het niveau van de consument zijn de belangrijkste trends het groeiende consumentenbewustzijn, transparantie en traceerbaarheid. Het voedselbos vult de niche van een efficiënt, inclusief, veerkrachtig voedselproductiesysteem. In dit systeem wordt grond geregenereerd, biodiversiteit gecreëerd en nieuwe en innovatieve voedingsproducten verbouwd.

Producten en diensten die in het voedselbos worden gecreëerd zijn afhankelijk van de waarde propositie: wanneer de nadruk ligt op natuurwaarde, zal het voedselbos het meest divers zijn. Zelfvoorziening kan ook een doel van het voedselbos zijn. Een keten voor voedselproductie moet gebaseerd worden op vertrouwen en communicatie; korte ketens worden als essentieel beschouwd om de toegevoegde waarde van een voedselbos te communiceren.

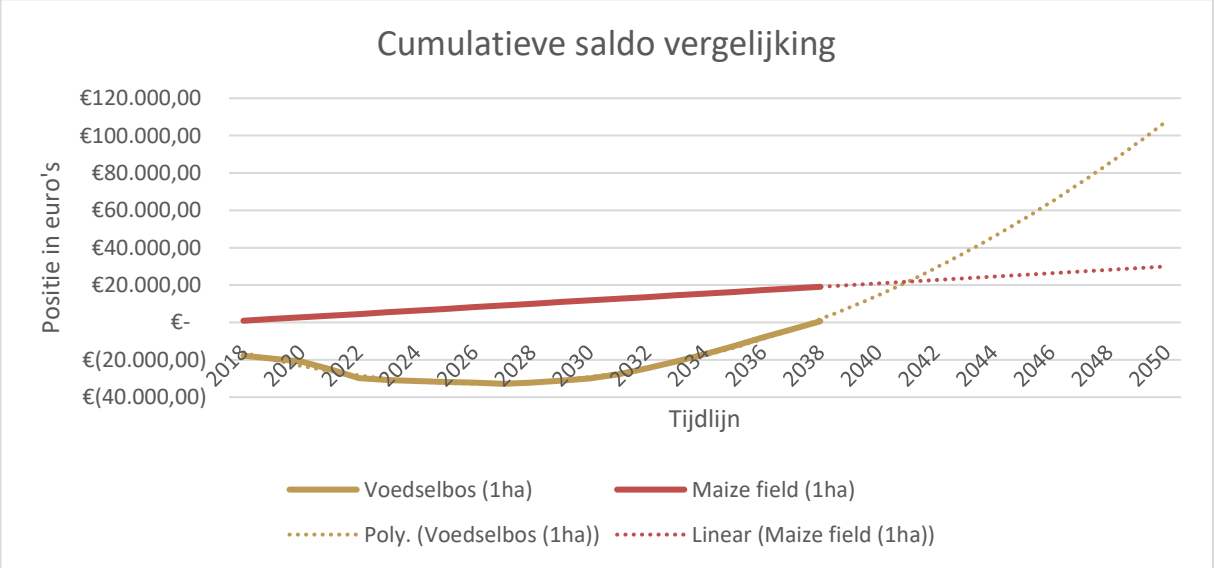


De waarde propositie van een voedselbos is samengevat in een verzameling van verschillende waarden. Belangrijke waarden, gescoord hoe ze op de verschillende kapitalen reageren zijn te zien in de figuur.

Wat het verdienmodel betreft zijn de grootste investeringen van het voedselbos land, plantopstand en arbeid. Een probleem voor veel ondernemers is de lange tijd die het voedselbos nodig heeft om economische productie te bereiken. Wanneer groothandelsprijzen worden gehanteerd, duurt het 20 jaar voordat de investering is terugverdiend. Wanneer een supermarktprijs voor de producten wordt gehanteerd, duurt het 7 jaar voordat rendement op de investering is bereikt. Wanneer een landbouwprijs wordt gehanteerd, toont het voedselbos een rentabiliteit van € 525 ha / jaar, maar gecombineerd met een hogere vraag naar arbeid of een hogere prijs voor arbeid is de rentabiliteit negatief, namelijk -€1915 en -€423.

Vergelijking

De twee casussen werden vergeleken op basis van een maatschappelijke kosten-batenanalyse (MKBA). De balans laat zien dat natuurlijk kapitaal veel groter is in een voedselbos. Op geproduceerd kapitaal heeft de maïsboer een hoger cumulatieve balans op een tijdschaal van 0-24 jaar, zoals te zien in de volgende figuur.



De toepasbaarheid op bedrijfsniveau is afhankelijk van twee factoren: rentabiliteit en opschaalbaarheid. De rentabiliteit van een standaard voedselbos is hoger per hectare dan maïs of aardappelen. De winstgevendheid van een voedselbos kan wordt beïnvloed door toepassing van korte ketens, ontwerp en prijsniveau. Dit zijn factoren die een voedselbos kan gebruiken om de rentabiliteit te vergroten.

Voedselbosbouw vanuit het perspectief van klimaatverandering biedt kansen; dit zal akkerbouwers treffen. Vanwege veranderende waarden van stakeholders zal het huidige landbouwsysteem minder steun krijgen. Voedselbosbouw zal meer steun krijgen omdat het meewerkt aan mondiale uitdagingen. In de toekomst kan een systeem voor betaling worden gevormd waarin ook waarden die door het voedselbos worden gecreëerd, die huidig nog geen inkomen verwerven, kunnen worden omgezet in inkomen. Ook aan de consumentzijde veranderen waardes. Voedselbossen reageren hierop door voedzaam, duurzaam gekweekt voedsel te leveren vanuit een transparante en traceerbare keten.

1 Introduction

The EU recognizes that industrial agriculture has impact on climate change. Industrial agriculture is responsible for increased CO2 emissions, due to soil disturbances and the use of agrochemicals. More people start to see that no matter how much more efficient we make our agricultural system; system change is what we need for our food production to become fully environmentally sustainable.

A food forest is an agricultural production system that mimics structural and functional relations in natural ecosystems and beneficial interactions that preserve ecosystem services. The ecological functions of the various plant species are used in an intelligent way to create a resilient food-producing system. The core principle of a food forest is to work with, rather than against, nature. By doing so, the synergetic processes in a natural forest can be used for the creation of productive forest ecosystems. In context with current global challenges, a food forest may provide a promising solution as it is an environmentally sustainable method for food production.

Carbon sequestration is the direct opposite of carbon emission. Carbon sequestration in the context of plants is the process where vegetation takes in CO2 from the atmosphere and uses carbon to build its' organs and excretes oxygen. A food forest system uses a wide range of measures, such as zero tillage, the use of perennial plants and natural regeneration to increase carbon accumulation (ECCP, n.d.). Other claimed ecosystem services a food forest supplies are the retention of water, purification of air and the increase of biodiversity (University R. , 2018). Since the implementation of the Sustainable development goals, food forestry is gaining momentum as it does not only seem to be able to provide solutions in ecologic, but also in social and economic terms. While having a positive impact on the environment a food forest produces an abundance of food. In social terms, a food forest provides promising solutions for reducing the gap between food consumer and producer. Furthermore, it could provide a wide range of other social benefits, such as improved cohesion and happiness.

Food forests are also becoming increasingly popular in the Netherlands, with new initiatives are developed every year. There is currently a wide range of projects, all operating in a different context and based on a different set of values. Many projects focus on social and natural values, where food forests are considered as a mean through which community values can be strengthened. Others are considering food forests as an alternative food production system, where production is valued. All food forest projects are still in the pioneering phase which makes the development extremely diverse and dynamic. There does not seem to be a right or a wrong approach since all projects share the starting point of producing food in harmony with ecological principles.

Since the interest in the commercial part of a food forest has grown, this research is intending to address the going concern of rentability and applicability of the system as food production system. Also, it investigates claimed ecological and social benefits. It will investigate the possibilities for food forests in the Dutch landscape and give insights on how a successful business case of a food forest could look like. It does this by analyzing two existing food forest initiatives, which provide practical information for a farmer about the economic viability of such as system.

Above all, the research investigates non-monetary values created in a food forest, which can influence decision making when financial figures are not yet available.

1.1 Project description

This project is an advisory research, the outcomes of the paper are aimed to show how a successful business case for a food forest could look like. The project starts with a conceptual perspective on the topic, in which the current role of food forests and the possibilities of food forest in the Dutch agricultural system will be described. After the wider perspective, two case studies are analyzed; a 20-ha food forest project in Schijndel and a 1-ha food forest project in the province of Limburg. The projects have different starting points and effectively show the spectrum in which a food forest can operate. After comparing these two cases to a conventional farming system, conclusions will be drawn. The aim of this research is to not just give insights on how business models could look like, but also to provide practical information for farmers on what the exact economic potential of the system is. To conclude the study, the conclusion talks about main takeaways and how these insights can be applied on individual farm level.

1.2 Problem analysis

Since the growth the food forest trend in 2009, a lot of research is gathered on food forestry, focusing on different aspects; the different designs, the effects a food forest has on the increase of biodiversity or the carbon mitigation potential. Those studies state a promising message; a food forest system creates ecological and social benefits. A common discussion between people is the economic viability of the system, where ideologists and pragmatists are making arguments about the system where pragmatists point out the short-term low performance. However, as food forests are operating on a timescale of 100 years, current studies are based on predictions and hard data on the economic performance for the different business models is lacking. Besides, it is not clear how the business will perform in case the production is scaled up. Therefore, the aspect of long-term economic viability and scalability will be an important part of this research.

1.3 Objective

The aim of the project is:

The aim of the project is to aid food forest enthusiasts in taking the first steps starting their project. The project should be useful for entrepreneurs who consider starting a temperate climate food forest system after July 2019.

1.4 Research questions

For this project, the main research question is:

What could be a successful business case for a temperate climate Food Forest in the Netherlands?

To answer this question, some sub- research questions are formulated:

1. How could the potential and principles of a temperate climate food forest fit into the Dutch future food system?
2. What are the possibilities for a food forest in the Dutch situation?
3. What does the analyzed business case of Schijndel look like?
4. What does the analyzed business case of Phien look like?
5. How do the two food forests compare to a conventional farm, keeping in mind the four capitals?
6. How could the developed business case be applied on individual farm-level?

1.5 Reading guide

The structure of this report is based on the research questions. Each chapter will give the analysis of the research questions. Before the sub-questions are tackled, background information is given in chapter two. The background information gives information about the definition and principles of a food forest. In chapter three, the methodology and theoretical frameworks are clarified.

In chapter four, an answer will be given on the sub-question 'How could the potential and principles of a temperate climate food forest fit into the Dutch future food system?' The structure there is based on the multi-level analysis. At the end of the chapter, an overview is shown.

Chapter five introduces the possibilities of a food forest. This will give an answer to the question 'What are the possibilities for a food forest in the Dutch situation?'. This chapter is structured using the transformative business model, respectively: Value proposition, products & services, production & chain, valuation and stakeholders

In chapter six, the case study of Schijndel is analyzed. The same is done in chapter seven for Phien, which gives an answer on research question four. In both chapters, the transformative business model is used as framework. At the end of these chapters, a SWOT is shown to give an overview of strengths, weaknesses, opportunities and threats to the business case.

To continue, the eight chapter compares the business cases with a maize farm. In this chapter, the sub-question 'How do the two food forests compare to a conventional farm, keeping in mind the four capitals?' is answered. Alternative parameter and complete calculations for this chapter can be found in the appendices. At the end of the chapter, a figure shows the comparison.

After chapter eight, chapter nine talks about the conclusion of the comparison and what this means for rentability and scalability. After these, the chapter describes what steps a farmer can take to implement a food forest system. In this chapter, the sub-question 'How could the developed business case be applied on individual farm-level?' is answered.

In the conclusion, all research questions are combined to form an overall conclusion in chapter ten. Also, recommendations are given concerning the takeaways of the research.

To conclude the research, a discussion talks about the limitations of this research and the bibliography shows used sources. Information about interviews and appendices are found in the bulletin.

2 Background Information

This chapter provides background information on food forestry, which is crucial for the better understanding of this research. As mentioned, there are many food forest initiatives, which are all operating in a different context. Different initiatives emphasize different values. Most initiatives are still in the pioneering phase. The chapter starts with describing the perspective of nature inclusive forestry, which has already been practiced since centuries and is an important starting point for food forest initiatives. After this, other principles used in food forest projects are described.

2.1 Close to Nature forestry

The concept of close-to-nature forestry, also known as close-to-nature silviculture (CNS), originates from central Europe where on small farms and community mountain forests different silvicultural systems were applied. The CNS systems were first described in the nineteenth century and since 1980s, it is applied to mainstream forestry in many central European countries. Important starting points for close to nature forestry are the ideas of Karl Gayer, a silviculture professor in Munich. In his work, he observed even-aged planted forests to be more prone to damage caused by disturbances. This led to his approach to advocate mixed forests with heterogeneous structures, to ensure the system is less prone to disturbances. (Peter Brang, 2014)

The close to nature silvicultural approach and its' underlying principles are advocated by the Pro Silva European federation of professional foresters across 20 EU countries. The foundation promotes a holistic approach to sustainability, using ecological principles which will reduce ecological and economic risks. The principles as described by Pro Silva include market and non-market objectives and take the whole forest ecosystem in consideration. Pro Silva describes 4 main principles:

2.1.1 Conservation of ecosystems

The conservation of ecosystems will produce the base for protective, productive and recreational functions of forests. The connection between all life forms in the forest ecosystems, serve as the foundation of all other function in the forest. Therefore, CNS systems see the preservation, and if necessary, the restoration, of the ecosystem as a priority. To reach the benefits of a well functioned ecosystem, different elements are very important. First, a CNS system aims to reach species and genetic diversity. Species diversity refers to the local and regional diversity of flora and fauna, while the genetic diversity describes the diversity within the local population of each species, which subsequently provides potential for evolutionary development. Further elements include, the local and regional diversity of ecosystems, the occurrence of ecological processes, the ecological networks and the ecological interactions of forests in relation to the environment. The development of mixed forests must include special attention to rare and endangered species and restrictions on the use of exotics.

2.1.2 Protection of soil and climate

The protective functions include the protection or restauration of the soil structure and soil fertility and the protection of natural forest types. Other protective functions in CNS systems include the protection of typical and rare or endangered species for the specific conditions, protection against erosion, protection of water quality, protection of the improvement of a forest microclimate and the subsequent impact on the landscape. In terms of world climate protection, the maintenance and improvement of carbon storage plays another important role in CNS systems. Besides, the continuous forest canopy is enabling a well- balanced mineralization of humus, which in return reduces the soil Co2 emissions.

The CNS uses different methods to achieve the protective functions of soil and climate in a forest ecosystem. These methods include a holistic approach where a continuous forest cover is present and specific guidelines are in place to achieve the nature conservation goals.

2.1.3 Production of timber and other products

Pro Silva considers both the production and protection principles as important for society, where optimal and continuing productivity is only possible if the protective functions remain intact. Therefore, essential elements include the ones described in the two previous principles and the additional maintenance of natural energy and mineral cycles.

Methods in CNS systems to achieve the productive functions include the maintenance of growing stock at optimum level and adding value by felling and tending at all stages of development. This will increase forest stability and ensure forest renewal. The spontaneous forest renewal and forest development can be achieved through single tree selection and group selection harvesting, separated by long regeneration periods.

2.1.4 Recreation, amenity and cultural aspects

Besides the conservation, protection and production in a forest, Pro Silva advocates the importance of forests for physical and mental health. Essential elements for the recreational functions include the suitability of forests for physical and mental recreation. Methods to achieve this principle include the establishment of trails and other facilities, the establishment of quiet areas in the forest and the maintenance and creation of attractive forests by varied forest structures.

Besides the described 4 principles, Pro Silva pays great attention to biodiversity and the landscape. Biodiversity is seen as an important intrinsic value of the forest, which includes a full spectrum of life forms and organisms of the forest ecosystem. Pro Silva recognizes that a wide, robust biodiversity can be developed by forming diversity and niches. (Europe, 2012)

Adaptive capacity of CNS systems to climate change

As with food forests, the CNS systems are advocated as being the most promising approach for managing forests to cope with climate change. In the discussion on the forests' resilience to climate change, the term adaptive capacity is used to describe the ability of forest ecosystems to either absorb climatic changes without major changes in forest composition and structure, to rebuild themselves after major disturbances or to evolve continuously and not abruptly in composition and structure. The adaptive capacity of a forest, and thus its ability response to changing climate, is said to increase when principles, including among others, the increase of species richness, structural diversity, high genetic variation within tree species, increase the resistance of individual trees to biotic and abiotic stress and keeping the average growing stock low are followed. (Peter Brang, 2014)

In conclusion, close to nature forestry (CNS) is a management approach in which a forest is treated as an ecological system that has multiple functions. Key to the approach is to have minimum human intervention for optimization of the forest ecosystem. In this way, the principles found in CNS resonate with various principles on which a food forest is based on. CNS systems have proven to be successful in terms of their ecologic outcomes and their adaptive capacity towards climate change. This leads to the conclusion that if a food forest works with the principles described in CNS systems, similar ecological outcomes can be achieved, and the adaptive capacity of a food forest can be explored and enhanced.

2.2 Food Forest Definition

Food forests are most commonly described under the umbrella term of agroecology or agroforestry. Agroecology implies systems which are applying ecological processes combined with the principles of agriculture. Agroforestry is seen as part of agroecological farming

systems and includes the use of trees and shrubs among crop- and pastureland. The term includes a range of different systems. It is said that the more different species, the more the system is following a natural pattern and the more diverse biodiversity will develop.

Food forestry takes the principle of diversity, but controls it by planting selected (mainly edible, some functional) species. By doing so, they mimic the functional and structural relations of natural ecosystems, that provide a natural system diverse ecosystem services, but keep control in control of the species. Food forestry is sometimes defined as a complex agroforestry system. (Limareva, 2014)

In the Netherlands, a definition for a food forest has been set by the green deal which allows an entrepreneur who works under this definition, to receive subsidies from the CAP. This definition implies;

1. A Food forest has at least a surface of 0.5 hectares.
2. Canopy trees for food production are dominating and combined with other layers.
3. No cultivation of annual vegetation and no cattle in the food forest area.
4. No use of fertilizers nor animal manure on the food forest area (Greendeal, 2017).

In this research the term `food forest` is approached in a flexible way, since many of the food forest initiatives do not necessary work with the definition as stated in the green deal. More important for this research is that the initiatives all share the same idea of creating high biodiversity and restoring ecosystems with agricultural production, to create a resilient food production system. It is important to keep an open perspective on the different approaches of food forest initiatives, in order to explore the potential of different food forest approaches.

2.3 Principles of food forests

Clearly, there are different types and different approaches for a food forest, where certain principles are used in the design and management process. In the mid-1970s, the permaculture pioneers Bill Mollison and David Holgrem studied the interrelations between natural ecosystems, agriculture, energy and human living and have developed an integrational approach for an agricultural system and lifestyle. Food forests are considered as part of permaculture, as the principles are the same ecological principles of permaculture. Permaculture and ecological principles play an important role in different food forest designs and approaches (Holgrem, 2013). Below, the most important permaculture and ecological principles are discussed.

2.3.1 Permaculture principles

Permaculture is a conceptual framework for sustainable development, which find its roots in ecological science and system thinking. Permaculture works with patterns and relationships that can be found in nature, to design a landscape that not only aims to create permanent, sustainable agriculture but also a permanent sustainable human culture. People, their crafts and the way they organize themselves is therefore central in permaculture. Permaculture builds persistence of both the culture of self- reliance, community value and the retention of both conceptual and practical skills. By using the patterns and relationships found in nature, permaculture is valuing the interrelation of the organism and is not treating an organism as a sole thing. When properly managed, the designed landscapes will yield an abundance of food, fiber and energy.

Permaculture uses 12 design principles which are derived from system thinking to create holistically functioning systems. These principles are guided by 3 main ethics which are people, planet, prosperity, or as placed in permaculture terminology: people care, earth care and fair share. (Holgrem, 2013) The 12 principles are presented in the figure on the next page.

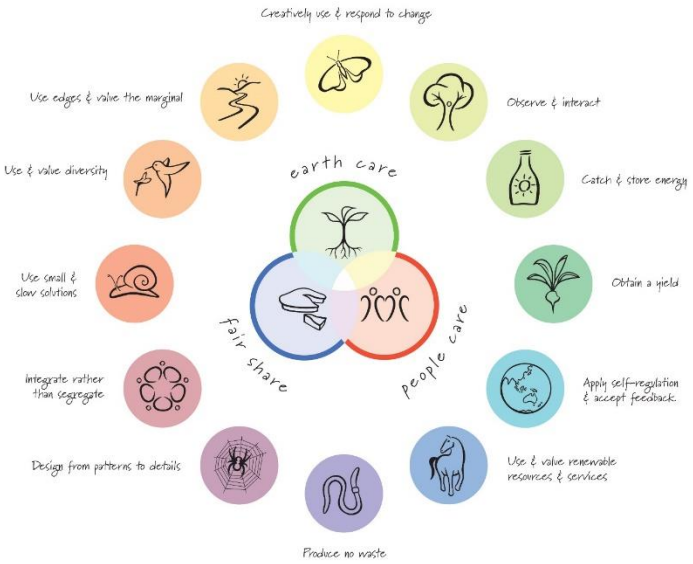


Figure 2-1: The twelve principles of permaculture (Holgrem, 2013).

The principles as described above are often used in designing a food forest, since they provide an idea on which ecological principles can be used and how these are guided by the three central ethics. To which extend these principles are used depends greatly on the context of the project and the site. However, permaculture generally advocates that humans are part of the design and that their interactions with the systems plays a vital role for the functioning of the processes.

2.3.2 Ecological Principles

Even though the permaculture design principles provide a conceptual idea on how resilient systems can be developed, these principles are validated the modern science of ecology, and more specifically in the branch of ecology called ´system ecology´. (Holgrem, 2013)

There are many ecological principles which influence the productivity and the ecological outcomes of food forest ecosystems. Such principles are climate, forest structure, sunlight, water, wind, soil, nutrient cycling, fungi, beneficial animal interactions, managed succession, native or exotic plants use, use of nitrogen fixing plants, time for growth and time for harvest (Limareva, 2014). Each aspect is important and is considered in a food forest design. However, in the following paragraphs, the focus is on managed/steered succession, layering of a food forest, diversity, soil and ecosystem services.

Managed succession

Food forests generally seek to reproduce the logic of building a productive forest based on ecological succession. To better understand the logic and design of different food forest systems, it is therefore first important to understand the basic scientific principles of succession.

In nature, succession takes place when bare earth is colonized by certain types of annuals grasses, herbs and flowers. These plants are called pioneer species due to their speedy colonization and their capability to colonize on poor soils. When the pioneer species are left undisturbed, the early annuals will be crowded and shaded out by, taller, mostly perennials species (such as shrubs). These short- lived pioneer species preserve and restore the fertility of disturbed ground and make it possible for the secondary forest to grow. The secondary forest undergoes several cycles, in which the lifetime of the dominant species increases gradually, 3-15-30 and up to 80 years. The secondary forest creates soil conditions conductive for the growth of longer-lived forest species, which have a cycle of roughly 200

years. The figure below shows the different stages of succession within a natural forest. (Götsch, 1994)

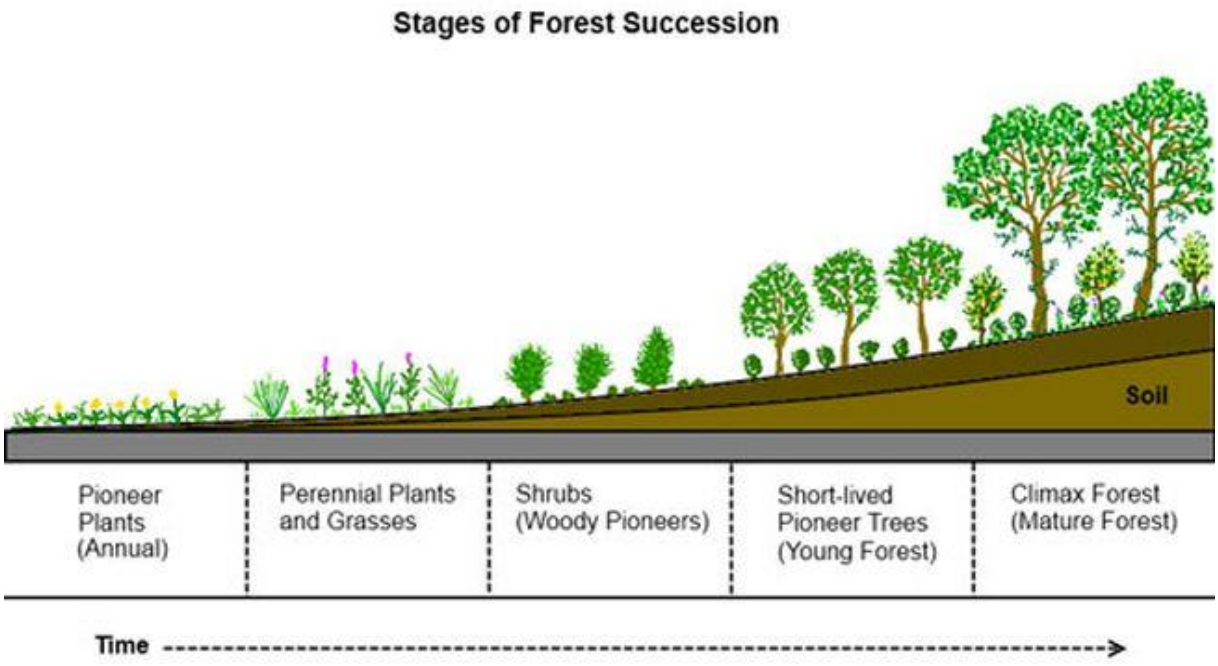


Figure 2-2: Stages of forest succession (eliades, 2012).

Succession is not linear, which means that at any stage of succession disturbances such as fire, wind, lightning or tillage practices can set the process back to an earlier phase of succession. Most of the landscapes we know today are mosaics of many succession-stages, on many scales. Even in a late-succession community, species of other successional phases lurk in the margins.

The main difference of a food forest ecosystem and a natural ecosystem is the canopy layer. In a natural ecosystem the canopy will eventually close as the forest reaches its maturity. In a food forest though, the eventual canopy is open to let sunlight through. Using management, the forest can be kept in a mid-successional stage, which is considered the most productive. It can take many years for an ecosystem to go through one phase of natural succession. 'Adjustments' on natural succession are made in a food forest, as the successional species might not be edible plant species. Non-productive species are replaced by productive ones. Also, adjustments to natural succession are made to increase light availability and to restore a disturbed soil food web. (Limareva, 2014)

Even though natural succession plays a vital role in the design and outcome of a food forest, there several approaches that interference in this process. Some food forest initiatives use minimum interference in the process, while other projects include a greater degree of human interference. One well known approach which demonstrates the role of human labor in the system has been put forwards by Ernst Götsch, a Swiss farmer-researcher in Brazil, dedicated to studying managed succession in agroforestry. As in succession discussed above, consortiums of species that succeed one after another are introduced. A consortium is classified as a group of species that have similar life cycles and therefore lasts the same time in the system. Each consortium consists of species that belong to the same successional group. Besides the consortium, the term strata describe the height of a plant in relation to plants of the same consortium. Trees within a forest occupy different strata, each with a

different optimal canopy density. Based on the principles of Götsch, an agroforestry system should have all consortiums growing at the same time, be diversified, includes all strata to ensure that the vertical space is well occupied and the energy of the sun is optimally harnessed with the highest possible production of biomass. The plants are planted on high density, about 10 trees per m². (Vianna, 2018) Over time, thinning of the plants takes place to reduce density and allow more vigorous plants to develop in the agroforestry system. The pruning process leads to acceleration of rate of growth for the whole plantation by rejuvenating plants. The dead plant material is placed on the soil as mulch to protect and add nutrients. This method is said to induce beneficial changes in the soil fertility as the changes in soil texture lead to an abundance of earthworms. Another method used within his system is selective weeding. As soon as mature plants have fulfilled their function for delivering biomass or produce, they are cut back or removed all together. (Götsch, 1994)

Layers of a food forest

A food forest is a multi-strata agroforestry system which works with the principles of managed succession. As described above, different strata and consortiums are used. Robert J. Hart was first to describe the seven dimension of a natural forest and used this concept to reshape a small orchard into an edible landscape. In the process, he built the framework for modern food forest structure, which can be observed in different food forest designs. Layering in a food forest is an important aspect. Different species occupy different layers, where each layer interacts with one another. Below, the different layers are disrobed and illustrated in figure 2-3.

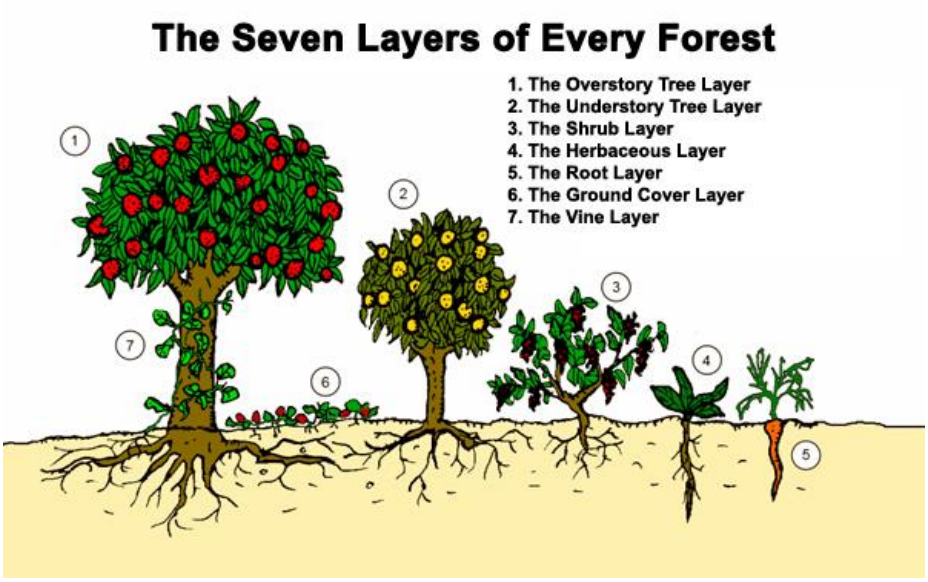


Figure 2-3: The seven layers of a food forest (Limareva, 2014).

1. **The overstory tree layer,** also called canopy layer, includes climax trees**.** This layer includes trees with around nine meters high, mostly nut and fruit trees or nitrogen-fixing trees.
2. **The understory tree layer** or lower tree layer includes trees with between 3-5 meter in height, which are mostly small nut and fruit trees on dwarfing root stocks, like apple, cherry, hazels etc.
3. **The shrub layer** includes berries, fruit, nut, currant shrubs but can also be medicinal and flowering shrubs.
4. **The herbaceous layer** than consists of perennial plants without woody stems, such as medicinal herbs, vegetables and bee- foraging plants.

5. **The root layer** refers to the rhizosphere and consists of root crops such as potatoes and carrots.
6. **The ground cover layer** covers the soil surface and fills the remaining space on the ground. In this way the soil is protected, and the weed growth is prevented. This layer includes edible plants, which spread horizontally.
7. **The vine layer** is the vertical layer which consists of vines and plants that climb trees. Such crops could be grapes, berries or beans**.**

In addition to these seven layers, some food forest designs add more layers, such as a wetland/aquatic layer or fungal layer. (Limareva, 2014).

Diversity

Food forests follow the principle that diversity creates stability. This implies that the higher diversity, the more resistant a system is to diseases and pests. Diversity of natural forests is depending on complex interactions below and above the surface. In food forests, a high diversity of species is planted. If there is a fluctuation in the population of a certain species, nature will always seek for a balance and even this out. A food forest aims to minimize competition of nutrients, water and sunlight and maximize the cooperation between the plants through providing shelter, establishing similar functional relations as found in natural forests. This can be achieved by selecting plants that fill a niche. (Limareva, 2014).

Soil

In food forestry, one of the key goals is soil restoration by planting nitrogen fixing trees, spreading pruning material of shrubs or leaves on the ground and care for the mycorrhiza development through avoiding frequent soil disturbance.

In general, mycorrhiza is known for its beneficial association between plant roots and fungi. In a food forest design, it is important to stimulate the mycorrhiza associations as the fungi provides important ecosystem services, such as reduction of drought and temperature stress, protection from soil pathogens and improvement of nutrient uptake and transfer to plants.

Besides the fungi, the humus content plays another important role in soil health. In naturally developing forests, the decomposition is maintained running as fresh residues from forest vegetation added. Important to note is that if one process becomes slower in a forest ecosystem, the one following will become slower, as well. In this sense, in those circumstances, the rate of tree growth in the forest will diminish. If a disorder in a forest ecosystem occurs, this can lead to a potential disorder of the whole ecosystem.

Leaving the soil undisturbed is an important aspect in the soil management of a food forest. As there is no disturbance, the interconnected soil food web can increase the soil fertility without great external inputs. To increase soil fertility, it is important to plant enough nitrogen- fixing and mineral- accumulating plants, while avoiding stepping beyond the paths. (Limareva, 2014)

Ecosystem services

In general, a food forest aims to enhance ecosystem services, which are classified as the services that people obtain from the environment. The services are classified in four groups of provisioning services, regulating services, supporting services and cultural services. By taking into consideration the information stated above, a food forest will aim towards enhancing the supporting and regulating services, in order to make use of the provisioning services that are food, water, pharmaceutical and energy and the cultural services. The supporting services include services such as soil formation and nutrient recycling. The regulating services on the other hand comprises the services such as carbon sequestration and climate regulation. If the food forest is properly managed and ecosystems are stimulated, a sustainable production system can be established. (BISE, n.D.)

3 Research justification

The chapter below provides an overview of the theories which will be used to analyze gathered data. The theories presented aim to ´frame´ the research and help to answer the research questions. The chapter is describing the multi- level analysis, the four capitals for environmental quality and show how coding was done in the project.

3.1 Theoretical framework

Firstly, some theoretical frameworks will be explained. These are: Transformative business model, Multi-level analysis and the four environmental capitals.

3.1.1 Transformative business model

This model is specifically designed for entrepreneurs who are active in sustainability, as it shows what niche a company is operating in. This model was designed by P.J. Beers to show how a business model is transformative towards sustainability. The business model is the product of a growing interest into transition-driven business models. Where other business models look at the narrative of the sector, designed by the companies themselves, and the economic performance in the current system, the transformative business model puts the value proposition central.

As the value has prominent place in the model, there is more awareness about the broader value a business can create, rather than only showing current economic value. Lastly, the business model considers changing societal context and allows for reflective orientation. These ideas are flexible to change in the model however, the center value will remain the same (Beers, Bemmel, Grimm, & Maas, 2017).

In figure 3-1, the model is shown. The value proposition gives an idea of how value is embedded in the organization and communicated to external stakeholders. Secondly, products and services show how the product or service fulfils the value proposition. The architecture of production and chain presents the supply chain of the company and will answer the question 'Who are the clients and which channels are used to reach them?'. The last factor is the valuation, which gives insight into the value of the company in economic terms. Costs and revenue are most important for this part. The importance of stakeholders is seen in the red external part, these stakeholders are in the part relations and institutions. Practices and discourses are other external resources .

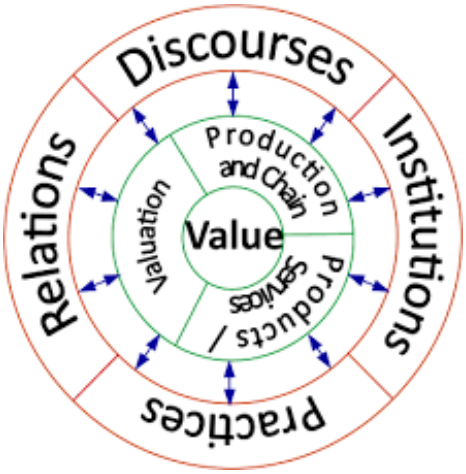


Figure 3-1: Transformative business model (Beers, Bemmel, Grimm, & Maas, 2017).

This model will be used in the 3rd and 4th sub-question, as both the food forests are transformative in a sense that they have adapted a broader sense of values.

3.1.2 Multi- level analysis

In the first part of the project, the transition theory of the multi- level analysis is used to better understand dynamic transition processes and investigate the potential of a food forest in this process. The multilevel framework consists of the three levels; landscape, regime and niches. By looking at all the three levels of the multilevel analysis, a specific sector can be analyzed through the perspective of transition. The model is therefore used to provide insight to the first sub question on 'how the potential and principles of a temperate climate food forest could fit into the Dutch future food system'. The figure below shows the different levels and how these are connected to each other.

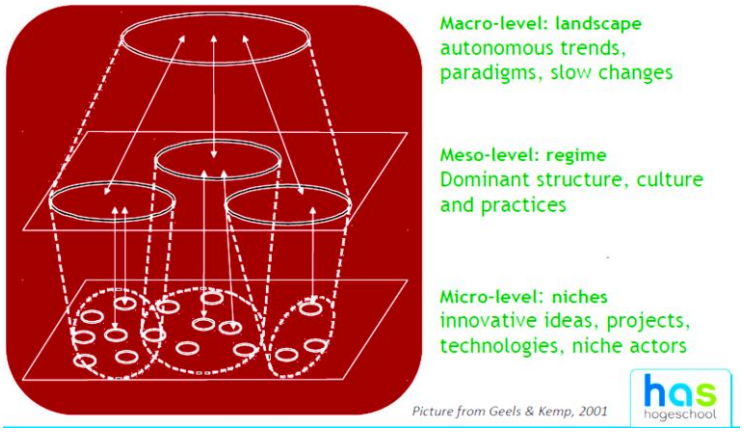


Figure 3-2: Multi-level analysis (Beers, Bemmel, Grimm, & Maas, 2017).

In the analysis, the **regime** describes the dominant structure, culture and practices within a specific market area, which is most accepted today. The regime gives an idea of what the most control has in the current system and therefore refers to the question of ´how we are doing things now´ In the regime, the question about the current role of Food Forests in Dutch agri-food system will be answered.

Secondly, the **landscape** describes trends, paradigms and, changes which are happening in a specific market area. The regime, as described above, operates within the broader socio-technical landscapes, which affects how effectively the regime can function. The landscape includes societal trends and ecological developments, which pressure the regime, and thus affect the sustainability of the regime. The landscape refers to the question; 'what makes the sector unsustainable for the future'. In this context, the question about the trends a food forest responds to will be answered.

Thirdly, the **niche** within the multi- level analysis describes innovative ideas, projects, technologies, and niche actors. Based on the information gathered on the regime and identified developments in the landscape, niches are discovered which response to the question on ´where we see promises of real change´ (Beers, Bemmel, Grimm, & Maas, 2017).

3.1.3 Four environmental capitals

The four capitals theory is based on the idea that all actions have an influence on 4 types of capital;

1. **Natural capital**

   Everything that has to do with ecology, soil, water, air, energy. This capital is maintained and created by natural and ecological processes. Biodiversity and soil fertility are also in the natural capital.

2. **Produced capital**

   Everything that has to do with produced products, such as housing, transport, ICT, Data, industry products. This capital is produced by human activities; and for this reason, company profit is also in this capital.

3. **Social capital**

   Everything that has to do with consumer trust, social cohesion, the neighborhood dynamics, collaboration and interaction.

4. **Individual capital**

   Everything that has to do with your personal development and lifestyle, such as education, diet, self-reliance.

These four capitals are mapped for the company, project or process. Generic sources show different parameters which fall into the four capitals and show how to quantify these. The different capitals can be divided into many different parameters, but the most significant and trustworthy should be taken. The theory is tested in a social cost benefit analysis, SCBA (MKBA), which is a test on the overall performance of a project, process or company, including all externalized costs. It includes all four of the capitals and calculates the value of each by scanning direct factors, which are directly linked to the company, indirect effects such as effect on local communities and external effects which don't have a direct monetary effect, such as noise, emission and social security. It is important to quantify as much of these costs as possible to be able to have the complete overview of the project and how it compares to other options. Effects that can't be monetized are presented in a way that they are representative. The method of monetizing externalized costs can have a high influence on the attractiveness of a project, generic sources should provide a good unbiased base.

Measuring change in the capital can be measured using two methods;

- By determining the size of stock capital is at the starting point; measuring the number of hectares of forest, measuring how much fresh drinking water is available etc. When there is a clear sign that something is diminishing, the values are recalculated.
- By determining the development/progress in a region by physical changes in capital. This method can only be applied when the generic values for the parameters are known.

In the SCBA (MKBA), all relevant costs are in the analysis and it yields a clear overview of the least harming process/company. Also, it clearly shows where the biggest costs are made and whether there are high externalized costs (which is commonly not visible to the consumer). Lastly, it presents the policy maker with a calculated, quantified risk or opportunity rather than an undefined one.

This model will be used in answering the 5th sub-question, when comparing the different farming systems. In the model, the option for creating a food forest in the two different locations is compared to creating a maize farm.

3.2 Methodology

3.2.1 Interview justification

For gathering data, interviews were conducted in the period of April 1st 2019 to May 13th 2019. The interviews were conducted in a semi-structured form, with open questions to gather as much points of view as possible. The interviews were done for the clarification of theory, for both case studies and for the 'possibilities of a food forest in the temperate climate' chapter. For the theory, two experts were interviewed. For the 'possibilities of a food forest in the

temperate climate' chapter (5), food forest entrepreneurs were interviewed. For the case studies (6/7), stakeholders in the corresponding food forests were interviewed.

In the theory interviews, the questions were regarding the transformative business model and the SCBA.

All topics discussed in the entrepreneur interviews were corresponding with the topics of the transformative business model: starting with values, following with production and chain, products and services, validation and stakeholder. Next to this, their opinion on food forests was asked, with regards to scalability, rentability, current trends and opportunities.

In the stakeholder interviews, the interviewees were asked about their role in the project, how this developed, what their mission and vision is and what their opinion is on certain aspects of the business case. For both case studies, there was also a general introductory interview where the same format as the one for the entrepreneurs was followed. In both these interviews, the entrepreneur and closely connected stakeholders were present.

Table 3-1: Summary of conducted interviews.

Group	Interviews conducted	Appendix
Theory	2 experts	**I**
Chapter 'possibilities'	10 food forest entrepreneurs	**I**
Case study VBNL	1 introductory interview, 3 interviews with stakeholders	**II**
Case study Phien	1 introductory interview, 3 interviews with stakeholder	**II**

3.2.2 Way of coding

The transcripts were coded in a semi-structured manner. The codes used were based on the transformative business model, the multi-level analysis, the comparison and the background information. The codes used were:

Table 3-2: Used main codes.

For the background information	Definition food forest, definition permaculture, ecological principles
For the multilevel analysis	Landscape, regime, niche
For the 'possibilities' chapter and the case studies	Value proposition, products & services, Value chain, stakeholders, valuation,
For the comparison and conclusion	Scalability

3.2.3 Economic methodology

In the theoretical framework of PJ Beers, the transformative business model, the part valuation is about how the revenue model is designed. Furthermore, it talks about what the financial (micro-economics) impact of the business will be (Beers, Bemmel, Grimm, & Maas, 2017). To get a good view on micro-economics, it is important to investigate the financial budget as well.

For farmers, an important source for financial figures and benchmark information is the KWIN. Each agricultural sector has their own KWIN. Because of the abolition of commodity boards, some releases of the KWIN are a dated. In the following list, each KWIN is mentioned together with the year of the last edition (Greeni, 2019).

- KWIN Cattle farming 2018-2019

- KWIN Arable farming and open field crops 2018
- KWIN Greenhouse horticulture 2014-2015
- KWIN Fruit growing 2009-2010
- KWIN Tree nursery 2006
- KWIN Flower bulbs and bulb flowers 2005

As seen in the list above, some releases of the KWIN are dated. On the internet, some new benchmark information is found. A source is for this is Agrimatie (database), an initiative of Wageningen University. In the database, benchmark financial numbers of each sector are available. The approach of this source is financial as well as micro-economical. Because of this, it is possible to see the difference and influence of both. (WUR, 2019).

The KWIN is based on micro-economics. In this, each cultivation is specified as balance calculation. This will give an idea about the total earnings of a product, the calculated costs and the cost price. This commonly shows a balance per hectare. Furthermore, the calculated labor part is specified in which de total hours of needed labor is shown as benchmark. The balance shows earnings before labor, interest, taxes, depreciation and amortization. (Wekken & Schreuder, 2006)

In this report, the comparability to other farms is very important. The KWIN and Agrimatie are important instruments to get a view into the economic situation of farmers. The KWIN is based on a micro-economics. On Agrimatie, the micro-economical approach is also available. The used approach in this report will also be micro-economical.

Clarification and reading guide of the excel sheets is attached in appendix **XIX**.

Microeconomics

To know if they project will be rentable on the long term, it is important to look into the microeconomic result in year 20. For that, the following assumptions/ methods are used:

Going concern value

Based on the long timeframe a food forests operates on, the assumption is taken that a food forest is a stable system after twenty years. With planning for replanting, the assumption can be made that the balance of the company is the same from year twenty to hundred. The balance calculation gives an answer on the rentability of the system on the long run.

For that stable system, the going concern value is used. For example, a food forest should replant some fruit shrubs every thirteen years. For the microeconomical approach, calculated costs need to be used and it is important to divide the costs over the thirteen years. Related to the fruit shrubs example, every year one thirteenth of the fruit trees should be replanted. By doing so, costs are equally divided over the years. The calculated costs for the time span after 20 years are the same each year. In practice, there will most likely be some fluctuation. This practical situation is financial methodology which isn't important for the micro-economics. For this research, the calculated costs will be divided by the years based on the going concern value.

Balance calculation

A balance calculation is essentially the same as a cost price calculation. Because the diversity of food forest plants, the balance will be calculated on a one-hectare standard food forest. In this standard food forest hectare, plants of every layer are included. Because of the going concern value, the balance calculation of this one-hectare food forest will be the same from year twenty till hundred.

According to the KWIN, a balance calculation has different parts. First of all, the starting-point, for example how much plants are productive per hectare. After this, earnings will be specified and calculated. The third part is about costs in the system, in which the calculated costs are analyzed. After that, the balance is calculated (earnings minus calculated costs).

The last part describes labor and labor intensity. In the KWIN, the labor costs are only analyzed and not calculated. (Wekken & Schreuder, 2006).

Cumulative balance calculation

In the analyzing chapter, (chapter 8) the different cases are analyzed on return on investment (ROI). For this, a micro-economic comparison which should not take into account company specific information is needed. In the end, cumulative balance including field stock is used. The method used is clarified in appendix **XX**. The cumulative balance calculations include the balance for the first twenty years, as well as the investment for field stock. For a conventional maize farmers, these are seeds which are part of the calculated costs. For the food forest farmer this is part of the investment. The calculation gives monetized balance after twenty years. The higher this value, the higher the ROI.

Financials

When the project is profitable in year twenty, the next step will be to look into the financial position for year one to twenty. For that, the following methods are used:

Valuation of investment

It is important to have an opinion on how to valuate investment and assets. On the financial side, the investment costs will be activated after which a part of that will be depreciated every year. For buildings, the rest worth will be 50% of the investment which means that depreciation will stop when the rest worth is the value. For inventory, no rest worth will be taken into account. The buildings will be depreciated with 5% per year. For the inventory, a depreciation percentage of 20% will be used. Both are based in linear depreciation.

Valuation of the field stock

More difficult will be the valuation of the field stock. On financial side, the agricultural tax norms are used for that. In this, the valuation is based on the increment and instance norms (Belastingdienst). The valuation of the field stock should be based on the calculated costs. Based on going concern value, the valuation should be stable after year twenty. There can be seen a payment for replanting and a loss. Before year twenty, replanting in the food forest will have a profitable influence on the valuation of the field stock.

Balance Sheet

On the assets side, on financial side, the valuation of investments and field stock are already specified. Besides that, receivables and cash equivalents are important. These can be based on the real worth. The same about bank debts. Another important point on the balance sheet is the equity. Every year, the equity will grow with the result of the company. Private expenses will have a negative influence on the equity on the company.

Profit- and loss account (PLA)

The starting point of the profit- and loss account will be the balance calculation of each product. After that, the total labor costs can be calculated based on the needed labor and a standard amount for each hour. Thenceforth, some other company costs are needed to take into account. These can be for example: Housing costs, inventory costs, selling fees, car expenses and general costs. If the balance is reduced with the labor costs and other business costs, the result can be called EBITDA. There after some depreciation can be reduced which gives the result EBIT. In this last result, only the bank- and interest costs and taxes are included.

3.3 Terminology

Natural principles

Natural ecosystems are diverse in species and self-sustaining, resulting for spontaneous natural reactions and the interaction between organisms and the environment. When natural principles are followed, succession can take place and natural nutrient cycling occurs

(biotechnical centre Naklo, 2019). Also, high genetic diversity is maintained (Ecological society of America , 2019).

Nature

An ecosystem is considered nature when natural principles are followed, where the potential natural vegetation allowed to develop without the intervention of human intervention. (Alessandro Chiarucci, 2010)

Ecological principles

The term 'ecology' is sometimes inaccurately used as synonym to 'natural', referring to a personal perspective. Ecology seeks to understand dynamic relations between biotic and the physical environment (Benson, 2000). It stresses on the uniqueness of lifeform in unique landforms, developing a much wider understanding of ongoing processes in complete ecosystems (Figaroa, 2018). When ecologic principles are followed, plant interactions, rather than naturally occurring species, are leading in the development process.

Regular products

Regular products are product produced in the food forests system that are heavy cropping species or well-known products. These products are already known to consumers, yet the novelty of being grown in the food forest makes the interesting for consumers. These products, from a supply-perspective, are niche products as they appeal to a small part of the market. From the perspective of the food forest, these are bulk products as they present the heavy or reliable producers in the system.

Specialty products

Specialty products are products produced in the food forest system that are characterized by unique flavor, unique appearance or any different unique quality. Most are unknown to consumers and present an opportunity for developing into a novelty product.

Long-term sustainability

Land use is sustainable when the land can support natural regulation functions over generation and allow for profitable economic activities (P.M. Pereira, 2003). Long-term sustainability refers to supported functioning in three different quadrants; social, environmental and economic. Rentability is a way to express economic long-term sustainability.

Short-term sustainability

Short-term sustainability refers to output on the short term; referring to profitability and performance regarding stakeholders.

Rentability

Rentability is the result of the way a company is operating (Koetzier & Brouwers, 2015) . For that, the balance calculation (revenue minus calculated costs) on the long term is leading. The term rentability is used on microeconomical side.

Profitability

In profitability, the company specific costs and financial inputs are taken into account. Profitability is used on the financial side. The profitability of the company can be analyzed by the net result and relation with the cash flow position of the company (Heezen, 2015).

4 The potential of a Food forests in the future agri-food system

This chapter is presenting the potential of a food forest in the agri-food sector, by using the multi-level analysis. First, the regime will introduce the current agri-food system in the Netherlands and the role of food forests within this regime. This well help to identify barriers that currently prevent the transition towards agroecological farming systems in the Netherlands. After this, the trends on which a food forest is responding to will be clarified and are described under ´landscape´. To conclude, the niches which a food forest fulfils, are described. These niches will give an idea on the micro level a food forest is acting on.

4.1 Regime

The first part of the multilevel analysis is the regime, which describes the meso-level. First, an introduction to the current agri-food system in the Netherlands is given, where after the state of food forestry in the Netherlands and the role of institutions is described.

4.1.1 Intro to Agri-food system in the Netherlands

Agriculture is important to the Dutch landscape and economy, as it compromises 70% of the land area. The strengths of the Dutch agricultural sector rely on natural and geographical conditions in favor of agriculture. Besides the resilient primary production structure of family enterprises, a strong international orientation and a well-educated labor force are main advantages of the agricultural sector. The Netherlands is an export country, and a large part of the GDP is dependent on Agri- food products.

Conditions for agriculture are becoming more uncertain due to the economic risks related to price variability. Governments respond to societal pressure to put restraints on animal welfare and environmental impact, which are also influencing the sector. Furthermore, the Dutch agri-food complex is responding to growing demand for high-quality and diversified products. They do so by agricultural innovation, which is constantly working on solutions that can help to save resources and energy, while improving productivity and quality of agri-food products. (OECD, 2015)

Statistics

In the timeframe of 2000 to 2018, the total agricultural area has decreased by around 10%, while the number of companies nearly halving in the same period. In 2018, the total agricultural area was 1.7 million hectares. This change is visualized in figure 4-1 on top of next page and shows that the decrease in number of companies is much bigger than the decrease of land area. From this we can conclude that the acreage per company has increased with 60 % in the period from 2000 to 2018. Currently, the average land area of an agricultural company is 32.8 hectare. Within the agricultural sector, arable farms have the highest land use of around 45 hectares on average (CBS, 2018).

Looking into the division of agricultural area, grazing animal farms are responsible for 58% of the total agricultural land area, followed by arable farmers, who compromise 26% of the total. Based on the number of companies, livestock farms make up 51% of the total number of companies (CBS, 2018).

The Netherlands is an export country. The export of agricultural products has increased by 38% from 2008 to 2018, however, has stabilized in recent years. The difference between import and export is, according to figures, 30 billion euros. This trade surplus is around 60% of the national trade surplus (Jukema, 2019).

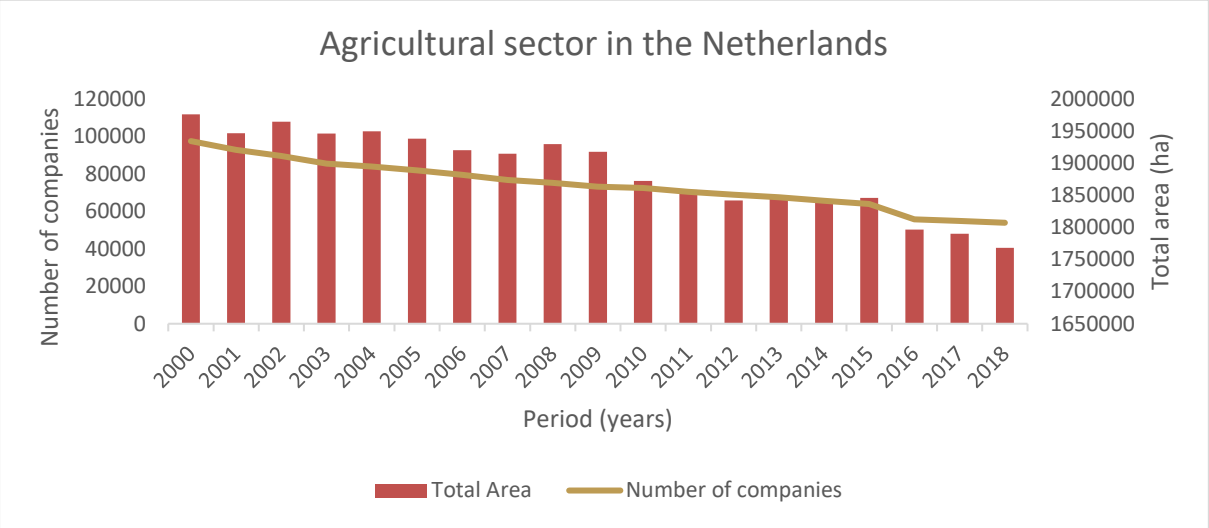


Figure 4-1: Agricultural sector in the Netherlands (CBS, 2018).

The development of the agri-food chain

About hundred years ago, the Dutch agricultural system was characterized by short agri-food chains. Farmers cooperated with other companies and were selling their products directly on the local farmers market. The farmer was connecting to the consumer and self-sufficiency and barter were important principles in the beginning stages. This short chain has changed in the last fifty years into a long chain where customers are buying products in the supermarket. This supermarket will buy their product from a supplier, which is the customer of the agricultural trade organizations. This last group are the direct customers of the famers. In figure 4-2 the Agri-food chain in the Netherlands is visualized. The changes from short to long chains formed because of a logical reason; geography and population growth didn't allow for the shorter chains anymore. An example of geographical reasons is that the consumers are living further away from the farmers due to urbanization (Bruchem & Silvis, 2018)

Figure 4-2: The classic agricultural chain.

Agricultural entrepreneur can make several choices in the current Dutch agricultural system, where options can co- exist. The options are; the world market, the quality market, the niche market and stopping to farm. Currently most entrepreneur decide to supply for the world market which makes it difficult for them distinguish themselves from other entrepreneurs. Therefore, the niche and quality market offer opportunities to make nature part of the business (Groot & Woudenberg, 2017).

Large scale production focused on the world market

The regime in the agricultural sector of the Netherlands has changed a lot over the past fifty years. Farmers are focusing on regular and largescale production and is losing diversity in the process. Most of the farmers are working with a limited number of crops, where fields are becoming bigger and bigger. Because of this, common practice in agriculture in the Netherland is characterized by the endless hectares of monoculture crops. However, these monocultures present a risk to the farmers as the farming systems have a higher disease susceptibility. To counter this, a lot of pesticides, herbicides and fungicides are needed. This

makes the Dutch agriculture sector vulnerable for crop failure and market risks (Beers, Bemmel, Grimm, & Maas, 2017).

In earlier times, common practice was to have a mixed farm with different types of crops. The biggest advantage of this system is risk- spreading, which display benefits on financial side (liquidity), crop side and labor efficiency. As crop rotation is practices, disease susceptibility is lower for these companies. However, the number of mixed farms has decreased significantly in the course of the past fifty years. At this moment, this decrease is stabilizing, and entrepreneurs start seeing the advantages of a combined agricultural company again. Yet, it is perceived as difficult for monoculture farms to return to mixed farming (Stevens, 2017).

Specialization vs mechanization

In general, the agricultural approach in the Netherlands is based on specialization and mechanization, where farmers are focusing on cost reduction. As said before, this will have an influence on other aspects of the agricultural farms. At this moment, specialization in different sectors is seen in the gap between nature and agriculture, alternative and conventional and the gap between consumers and producers. (Beers, Bemmel, Grimm, & Maas, 2017)

4.1.2 Food forests in the Netherlands

In the Netherlands, food forests are a new phenomenon that is gaining momentum (Jan Willem Erisman, 2016). In recent years, the interest into food forests is constantly increasing (Stichting van Akker naar Bos).

Entrepreneurs are recognizing permaculture principles and start to see them as a tool to make their practices more sustainable. At the same time, permaculture has seen a wide-spread recognition in small initiatives and private gardens. Each food forest starts with the idea to combine high biodiversity and restoration of ecosystem services with agricultural production.

Even though a food forest is recognized as an alternative food production system, the bigger part of the food forest initiatives in the Netherlands are not seeking economic approval and are currently based on social and community value. This is mainly due to the lack of data on the business side of a food forest, which displays a weakness for the possibilities for permaculture, and therefore food forests, to play a role in the agri-food transition (Beers, Bemmel, Grimm, & Maas, 2017)

A food forest needs around 5-10 years before the system becomes productive. Most of the food forests in the Netherlands are just planted or are getting slowly into production, which is why most of the business cases are based on assumptions. One of the oldest food forests in the Netherlands is Food Forest Ketelbroek in Groesbeek. The food forest was established in 2009 on an area of 2.4 hectares and is growing into its peak production now (Groot & Veen, 2017).

Statistics

In total, the area of food forests in the Netherlands is around 150 hectares with 85 initiatives[1]. In the last years, the number and area of initiatives grew rapidly. At this moment, most of the food forest can be found in the provinces of Gelderland, Noord- Brabant and Noord-Holland. In Gelderland, a lot of the food forests are based on research and education. On contrary, the food forests in Noord-Brabant are mainly commercially oriented (Stichting van Akker naar Bos).

Before 2006, the Netherlands already had four food forests, of which the oldest one is Helleborus in Groningen from 1991. With the start of Food Forest Ketelbroek, more food forests emerged. In 2015 the amount of food forest increased with 16 new food forest which

[1] In appendix **IV**, an overview of already existing food forest can be found.

cover a total area of 30 hectares. Next to the 65 food forests in the appendix, around 20 food forests are still in their planning phase (Stichting van Akker naar Bos). Important to mention is that the newest food forests are bigger than earlier ones.

Self-sufficiency / local oriented

Currently, 60% of the food forests in the Netherlands are acting on a small scale and are focused on self-sufficiency and small communities. Typically, the small communities initiate a food forest and manage an average area of land of 1.25 hectares of food forest with a group of volunteers. The social aspect is of great importance to these food forests, where the people who initiated the project, often have the ambition to educate the society about alternative agricultural practices, trying to accelerate the transition of the food sector. (Beers, Bemmel, Grimm, & Maas, 2017). These food forests are often owned by private parties, local governments or self-funded NGO's.

Economic focus

In general, the idea of commercial food forests is a niche which has gained attention in the last years. Currently, around 25% of the Food Forests have an economic focus with an average food forest area of 3.17 hectares. This is much bigger than the average area of the earlier group and implies that the economically focused food forests contribute around 45% of the total area of Food forests in the Netherlands. Commercial focused food forests are typically selling the products produced by the food forest with options for other revenue-generating processes (Oostwoud, 2019).

In the future, it can be expected that food forest principles will become increasingly important in the Dutch Agri Food system. (Beers, Bemmel, Grimm, & Maas, 2017).

Community supported agriculture

The last group of food forest is social oriented as well, but with the difference that such projects are initiated to produce a crop for a group of people. Community supported agriculture is based on mutual commitment between farm and the community, aiming to reinforce the link between production and consumption. Supporters of such projects are usually covering the yearly operating budget through the purchase of the season's harvest. Often, supporters also assist with farm work in exchange of healthy and seasonal food, which is supplied by the farm. (IFOAM, n.D)

At the moment, twelve examples of such initiatives can be found in the Netherlands (Stichting van Akker naar Bos), which cover a total area of 19 hectares with an average area of 1.6 hectares per project.

4.1.3 Role of institutions

Governmental institutions have an important influence on the agriculture sector and developments like food forests as they address for instance the opportunity to create high biodiversity in an agricultural setting. In this way, international, national, regional and local institutions will have an influence on the overall development of food forests, while some foundations start to play a bigger role as well. The support and growing interest of all these institutions give an increasing effect to the possibilities to start up in this niche development (Beers, Bemmel, Grimm, & Maas, 2017).

International

On international level, the common agricultural policy (CAP) plays a vital role in the European Union, and has been in place since 1962. Since the CAP came into place, the policy was mainly focused on a stable income for every farmer which should be able him to attempt on a stable market. Therefore, one part of the policy was focused on market- and price and the other part on the structure of the agricultural area. Fifty years of the introduction of the CAP, a lot of changes have been made and reforms have been adapted, which had a big impact to

the way farmers received money. (Figure 4-3) Firstly, these subsidies were based on direct and coupled aids, where now, these are focused on the decoupled direct aids, of which greening becomes a bigger part (European commision).

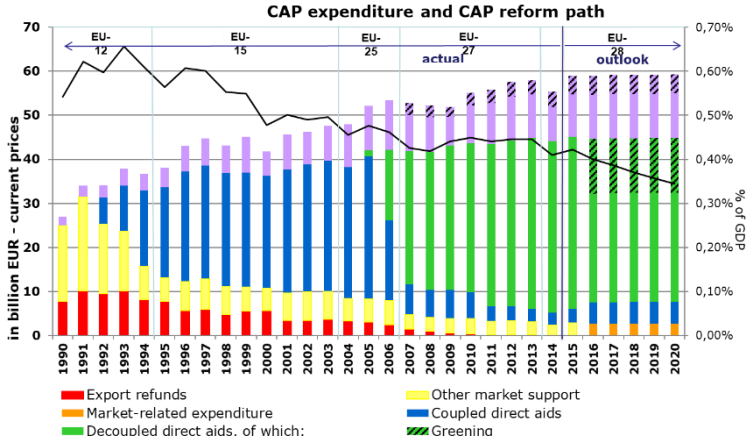


Figure 4-3: CAP expenditure and CAP reform path *(European commision)*

To receive the subsidies of the CAP, the farmers needs to do a combination of contents every year, in which they are justifying which vegetation they are using on which piece of land. Earlier, a food forest must justify every vegetation in the food forest but since 2019 a vegetation code for food forests has been introduced. By this, it became possible to have a food forest on the agricultural land area and hold the right on the CAP. Besides, this code implies that the institutions are giving more possibilities for a farmer to have a food forest (Stichting Voedselbosbouw, 2018)

To use this vegetation code, the definition of a food forest regarding to the green deal is used, which has been described previous in the background information. (Greendeal, 2017)

National

In 2017, the green deal was signed by a lot of institutions, in which the national government has played an important role. Besides that, a lot of foundations are part of this deal as for example, Stichting Voedselbosbouw Nederland. These institutions have the shared ambition to increase the area of food forests in the Netherlands. To reach this, the gap between agriculture and nature should become smaller on an ecological, legal as socio- economic side.

The ministry of agriculture, nature and food quality of the Netherlands has the most important governmental role on that. Their ambition is to find solutions for the administrative charges regarding the combined of contents, for which the vegetation code Food Forest is an example. Against to that, the ministry will take the development of food forest into account in the policy of environmental- friendly agriculture systems (Greendeal, 2017).

A starting point for this policy is recognized by the vision of the ministry: "Agriculture, nature and food: valuable and connected." which relates to the climate agreement of Paris. This vision illustrates that the Netherlands should be, in some years, leader in circular agriculture. With this, the government recognizes that the current situation of agriculture is not a future solution, where agricultural farms need to be aware of the trends that are going on in the world. In this sense, food forests resonate with the vision of the ministry by providing promising solutions to the current agricultural situation. Because of that, the vision of the ministry will boost the development of food forests (Ministry of Agriculture, Nature and Food Quality, 2018).

Regional

Water board

The Netherlands has twenty-one water boards which take responsibility of the water management of their area. In context of food forests, the water boards have taken the responsibility on knowledge development based on the influence of food forest on the robustness of the groundwater system and its relation to climate change. (Greendeal, 2017).

Province

Another important regional institution are the twelve provinces of the Netherlands, which have an important responsibility regarding to the rural planning and nature policy. Both of these instruments can present benefits, but also bottlenecks for starting a food forest. To stimulate food forests, it will be important that the province have a proper policies in place. For example, the provinces are implementing research about the possibility to give food forest entrepreneurs an exemption of replant duty, which will make it possible to start a food forest on agricultural land area as well as in a natural forest. For the last option, the province is researching on changes in the nature management plan. At last, the province is working on provincial subsidies based on innovation, rural development and sustainability to stimulate farmers or other entrepreneurs to start a food forest (Greendeal, 2017).

Green development fund Brabant (GOB)

Another regional institution is the GOB, who has the intention to help entrepreneurs to start up initiatives that combine agriculture with high biodiversity and restoration of ecosystem services. For this, they are providing financial support for stimulation. Their plans are based on 1+1=3, which means that the combination between two parties gives benefits to both. (Groenontwikkelfondsbrabant, 2018)

Local

The task on local level is to develop ideas and take initiative to start a food forest. This can be done by municipalities, village councils or neighborhood councils, where in the end, the responsibility for a local food forest which is open for public is taken by these organizations (1limburg, 2017). At this moment, the vital outdoor area is becoming more and more an issue, which is why the local institutions can take responsibility to let their citizens think about possibilities for improvement (Zundert, 2019).

Moreover, the province and municipality play an important role on rural planning and planning permission. The municipality processes these national requirements into their vision of structure and zoning (Fiers, 2015). At this moment, most of the food forests are based in a designated 'nature' zone. However, for the commercially oriented food forests, an agricultural zone gives more possibilities to receive the benefits from the CAP. A combination zone between agriculture and nature is also possible and the best way of starting a food forest. However, the difficulty is not in the zonings but in the restrictions behind. For example, these restrictions can imply that vegetation should not be higher than 1.2 meters because of the landscape, starting a food forest with these restrictions is difficult. (Voedsel uit het Bos, sd).

4.2 Landscape

This subchapter will introduce the trends to which food forest responds to. These trends are divided into Global trends, (European) consumer trends and related sector trends. By analyzing these trends, the landscape in which a food forests is acting on, will be analyzed. Further, the landscape will reveal the underlying motives and drivers for food forest entrepreneurs.

4.2.1 Global trends

Climate change

Agriculture is a significant contributor to greenhouse gas emission. A source from the FAO reports that forestry, agriculture and 'other land use' are responsible for 21% total greenhouse gas emissions. Another source states that 31% of all greenhouse gas emissions is related to food production and the supply chain in the EU (Garnett, 2011). Furthermore, agriculture uses certain processes that indirectly accelerate climate change, where an example of this is soil erosion. According to the intergovernmental panel on climate change, greenhouse gas emissions are at their all-time highest.

Climate change will lead to increasing variability in the weather and crop performance in certain areas. Droughts and floods will increase in frequency, which might occur in the same years as one another. In this sense, climate change will have severe effects on food security in the most vulnerable areas. The adaption of sustainable practices is important as it will make food producers more resilient against climate change.

Food forests are interesting in a sense that they propose a system for food production that is carbon-neutral or might even mitigate carbon. Furthermore, this system is very adapted to increasingly extreme weather and mitigating peaks and shortages of rain.

Scarcity of resources (increased competition for natural resources)

Diversification of agricultural lands is the main driver of deforestation. Developing, growing economies based on agricultural exports are often undermined by the unseen costs for loss of natural resources. These economies are often characterized by biodiversity loss, soil erosion and groundwater depletion (Hermann Lotze-Campen, 2008). Especially fertile lands are sought after, and forest soil is very fertile.

An example of resources running out is Phosphate. This mineral is broadly used in agriculture and is non-renewable and is expected to run out in 300 years. However, considering the importance of the nutrient and the usage rate, it is of vital importance to reduce the use of this nutrient or find a way to recycle it (Sheida Z. Sattari, 2012). There is a method for reclaiming the nutrient, but this is very resource-intensive and expensive, as shown in the two researches (WUR , 2019).

About 70% of sweet water is withdrawn for agriculture. Other competitors for water are industry and cities. The FAO has estimated that 40% of the global population lives in areas that are water scarce. In some of these areas, agriculture uses up to 90% of all available water. Global water scarcity has increased rapidly since the 1960's and the trend shows problem for Central America, northern-Africa, sub-Saharan Africa, Europe and South and East Asia. The effect of water scarcity is catalyzed by growing population and more water-intensive diets. (M. Kummu, 2016)

Food forest relate to this trend as they are based on the principle of not needing any external inputs other than labor. Scarce fertilizers, water or land is not needed; fertilizer is made in the system itself, water is maintained in the humus of the soil and land is not prone to erosion.

Economic growth and population dynamics change demand

The world's population is expected to rise to 9.7 billion by 2050. Income growth in the middle-class countries will result into diet shifts to more resource-intensive diets. Population growth is concentrated around new economies; Africa and South Africa. This population growth is fragile, as most of these economies are built on agricultural exports from stressed natural resources. By 2100, of the 11 billion people inhabiting the earth, 9 billion will inhabit Africa and Asia.

Populations in sub-Saharan and southern-Asia are becoming younger and without enough employment opportunities, this might lead to outmigration, further urbanization and possibly conflicts. In Europe, countries are rapidly aging, and economies are stagnating.

However, in the Netherlands a small decrease of population will take place in the coming years. Urbanization will continue to draw people away from urban areas and border-regions will be seeing a large decrease of population. The expected peak population of the Netherlands is 17.5 million, which it will see in 2038. After this peak, population is expected to decrease. (Vorst, 2011)

Food forests relate to this trend in that they provide an answer to the question of how we will feed the population of the future. Furthermore, urbanization drives the demand for recreation sites in and around cities. Food forests value the aspect of recreation and social hierarchy besides food production (Food and Agriculture Organization of United Nations, 2017).

Transboundary pests and diseases

Globalization has made it possible to eat foods produced on the other side of the world, from a completely different ecosystem with completely different exogenous factors. With an increasing resistance of pests and diseases to plant protection agents and medicine in humans, outbreaks of transboundary pests and diseases are becoming more common and severe.

With intensified farming systems, the probability of resistant pathogens developing is high, and the product produced on these farms often travel great lengths to their consumers. The potential impact of animal diseases transferring to humans is increasing. To continue, antimicrobial resistance is a difficult problem in modern medicine and makes these pandemics hard to contain.

Food forests relate to this as they are not using any pesticides that would induce resistance. Also, there will be a diverse ecosystem apparent at the site which minimizes pest pressure.

4.2.2 Consumer trends

Authenticity

The mass-production of products has lost its shine for many consumers. The internet enables consumers to interact with the product they are buying much more than in a real-time situation and they can order customized, atypical products.

Authenticity is the key word in this; customers want genuine, unique products. Visuals are most important in the age of digital communication.

Authenticity is something hard to pursue on purpose. Food trends, particularly natural-eating ones, are part of the trend of consumers being more aware of their purchasing decisions. They buy from 'responsible' brands that sell quality products with real value. Organic milk is an example of a rediscovered traditional food that is experiencing a boost from sales to young urban professionals wanting to eat natural.

An example of authenticity is regionalization; where regions are searching for their own talents or uniqueness. This is expressed in some farms also, where the products are sold locally in farmer-run shops or in the supermarket labelled as local produce.

Awareness of consumers

This underlying trend is expressed in the growing demand for healthy food products, consumers demanding transparency of producers and greater interest in sustainability. Within the European society, there is more interest for sustainable farming practices as consumers don't trust the government to do enough to tackle climate change. Because of social media, climate change, animal abuse and improper farming systems are seen much easier and picked up by concerned consumers much sooner. This trend is expressed in the following sub-trends:

Greater interest in nutrition and health

The UN is tackling the trend of nutrition and health, yet still about 11% of the worlds' population is going to bed hungry. There are parts of sub-Saharan Africa where the level of stunting growth due to malnutrition is not declining. On the flipside, there is an increasing amount of people battling obesity and overweight. These people are facing this due to changing diets and increased consumption of fats and sugars, which is becoming a pronounced trend in fast-developing economies.

The diversity and amount of food has increased globally, with a narrowing gap between the calorie intake of high-income populations and middle- and low-income countries. This narrowing gap is positive; however, it does not consider the type of food consumed. Fruits and vegetable intake in the middle- and low-income countries is often behind. A trend can be analyzed in fast-developing economies of rapidly growing consumption of processed foods high in refined sugars, salt and preservatives. Parallel to this is the increasing occurrence of micronutrient deficiency.

Consumers are increasingly aware of the supply chain that has given them a product. The internet makes is very easy for a consumer to do a background-check on a producer, or to check the ingredients listed. There is also increasing awareness that production efficiency alone would be insufficient to meet the future food demand without increasing the GHG emission (Kyle F. Davis, 2016)

Transparency and traceability

Transparency and traceability are closely linked; the one can't survive without the other. Traceability is an instrument to assure food security. Transparency is the broader concept, if a company claims to be transparent, they are open about their production process, the resources they use and the products they produce. Food supply chains are more complex and integrated than before, and raw materials are transported worldwide. Traceability is of growing importance and can be used by companies to show consumers the authenticity of their products. It is also important for food producers, as they can ensure the safety and quality of a product. All companies are obliged to record the source and movement of their products to ensure food safety. This is important as it ensures that in the situation of an outbreak of a pathogen, the source of the problem is easily identified.

The introduction of traceability systems is the result of public concerns for human health. Quality and safety governing organizations can enable companies to increase their transparency, however, information technology is a bottleneck. There is a trend identified of an increasing number of consumers demanding transparency from companies, and an increasing amount of companies taking transparency as a core value. (J.H. Trienekens, 2012) (Vorst, 2011)

Fast, Fresh and easy food & the transition of the food system

The global population is growing and the demand for food is ever increasing. Urbanization drives the development of longer supply chains, as it physically divides the consumers from the producers. The demand for processed foods is also growing, as 75% of food sold through supermarkets in high-income countries is current processed foods. In 2001, this number was 72% (Food and Agriculture Organization of United Nations, 2017).

This need for processed foods fundamentally changes food production, as they demand homogenized, standardized raw materials. These large-scale production facilities are driven by multinationals and coincides with the trend of the biggest food industries in the hands of fewer people.

Integration is another effect of this trend. Primary production is often integrated with primary processing plants to ensure production stability and control of the supply chain. Further in the

chain, at the consumer side, supply chains are growing longer. The integration of food producers with traders and retailers is becoming more prevalent. The retailer is integrating and transforming in a service organ rather than a sole trader. Furthermore, they are more at service of the consumer than ever before. The UK supermarket Sainsbury's launched a delivery service where groceries are delivered only one hour after ordering. In the same market segment, Deliveroo and Prime now by amazon are active. In the Netherlands, Picnic is changing the game of grocery shops with next-day delivery of groceries. This trend is responding to the trend of consumers wanting healthier, better quality food on-the-go and is expected to accelerate (Limareva, 2014).

Another part of this trend is the development of 'grocerants', a grocer that offers restaurant-quality meals on the go. This concept is gaining popularity fast. (Kasriel-Alexander, 2017)

Food forests relate to these three trends as they are using a fully transparent system to produce healthy, nutritious food. These foods are sometimes processed on the food forest to minimize food waste and to create new, nutritious foods.

4.2.3 Related sector trends

Biodiversity loss and soil degradation due to agricultural activities

Intensified agriculture is known to have a negative impact on biodiversity. It is often taken as trade-off for the produced food. Intensified agriculture reduces food webs' complexity and fewer biotic factors in the micro-environment (Maria A. Tsiafouli, 2015). Also in the Netherlands, biodiversity is at stake. The current red-listed species in the Netherlands includes 8% of all mammalian species, 11% of all bird species, 22% of all bee species and 28% of all reptiles. In agricultural landscapes, the downfall of biodiversity is most pronounced. Also, in agricultural areas, the deposition of nitrogen causes eutrophication and issues that challenges nature conservation. (Venhuizen, 2019)

Food forests include high biodiversity and are interesting from the perspective of nature conservation as they, while producing food, create biodiversity and restore ecosystem services. Also, the diversity could attract a higher biodiversity than nature sites. (Limareva, 2014)

New business models

There is a growing awareness that the current economic system is based on short-term profits, which is not always the best option. There is a need for new business models where sustainability is a central feature. There is more creativity in businesses, and the 'creating' business models are booming. Other new business models are centralized around innovative trade and sharing. A common feature is cooperative collaboration. The ability to connect is becoming central to the value-creating processes. Economic traffic is becoming more fluid, with access to something becoming more valuable than owning it.

An example are CSA structured farms, where the community owns and runs the farm. Food forests can also be fit into this concept, as most of the food forests currently in development are community initiated and run. Also, the 'sharing' principle is apparent; individuals share their labor for the benefit of the community. (Jonker, 2012)

4.3 Niche

The following chapter describes why a food forests can act as a niche in the Dutch future food system by responding to the above-mentioned trends. As part of the multi- level analysis, the following sub chapter shows the different niches a food forest fulfills.

4.3.1 An efficient, inclusive and resilient farming system

The current Dutch agricultural system is recognized by bulk and large- scale production, with farmers focusing mainly on a limited number of crops. As the Dutch agricultural landscape is

shaped by monocultures, the risk of farmers has increased and lead to greater use of agrochemicals such as pesticides, herbicides and fungicides. (Beers, Bemmel, Grimm, & Maas, 2017) This in turn makes the sector vulnerable and susceptible to the global trend such as climate change. In general, climate change will have a great impact on the agricultural system, as droughts and floods will increase in frequency. The FAO has therefore emphasized that the efficient use of natural resources and the recognition of climate change will be of great importance for the future of the planet. (Food and Agriculture Organization of United Nations, 2017)

In this context, a food forest fulfills the niche of an efficient, inclusive and resilient farming system, which can respond effectively to global trends. Resilient farming systems, which includes for instance agroforestry and organic systems, are proven systems which do not deliver the same production levels in a short- term, when compared to conventional farming systems. However, in a long- term, these systems appear more resilient, especially when climate extremes are increasing. In such systems the focus is to increase soil quality and biodiversity. This approach derives from the thought that a system which has healthy soil and an increased biodiversity, is capable to better cope with external stress such as disease, plagues, heavy rainfall etc. The increase biodiversity can be seen as win- win situation within an agricultural system, as biodiversity increases stability of ecosystems while increasing productivity. Therefore, biodiversity is essential for food security and the resilience of systems. In a resilient system, on a long term, the lower costs will eventually compensate for the lower production levels. This implies that such a system is capable to yield a better margin for the farmer in a long term through the greater resilience and the better ability to cope with disturbances. (Jan Willem Erisman, 2016)

4.3.2 Regeneration of land and increase of biodiversity

In the Netherlands, the large-scale bulk production from monocultures has left his marks on the soil quality and biodiversity within the agricultural areas, as farmers are focused on intensive farming practices. The soil quality has suffered, and species have disappeared. (Maria A. Tsiafouli, 2015). As 70% of the Dutch land area is under agricultural practices, this area is largest habitat for plants and animals. More than 45,000 plants, fungi, insects, animals and other organisms know in the Netherlands, and depend on the agricultural landscape for their habitat. However, species, for which the Netherlands is very important, have been on a decline. (Jan Willem Erisman, 2016)

A food forest responds to these developments, by regenerating land and increasing the biodiversity of the site. A food forest is a low input system which does not pollute the land, products or surrounding water, but strengthens them. As different layers of many species are integrated, a permanent cover of productive photosynthetic activity is created that protects the soil. Next to that, a permanent root system is established, which benefits soil life, fertility and water retention capability. The biomass above and below ground is able to store carbon in its biomass. As mentioned in the background information, a food forest aims to create diversity, which leads to resilience of the system in times of disturbances, and an abundance of food products can be harvested throughout the season, while the diversity of the site will not be disturbed. (Beers, Bemmel, Grimm, & Maas, 2017)Such an agricultural system based on the full potential of biodiversity provides opportunities to create resilient system, in which not only production but also endangered fauna can thrive. (Jan Willem Erisman, 2016)

4.3.3 Blurring the line between food production and nature conservation

Agriculture is characterized by specialization and mechanization, where farmers are focused on cost reduction. Such an agricultural system presents agricultural farmers with opposing values with the community and creates gaps between nature and agriculture. (Beers,

Bemmel, Grimm, & Maas, 2017)The consequences of the gap between agriculture and nature can be recognized in the environmental impact, such as decrease of biodiversity, pollution of land and water etc. The analysis of the current Dutch Agri- food system has therefore shown that many Institution show increasing interest in reducing the gap between agriculture and nature.

A food forest seems to respond to this increasing interest of institution to blur the line between agriculture and nature, yet the natural value of the system is sometimes debated. However, regarding the main aspect of creating high biodiversity, food forests can be a mean in reaching this goal. Generally, a growing notion is promoting the idea that functions of natural systems should be performed by agri-ecological systems (Beers, Bemmel, Grimm, & Maas, 2017). Agriculture is depending on biodiversity, in the same way nature is. Therefore, the understanding that many specific species of animals and plants are relying on a sustainable agricultural landscape is important in the approach to resilient agricultural systems. A holistic approach can be of benefit for agriculture and nature, as such an approach focuses on the optimal use of agrobiodiversity and the reduction of long- term (economic and natural) risks through using ecosystem services rather than external inputs. (Jan Willem Erisman, 2016). In this context, a food forest can be seen as a mean that combines high biodiversity with agriculture (Beers, Bemmel, Grimm, & Maas, 2017).

4.3.4 New and innovative food products

Food forestry is a new topic in the Netherlands, where most of the food forests in the Netherlands are currently small scale and focused on self- sufficiency and local production. Nevertheless, the interest in the economic performance of a food forest business model is increasing and more commercial oriented food forest projects are arising. Next to this, the consumer trend of authenticity, where consumers demand more genuine, unique products rather than the uniform products from mass production plays an important role in this development. Besides, consumers pay a greater attention to nutrition and health, and desire products which have been produced sustainably have a high nutritional value. (Kyle F. Davis, 2016)

A food forest responds well to these developments, as it is a sustainable agricultural system which is not solely profit driven, but which also produces other social and environmental values. A food forest produces a variety of food products, which means that more nutritional value can be derived from one piece of land. Besides, the stability of the system which has been created through the higher diversity of organisms, enables the farmer to produce new and innovative food products. Such products can act as niche products on the market with a high nutritional value.

4.3.5 A food forest fulfills multiple values

The projects of food forests in the Netherlands are different from each other, as each project produces a variety of values. Clearly, each project is unique and has its own vision and context. In general, a food forest can be considered as a niche in the Dutch Agri food system, as non- monetary values are produced. In this way a food forest is responding to the consumer trend, where consumer become more aware of their purchasing decisions. Consumers want to buy from responsible brands, which provide quality products with real value. It can be said that within the European society, there is a greater interest in more sustainable farming practices. Consumer express a distrust to the government in tackling climate change through different trends. Therefore, traceability, transparency and a greater interest in nutrition and health is a recognizable consumer trend.

In a food forest, a broader range of values are evident which are not merely focused on the production of food. The maximization of production can be achieved but simultaneously value

creation is maximized, which includes social and ecological values. (Beers, Bemmel, Grimm, & Maas, 2017)A food forest is therefore multiple function where value is added. As it can be seen by various examples of food forests in the Netherlands, such project can be a location for education, training and awareness to various target groups. These groups can be stakeholders interested in the high biodiversity, landscape, produce or the promoting of mental well-being. Besides, a food forest provides opportunities for collective management by local communities including social education and economic added value. In this way, the local community is strengthened, and consumers build a stronger connection to agriculture and the production of food.

4.4 Overview multi-level analysis

All the subjects in the multi-level analysis are related to each other and are presented in figure 4-4. At this moment, food forestry plays a small role within the Dutch agri-food system which is due to the dominant regime is characterized by large scale production for the world market and a high degree of mechanization and specialization. Nevertheless, the MLA shows that food forestry slowly starts to find ground within the Dutch agricultural landscape, as stakeholders realize the potential of a food forest to respond to current trends, through the fulfillment of multiple niches.

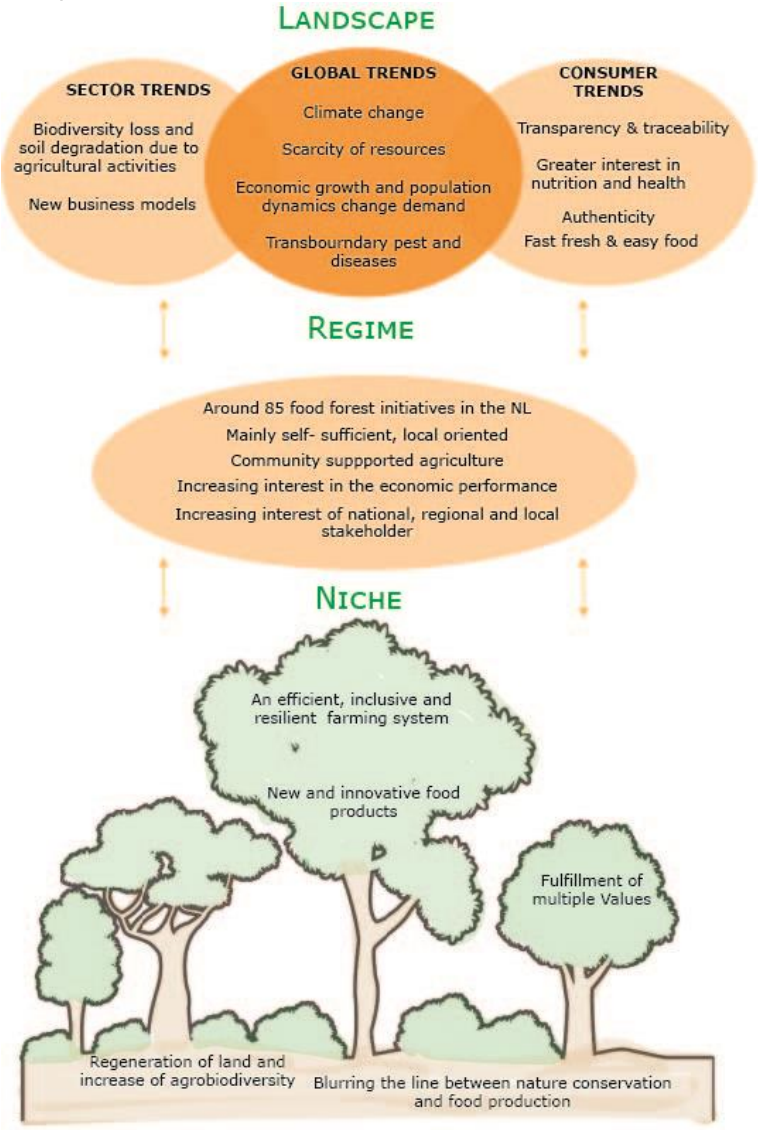


Figure 4-4: Overview diagram of the multi- level analysis.

5 Possibilities for a food forest in the Dutch situation

In this chapter, the possibilities for food forests in a temperate climate setting will be described. The outline of the chapter is based on the transformative business model in which the value proposition is central. The data that is used in the next chapter is combining the outcome of the multi- level analysis with the additional data that has been collected through interviews with food forest entrepreneur and other important stakeholders. The next chapter answer the question: `What are the possibilities for a food forest in the Dutch situation? `

5.1 Value proposition

To investigate possible value proposition for a food forest business case, a holistic approach is used. Müller describes a holistic concept for a value proposition as a useful tool in which sustainability is moving in the foreground to design a sustainable human society. (Müller, 2012) Therefore, a value proposition does not only take into consideration the profit which a business generates but pays further attention to all three pillars of sustainability; people, planet and profit. For the design for a possible value proposition for a food forest, the four capitals become practical in which the three pillars of sustainability can be addressed. The planet aspect is addresses by the natural capital, the profit is addressed by the produced capital and the people are addressed by the social capital. In addition, the individual capital describes the personal development of the entrepreneur. This includes aspects such as reliance, education, risk management and diet.

Through the interviews with food forest entrepreneurs and other important stakeholder, several values for a food forest have been revealed. Based on this input, a list of possible values for a food forest has been established. Afterwards, each value has been ranked on its importance on the four different capitals. Therefore, 0 is neutral, 1 important, 2 very important, and 3 is extremely important, for the specific capital. An example would be that the value ´Increase of biodiversity´ is ranked with 3 on the natural capital, where it has a rather neutral influence on all other 3 values. On the other hand, other values have an importance for more than only one capital and have been ranked accordingly. Afterwards, two axes are established on which the 4 capitals are placed on. Through this, 4 different quadrants are formed where each quadrant lies between two capitals. Through the ranking it became possible to make a pre- selection of the possible values of each quadrant. Afterwards, the most recognizable values for each quadrant are selected by taking into consideration the trends to which the values respond to and their appearance in already existing business cases. These trends were described previously in the multi- level analysis. The figure below shows the axes and the different quadrants[2]. To keep an unbiased perspective, a common food forest crop has been selected for each quadrant, which visualizes the diversity of food forest businesses. The quadrants are classified as follows:

Quadrant 1: Produced and individual capital- Pawpaw
Quadrant 2: Individual and natural capital- Nashi pear
Quadrant 3: Produced and social capital- Honeyberry
Quadrant 4: Social and natural capital- Aronia

[2] In Appendix **V**, a total list of values and list of values per quadrant are specified.

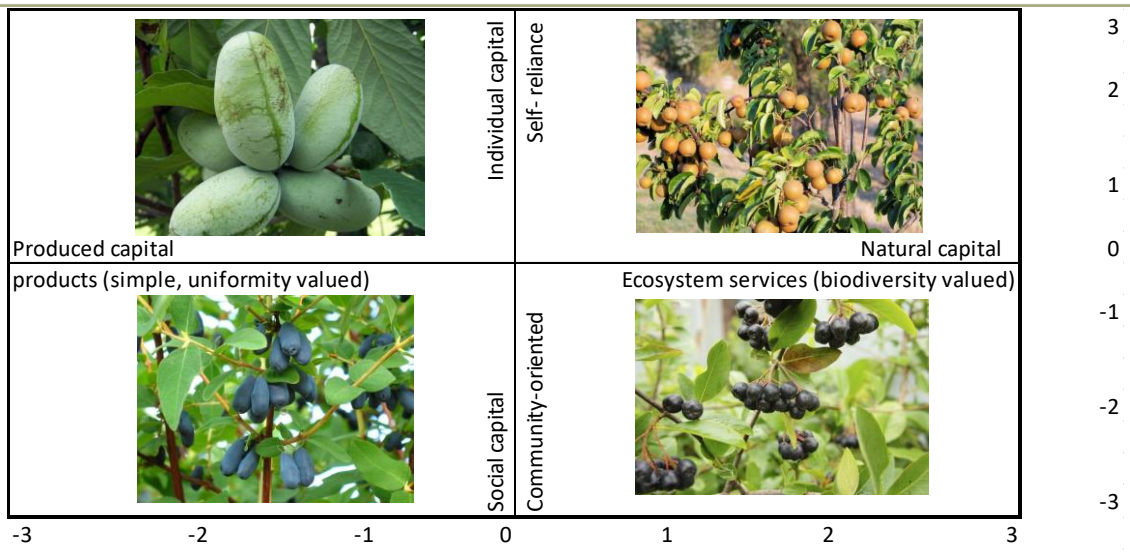


Figure 5-1: Matrix with the 4 capitals and the 4 different quadrants.

It is important to mention that the starting point of each food forest lies in the valuation and integration of ecological principles to create an efficient, inclusive and resilient food-producing system. Above that, a food forest shows a variety of additional values, which can be monetary or non- monetary. But in addition to the natural value, the value of experimenting is recognized in all initiatives, since all projects are still in their pioneering phase. On the contrary, it is important to mention that the selected values for each of the quadrants can shift during the long-time frame of a food forest. For instance, a food forest entrepreneur might decide to bridge his initial years of low productivity by focusing on the value of exchange of knowledge and education, through which profit can be generated. However, as the food forest starts to reach its productivity, the entrepreneur might shift to a greater focus on the commercial side of the food forest. This shift of values in time must be realized when viewing the figure below. Besides, the axes below and the allocated values present the extremes of different food forest initiatives. The aim of the figures below is therefore to show the diversity of food forest initiatives, while providing an idea about possible values for each of the quadrant.

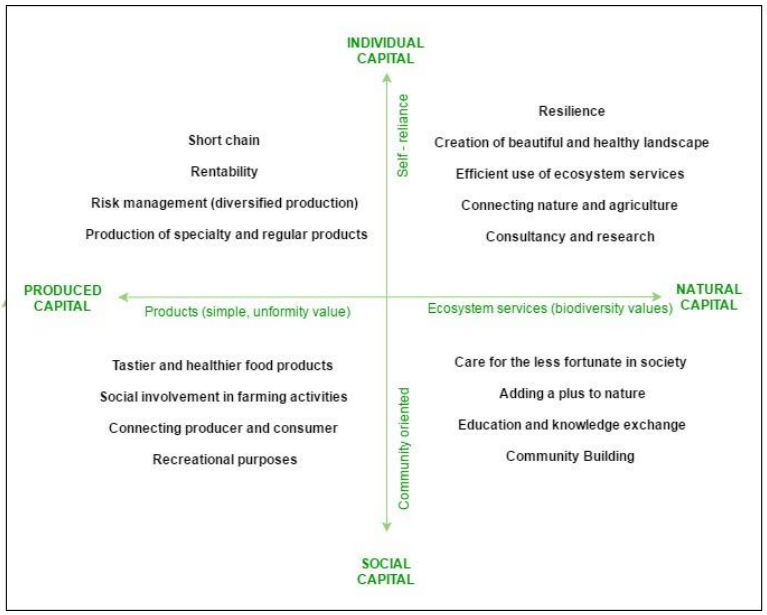


Figure 5-2: Matrix including selected 'extreme' values for each quadrant.

5.1.1 Quadrant 1: Produced and individual capital- Pawpaw

The fist Scenario lies in between the produced and the individual capital. Those food forests have a great emphasis on the commercial part of a food forest and are more market-driven than those businesses in the other quadrants.

In such food forest, time is spent on marketing and more careful decisions are made on which crops should be grown. In terms of production, these food forests are most likely to have the value of a balanced production of **regular products** and/or the production of **specialty products**, which they sell through a value chain to consumers.

Risk management is seen as an important value, as through diversifying the production, the entrepreneur is capable to adapt to occurring changes in the market. An example in which this value is clearly visible is the production of a dairy farmer, who has implemented more complex and diverse agroforestry systems in his production. By doing so, he has diversified his production and will be able to not just generate income from his cows but also from the fruit trees that has been planted in a silvopasture system.

Recognizable in his production is also the value of **short chain.** Food forest which lie in this quadrant are expected to benefit from direct sales, which ensures that the farmer gets a higher margin.

Cleary, **rentability** will be another important value in this quadrant as entrepreneur are paying great attention to the long- term sustainability of the business.

5.1.2 Quadrant 2: Individual and natural capital- Nashi pear

The Nashi pear quadrant falls in between the individual and the natural capital which includes the ecosystem services and the experience that is derived from this. The values which fall in the quadrant are created and sustained by nature.

An important value and starting point for businesses in the nashi pear quadrant is **valuation of ecosystem services** and the aim to **combine high biodiversity with agriculture**. This results in the creation of a **beautiful and healthy environment,** in which ecosystems are valued and used efficiently. The value of **resilience** has equal importance for the individual as for the natural capital, as it is important for the entrepreneur to manage a system that functions on a long- time scale and which will be able to respond to future challenges such as extreme weather conditions.

Even though the businesses are focusing greatly on ecosystem services, such businesses are still commercially oriented. The focus is not directly on the sales of food forest products but rather on education and the **collecting of data** for a profit. These kind of food forests are few, as there is not a well-established market place for the selling of this data. A common business structure is the combining of a productive food forest with a **consultancy** where the gathered data is used and implemented in new projects.

An example of this category would be the most well-known food forest in the Netherland in Ketelbroek. This food forest was established in 2009 and has since than functioned as a showcase of a food forest in the Netherlands. The design of a food forest is complex and grounded in ecological principles, in which ecosystem services play an important role. In the first years of its establishment, the food forest has served as a site for education and data collection, where excursion and workshops were part of the business model and could generate a small profit. As the food forest currently starts to reach its greater productivity, the business becomes more market oriented, and products are sold to a restaurant and the organic supermarket 'Ekoplaza'. The case of Ketelbroek is also an example on how the values of a food forest can change and expand overtime.

5.1.3 Quadrant 3: Produced and social capital- Honeyberry

In the Honeyberry category, food forests initiatives are directing a great emphasis on the social - and produced capital. Food forests in this category are commonly focused on the production of healthy food and fruits for a community. Therefore, community supported agriculture-initiatives are also grouped in this category.

As this category falls on the social axis, values such as the **social involvement in farming activities** play an important role. In such a project, the involvement of the community is important to establish a **connection between the producer and consumer**. Food forest initiatives in this quadrant are approaching the gap that is currently recognized between the producer and the consumer, by being transparent towards the consumer and creating trust. The profit generation of such businesses can come from the sales of **tastier and healthier food products** to the local community, but also **recreational purposes** can be an interesting business strategy.

An example of a business case in which the value of recreation is greatly visible, is a project that combines food forest with a holiday homes. The idea of the project is to use the recreational value of the food forest, to create an environment for the tourists in which the connection between consumer and producer can be established. Besides this, the food that is grown in the food forest, will be used directly and served to the people who are staying in the park. In this case, profit is generated through the recreational value of the food forest within his holiday park. Besides, the produced capital is of great importance since profit is generated through sales of the produce in the restaurant and the local store on the site.

5.1.4 Quadrant 4: Social and natural capital- Aronia

The last quadrant is the Aronia, where the emphasis is on the social and natural capital. In this category, the most diverse food forests are found. These food forests are often experimenting with a large amount of species, where often no market information is known for. The products of these kind of food forests are often consumed by a group of connected volunteers and the local community.

In this quadrant, a value is to raise awareness of the existence of alternative farming systems such as a food forest. In this way **education and knowledge exchange** plays an important role to reach this goal. Such projects are aiming to **build a community** around the food forest in which the **care for the less fortunate in society** play an important role. In this way, food forest operating in this category recognize that a food forest can contribute to a healthier and happier society. It is a place in which everyone is welcome and where the services a food forest provides is shared among the community. As such projects also pay great importance for the natural capital, an important value is to **add higher biodiversity to nature**. In general, these projects are often grounded in permaculture principles to create a sustainable human culture.

An example of such a project is the ´Rotterdam forest garden network´ which has the ambition to renew the design, construction, management and the maintenance of urban greenery. The founders are doing this by creating food forests mainly in urban settings. In this way they bring food production close to the consumer and involve the community. It is their aim to raise awareness of food forestry and to add green spaces in an urban setting. In their business case, the idea is to work with volunteers which will not just help in the development of the project, but who will also be educated about the processes on the site.

5.2 Products & Services

As described in the background information, the food forest is built up of 7 layers of vegetation. In some models, there is a proposed 8th layer where the fungi are described. In each of these layers, multiple products can be grown. The products can be grouped into harvested cash crops (specialty & regular products) and supplied services. A cash crop is a crop primarily grown for its valuable fruits, roots, leaves, nuts or wood. The opposite of a cash crop is called a subsistence crop, which is a crop primarily grown to feed the farmer and its family. In a commercial food forest, there are commonly multiple cash crops in the system generating revenue. In a food forest where social capital is valued, subsistence crops are more often found. The great diversity of products in both provides the farmer with a kind of 'insurance policy' might one crop disappoint in yield or price.

A cash crop should be productive and marketable and are divided into niche and bulk products. However, all food forest products are still niche products as they supply a niche in the market (organic+ markets). However, some products produced in the food forest are high producers and serve a larger niche than some. For example, apples produced in the food forest can be sold in the wide niche of organic fruits. Szechuan pepper, on the other hand, is a low producer that serves a much smaller niche; chefs that are interested in experimenting with new herbs & spices. For this reason, the term 'niche' and 'bulk' are to be interpreted loosely.

The type of values the food forest is based on greatly affects the type of products grown in the food forest. For food forests in the pawpaw quadrant, the focus is on marketable products. There will most likely be the production of more known fruits, or small-scale production of specialty products. These products are most likely sold through a value chain. The food forests in the nashi quadrant are also commercially oriented but are focusing on natural capital rather than produced capital. Service-supplying food forests also fall into this category. The service these food forests are supplying are for example the gathering of data or consultancy. Following this, the food forest will most likely be planted with crops that show great market potential, yet lack cultivation data. Other likely crops in the system are crops where cultivation data is available, but there is not yet an established market.

Food forests in the honeyberry quadrant are food forests where there is a greater emphasis on the produced value. These food forests are most likely planted with species that are known to provide a stable yield. There might also be an experimental part, however, this is subordinate to the production. In the lower right quadrant, the aronia, are food forests that value great diversity. These food forests are planted with similar crops as the food forests in the nashi quadrant, yet there is no commercial incentive to gather data from them.

In the following paragraphs, practical examples of what products can be grown in the layers will be given. It is important to mention that this list should not be interpreted as a complete food forest, as in a complete food forest there will also be more elements, such as biomass producers. The products are grouped into cash crops and services. Some examples of crop combinations will be given and practical experience from farmers is considered.

5.2.1 Products

The overstory tree layer, also called canopy layer, includes climax trees**.** The trees in this layer are the biggest in the system, in both production as height. The height of these trees is commonly 12m and above. In this layer, possible trees are walnuts, chestnuts, heartnuts, persimmons, mulberry, cherries and exceptionally big fruit trees can be found. Products from this layer are nuts, fruits and lumber. There is a large number of possibilities, but we can observe that food forests in our setting commonly plant chestnuts and walnuts in this layer.

In the pawpaw quadrant, a logical choice would be walnuts and chestnuts, as for both of these there is already an established market and both of these products are well received in the community.

In the nashi quadrant, which is similar in products as the aronia quadrant, the choice is very wide. Some examples are heartnuts, buartnuts, Japanese walnuts, pine nuts, Alleghany chinkapin (*Castanea pumila*), Japanese plum-yew (*Cephalotaxus*), paper mulberry (*Broussonetia papyrifera*) and *ginkgo biloba*. In the aronia quadrant, the choice is even wider as the goal of these kind of food forests is to spark enthusiasm by offering a unique variety of plants growing, not necessarily the products they are yielding.

In the honeyberry quadrant, the choice of trees is similar as the pawpaw quadrant being walnut and chestnut.

The understory tree layer or lower tree layer includes trees between 6-12 meters in height, and a smaller spread than the canopy trees. In this layer, small trees such as hazel, apples, pears and high bushes such as the goumi (*Eleagnus multiflora),* autumn olive *(Eleagnus umbellata)*, *caragana arborescens*, figs (*Ficus carica)*, cornelian cherry (*Cornus mas)*, chokeberry (*Aronia melonocarpa*), apples on dwarfing rootstocks (*malus domestica*), plumbs (*Prunus domestica*), peaches (P*runus nucipersica*), and Medlars (*Mespilus germanica)* are found.

In the pawpaw quadrant, most commonly planted species are plumbs, apples, pears, quince and hazel. I the honeyberry quadrant, this is similar.

In the nashi quadrant, species such as medlars, figs, peaches, cornelian cherries, nashi-pears (*Pyrus pyrifolia)*, autumn olive, chokeberries and apricots are commonly planted. In the aronia quadrant, even more species can be added, such as pawpaw (*Asimina triloba)*, shipova (*x Sorbopyrus auricularis)*, goumi (*Eleagnus multiflora*) etc.

The shrub layer includes berries, fruit, nut, currant shrubs but can also be medicinal and flowering shrubs. These shrubs are commonly not higher than 0.5-6m and grow underneath the smaller trees.

The most common in the pawpaw and the honeyberry quadrant are currants, brambles and raspberries.

The most common in the nashi and aronia quadrants are Saskatoon, elderberries, elderberries (*Sambucus canadensis*), sea buckthorn (*Hippophae rhamnoides*), gooseberries and rowans (*Sorbus ssp.)*.

The herbaceous layer than consists of perennial plants without woody stems, used as medicinal herbs, vegetables and bee- foraging plants. Examples of species in this layer are asparagus, day lilies (*Hemerocallis ssp*.), ramson (*allium ursinum).* Some plants in this layer are commonly regarded as weeds but are edible and have valuable properties. Examples of these are dandelion (*Taraxacum officinale*), stinging nettles (*Urtica doica*) and horsetails (*Equisetum arvense*).

The ramson is known to perform well in the food forest system and need little to no maintenance. This product can be marketed as specialty niche product, as the taste is alike garlic. The leaves are commonly used as garnish. For this reason, it is sometimes planted in food forests in the pawpaw and the honeyberry quadrant. Other species in the pawpaw quadrant are herbs, such as rosemary and thyme, and asparagus. Edible flowers can also be planted in this layer, such as daylilies.

In the Nashi and the aronia quadrants, common choices include different types of sorrel (*Rumex ssp*.), different types of comfrey (*Symphytum ssp*.) or chamomile (*Matricaria chomimilla*).

The root layer refers to the rhizosphere and consists of root crops. These crops are sometimes left out of the system in order to lessen the disturbance of the soil or for practical reasons. Examples of species in this layer are potatoes, Jerusalem artichoke, groundnut, horseradish and carrots. In the pawpaw and honeyberry quadrants, common choices are Jerusalem artichoke (*heliantus tuberosus*) and potatoes.

In the nashi and aronia quadrant, Quamash (*camassia quamash*), Indian cucumber root (*medeola virginica*), Oca (*Oxalis tuberosa*) and skirret (*Sium sisarum*) are sometimes grown

The ground cover layer covers the soil surface and fills the remaining space on the ground. This layer is very useful for covering the soil to prevent leaching of nutrients or erosion. However, this layer might also be composed of leaf litter and debris. Examples of plants in this layer are the forest strawberry (*fragaria vesca*) or nasturtium (*Tropaeolum major*).

In the pawpaw and honeyberry quadrant, the crops of choice are forest strawberries and violets (*viola odorata*)

In the aronia and nashi quadrant, possible crops are; ground elder (*Aegopodium podagraria*), Hysop (*agastache founiculum*), welsh onions (*allium ssp*.), Columbine (*aquilegia vularis*), Udo (*aralia cordata*), wallflowers (*campanula ssp*.), Golden saxifrage (*chrysosplenium alernifolium*), Siberian purslane (*claytonia sibirica*), creeping dogwood (*cornus canadensis*) and many more.

The vine layer is a vertical layer which consists of plants with a vining habit. These vines will effectively use all space in between the layers and can also grow into the canopy of the trees. Species in this layer could be kiwis, grapes and hops.

Commonly planted in food forest in the pawpaw and honeyberry quadrant are kiwi, kiwi berries or grapes, as these markets are easy to develop, and the plants grow easily. The kiwi berries have the benefit of being a novelty, which could be developed into a profitable specialty product.

In food forests in the nashi and aronia quadrant, commonly planted are the magnolia vine (*Schisandra chinensis*), honeysuckle (*lonicera periclymenum*), chocolate vine (*akebia quinate*) and different types of kiwi berries.

The final layer is **the fungi layer**, where we can find mushrooms and beneficial fungi. Products in this layer can be oyster mushrooms, boletus mushrooms and morels (*morchella esculenta*).

This product group is difficult and is sometimes left out. This layer will become interesting to try when the food forest is established and there are more fungi present in the soil.

A total list of possible products can be found in appendix **III**.

5.2.2 Services

In this subchapter, the monetary services a food forest enterprise can provide, are presented. Services such as water retention and improvement of soil fertility are also food forest services, but these are not sellable at this moment. Food forest where providing services is the main revenue-generating process are most likely to be found in the nashi quadrant.

Since the nashi quadrant is placing emphasis on natural and individual capital, service providing enterprises fit well into this structure. For example, a food forest where research is done and sold through consultancy can be found in this quadrant. Besides, there are many different companies that are selling experience. The form of this experience can be as food forest design, as food forest maintenance, as consultancy on running a food forest business, as consultancy on market/product combinations etc.

In the pawpaw quadrant, possible services are focused on the produced capital and individual capital. Following this, the creation of 'experiences' is possible in such a food forest. Examples of this are; providing a place for taking photos, providing a place for gatherings, providing a place for conferences, renting out camping places or tents and similar experiences. Other experiences could be giving training and lectures on food forests.

In the honeyberry quadrant, possible services are providing a place for self- harvest of fresh fruits and vegetables. These food forests are not commercial but can be using a system where labor is shared with a larger group of people, same as harvest.

In the aronia quadrant, possible services the food forest could supply are acting as an adult daycare center. In this daycare center, people who got estranged with society get a change to reintegrate. People in this daycare facility can be people with a chronic condition, disabled or elderly people. The providing of a place where social connections can be made is very valuable for some and helps them reintegrate into society. This service is also possible the other quadrants but is most likely not seen on the upper quadrants (pawpaw and nashi) as it interferes with the revenue-creating process.

5.2.3 Examples

A broad range of food forests are already in place. Some are already reaching the point of producing, although none except food forest Kethelbroek is seeing economic production. There are a number of farmers that are implementing agroforestry principles in their cultivation and might also include a food forest.

An example of a dairy farmer implementing a commercial food forest is the nature-inclusive farmer in Slabroek. This farmer is located in Uden, in an area where a lot of impoverished soils are. This farmer has a total of 25 hectares, of which about half is used for the dairy cows, designed as agro-silvoculture. The other half is very impoverished soil, with the cultivation layer being only 10-20 cm thick. On these poor soils, this farmer invested into a food forest two years ago and started with planting a tree-dominated system. The trees in this system are Ginkgo, black walnut and buartnut. The trees in the system serve a double purpose, as they also produce valuable wood. The food forest products in this system would be nuts, leaves and berries; the ginkgo nuts, black walnut nuts, autumn olive berries and the leaves of the ginkgo.

Another example is found in the food forest planted by the forest farmers in Sint-michielsgestel. This system is very diverse and has many different types of crops. There are 100+ present on the one-hectare plot they farm, with canopy trees being chestnuts and pears. Furthermore, this food forest is very focused on improving the soil quality by actively growing and bringing down a large amount of biomass. This project is very much commercial, and plans to sell figs, medlars, cherries, apples, pears, kaki, cornelian cherry, pecans and annual crops.

5.3 Production & Chain

The production and chain of the transformative business model explains what is necessary to deliver value to the costumer. This includes the production and internal processes, such as labor and maintenance. Besides, the chain describes the channels which are used to reach the consumer are described.

As discussed in the multi- level analysis, a common value chain for food ingredients is long and involves several different parties. Value chains are essential in understanding the profit-generating processes of a company and should provide a clear overview of how the product is moved from producer to consumer. The term value chain describes where the value is brought and all other value-adding processes. The term 'supply chain' uses overlapping concepts, however, it is used solely for encompassing logistical and procedural activities. In

the supply chain, the focus is put on reducing procedural friction in between parties. In the value chain, the focus is on effective over efficient chains. (C. Martin Webber, 2010)

Value chains are designed for parties to strengthen the linkage between them. The main process in a value chain is building trust, for that separate parties in the chain can grow together and take advantage of market opportunities. The trust in the chain is essential for it to function. When one party loses trust or disrupts the trade, the whole chain will suffer. Consumer trust is a driving force behind traceability and transparency; whenever consumer trust is low, the whole chain is disrupted.

Shorter value chains are chains where there is a very limited amount of parties involved. This kind of initiatives is seeing growth as consumers are attracted to the concept, which is partly due to the high level of transparency. Shorter chains are characterized by higher margins for the producer, but commonly lower quantities as the market for the product is limited.

5.3.1 Production

Labor and maintenance

In terms of labor, it can clearly be seen that the food forest is not yet focused on how labor can be organized in the food forest. This is mainly because none of the projects has yet reached a high production capacity. However, as described above, many projects have made use of volunteers to keep up with the high demand of labor in the initial phase of a food forest. In this way, labor is directly seen as a way the producer can connect to any potential customers. This experience is also needed to educated people as food forestry is a knowledge intensive job.

For food forest operating in the paw paw quadrant, it might also be an important to employ an educated food forest farmer as soon as the amount of labor increases. In this way, it is advisable to have one person on the site who is monitoring the system and is organizing and implementing maintenance and harvesting activities. In this way, production risks are reduced, and the value chain be organized more efficiently. The food forest farmer can be the entrepreneur himself, or another person which has been educated previously on how to manage a food forest.

5.3.2 Chain

Certification

The chain design includes the importance of a certification since it is an important indicator for which channels are chosen to reach the consumer. The interviews have clearly shown that opinions of its necessity are divided.

For instance, some interviewees do not consider a certification as necessary, nor applicable. A food forest produces more than just produced values, and therefore adds a plus to the established organic certification. Besides, since a food forest operates on a short chain, which is built on trust, a certification should not be necessary to communicate the produced values.

> *"We invented the label because there was no connection between the producer and consumer. We established a label that gives you trust but if you know your producer, you don´t need a label anymore."*

On the other hands, some interviewees do consider organic certification as necessary as they see the advantage of an already an established market.

Supply

According to interview data with suppliers for food forests, it became clear that the demand for organic food forest plants is currently exceeding the supply. Besides, there is a high demand for exotic and speciality species, which are often not available in high quantities.

Therefore, a development can be recognized in which tree nurseries start to graft more speciality species themselves. Such species are than sold out quickly, which does not enable the tree nursery to arrive at the point of propagation. Due to the rapid growth of food forests in the Netherlands, it can be expected that new tree nurseries are established in the future due to the promising market opportunities. For already established tree nurseries it will be more difficult to specialize in the production of speciality food forest products.

"Suppliers try to adapt to this change of demand, but it is too much work to switch completely. Tree nurseries are often specialized in a few main crops and then diversify with other species, but a complete shift would require too much work and more land. "

Channels

By taking into consideration the existing food forest initiatives in the Netherlands, it is clearly visible that food forest entrepreneurs have chosen a short chain where trust between the different parties is essential. Even though, the current food forest initiatives are still in their early stages, there are many ideas and approaches on how a value chain can be designed.

Depending on the quadrant in which a food forest operates in, there can be a few differences on how the products reaches the consumer. These will be described in the paragraph below.

First, the paw paw quadrant focuses mainly on the production for economic return. As mentioned before, this can include a greater range of regular products but also specialty products, which are still not well known in the market. The interviews have revealed that due to its uniqueness and quality attributes, the entrepreneur is mainly focused to bring its products directly to the costumer, instead of selling to a commercial supermarket. Selling directly to the supermarket, is often perceived as difficult by various entrepreneurs as this means a direct competition with the conventional products and the potential loss of the products values. In this context, the dairy farmer in Zeeland is a good example, where the entrepreneur is aiming to sell his products to local stores instead of large supermarket chain. The local store already has an established consumer base and the reputation of selling local fresh products. In this way, it is not of great importance to invest in marketing, as the shop already in itself stands for local, fresh and quality products.

Figure 5-3: Short chain with local store.

On the other hand, the food forest in Hoogerheide has decided to sell directly to greengrocer, who is supplying 80 percent of the restaurants in that area. In general, the gastronomy sector is considered as an important customer for food forests, since chefs are open to experiment with new products and express a great interest in food forest products. In case of the food forest in Hoogerheide, all harvest goes to the greengrocer and the food forest entrepreneur does not has to take responsibility of the logistics. Products will be harvested fresh and will directly be delivered to the greengrocer. In such a value chain, the importance of certification such as SKAL is considered as low as the restaurants which are supplied by the greengrocer do not demand a certification. From the already establish value chains that has been revealed during the interviews, this chain through the greengrocer is considered as the longest.

Figure 5-4: Short chain including green grocer.

Even though the entrepreneur in the interviews are not specifically acting in these value chains yet, it is important to mention that there are also great opportunities for food forests to operate in longer value chain. For instance, the market of walnuts seems to show promising opportunities, where the possibility for farmers arises to sell their products to facilities, which further process the nuts into walnut oil. This oil is said to have high source of protein and essential fatty acids, where the demand for this oil is expected to increase in the future. (CBI, 2019) In such a value chain, the raw product is most likely to first pass via a wholesaler, processing factory and then the supermarket and end consumer. Since the chain is longer, there is a potential risk that the producer will gain a lower margin than he would in a short chain.

Figure 5-5: Long chain including processing and supermarket.

Within the nashi pear quadrant, the emphasis lies between the natural and the produced capital. This means that a lot of attention is payed to ecosystem services and the production is focused on diverse quality products, rather than a combined production with regular products. An example for such a production system is the food forest Ketelbroek, which has reached a higher production capacity in the last years. Also here, the short chain is chosen as a way through which the value of the products can be sustained. The products are sold directly to a chef cook who uses the products in the restaurant dishes. Gastronomy in general is seen as an important costumer for food forests, as they value quality and specialty products, which can be added to the menu. For a restaurant it is a unique selling point to add new products and dishes to the menu which have been produced in a sustainable manner. This can be a win- win situation as the restaurant attracts more costumer through diversification while the food forest entrepreneur can reach a fair share for the products by selling directly to the restaurants. In this chain, the products reach through a processing step which in this case would be the restaurant. Another example for a processing step can be selling the products to breweries who will further process the products into new specialty products.

Figure 5-6: Short chain including processing step

An option for a value chain for the honey berry quadrants is to build customer base through subscribers. The idea of such chain is that costumers are first invited to get to know the production and can participate in self-harvesting as well. As the consumer gets a direct idea of the production system, trust is built, and the use of certification becomes unimportant. At the point where the food forest entrepreneur has reached a greater production capacity, it becomes possible for him to inform the subscribers about ´the harvest of the week´, and the costumer can order the products online. Afterwards the products will be delivered to a specific point, where the costumer can pick them up.

Figure 5-7: Short chain including pick-up points.

In the aronia quadrant the social aspect and the natural value are likely to result in the production of more diverse products than in the honey berry quadrant. However, the connection with the consumer to the agricultural production and the community value is still of importance to such food forest initiatives. In this regard, such systems establish a consumer base as people become directly involved in the production. In this way, the costumer knows exactly how the crops are grown and feels stimulated to support such as production system. Since such a system is less likely to focus on generating a high production, the direct chain to the costumer is most likely to occur in this quadrant. Further, since community values are of great importance to his quadrant, the products are likely to be shared with the local community either in exchange of work or in profit. Besides, the entrepreneur can decide to sell his products directly at the site through his own farm store.

Figure 5-8: Direct chain.

5.4 Valuation

In this part of the chapter, possibilities for the valuation part of a food forest business model, are described. Therefore, the most important revenues and cost drivers will be described for each of the four quadrants.

5.4.1 Scenario Pawpaw

The pawpaw scenario is most related to agriculture scenario, where production is taking place on a larger scale with high investments. Land is in most cases the biggest investment followed by the investment of field stock. There is a big difference between the rent for nature land and the rent for agricultural land, with 400 to 500 euros per hectare of nature land and an average rent of 1,200 euros per hectare of agricultural land. In the last years, the value of agricultural land has increased continuously and is not expected to decrease in the coming years. The investment in land is stable, which is also why the food forests in the Pawpaw quadrant is considered as an interesting investment for pension funds. As the value of land will increase during the running time of a food forest, the land can be sold later for a higher value.

The difficulty about the high investments in this quadrant is the long timespan on which a food forest is operating on. However, there are a couple of possibilities on how this issue can be addressed. For instance, the investment of land can be saved if the land is rented instead of owned. Since the revenues of a food forest are low in the early years, it is a possibility to find an agreement on postponed rent. This means that the rent of the first years will be paid in the later years, when the food forest has reached the point of productivity.

Another option is to look for another income in the first years. This income could for example be based on recreation, consultancy or guided tours. Therefore, a side- income besides the food products can be developed.

"A food forests needs time. If you don't have savings or other aims, you need to have another or side income in the first years"

Currently the financial support for food forests is expected to last until 2027, which is due to the aim of the green development fund (GOB) to increase the amount of nature land in Brabant. To do so, the GOB is providing financial support to people who would like to change the designation of their land from agricultural to nature. In general, the average agricultural land value is around €60,000 per hectare (NVM, sd), while the average value for nature land is around €15,000 per hectare. The financial contribution of the GOB is intended to close the

gap between these two land values. But besides the support from the GOB, it has become possible since 2019 for food forests to receive subsidies from the common agricultural policy.

Since food forests in this quadrant are more commercial oriented, more careful decisions are made on where the products can be sold in the market to receive a fair price. Further, legal forms will be based on the commercial orientation of the food forest as well. In this quadrant, the revenues are generated mainly through the sales of products that are provided by a food forest. These can be fresh or processed products. When these two options are compared on their weight, it can be seen that the price for fresh products is higher than the price for processed products, which is due to the higher weight. At the same time, the fresh products will need a more careful and higher labor intensity as the products need to be harvest just in time. The result of this is that costs increase.

On the cost side, two important indicators are the costs for land and the labor costs. In general, on a common agricultural farm is tried to reduce costs through mechanization and efficiency (Beers, Bemmel, Grimm, & Maas, 2017). For them, costs for fertilizers and pesticides play a major role on their balance. For a food forest, these external inputs are not needed and therefore these costs can be saved. In the first years, when the harvest is low, the costs will therefore be low as well. The only costs an entrepreneur has then are the costs for land and other company costs. When the food forest reaches higher productivity, the needed labor and related costs are growing as well. Besides, in the first years, some maintenance needs to be done in the food forests, which includes additional labor costs.

5.4.2 Scenario Nashi

Another way to receive an income the first years is to focus on other values. As said before, the connection between agriculture, high biodiversity, restoration of ecosystem services and the creation of beautiful landscape is part of the nashi. This is expressed into revenues based on research, experience and consulting. For example, food forest Ketelbroek and Den Food Bosch are earning money out of this to receive income in the first years. Later on, the revenues of the food products will become more important.

At this moment, some of the farmers have a side income through diversifying activities. Some examples of this could be care, recreation, education or farm sales. In total, around 3% of the farmers are engaged in such activities, with the dairy sector having the highest percentage of diversification activities. Around 4% of the Diary farmers, are using the concept of diversification (Agrimatie, sd). Besides that, subsidies play a role for diversifications. The two options of diversification and subsidies can play an important role for food forests as well. Subsidies in this scenario could be based on ecological values, where simple hedgerow management is an example for that (Beers, Bemmel, Grimm, & Maas, 2017). The costs in this scenario are comparable with the costs in scenario one. Of course, the labor costs for the side incomes can give and increasing cost price and will have an influence on the balance calculation.

"Fanatic food forest people have a specific design and layout and they want exactly the trees which are in the design. Customers are not so much scared of the price."

Developing a better landscape is part of the goals of the Dutch government, which are related to the Paris agreement and imply that the Netherlands should develop 100,000 hectares of forest. Based on this, the government also gives financial support for initiatives that follow this goal. Food forests that operate in the nashi quadrant are likely to rely on funds and subsidies since they contribute to these goals through directing greater emphasis on the natural value. Since entrepreneur in this quadrant are not paying with their own money, they tend to more easily spend money and care less about the investments of plants. Their specific design and layout is leading.

5.4.3 Scenario Honeyberry

The third scenario is based on the produced and social capital, in which, next to the commercial orientation, additional monetary value is of importance. The commercial orientation can be recognized by the sales of produce while monetary value is produced through recreation or consultancy activities. For these food forests, the income of food products could be seen as a side income, while greater emphasis is directed towards the creation of additional monetary values (Beers, Bemmel, Grimm, & Maas, 2017). Main difference between the Pawpaw scenario and this one is the community orientation, which is why the services in this scenario also provide benefits. An example for this can be seen in the combination of a food forest and a recreation park. The most important in this example would be the revenue through the rental income.

"I gave households during the crisis vouchers for small vacation to get people talking about my park. Nowadays, they are willing to pay for it."

Since food forests in this quadrant are community oriented, the labor costs will be lower. The food forest will provide labor for the direct community, where volunteering can be part of such a project. Another example in this scenario is community supported agriculture. Community supported agriculture gives individual households the chance to become a member of the initiative and do their own harvest. If community supported agriculture is used, the value self-sufficiency is very important and the commercial side of the business is lower.

5.4.4 Scenario Aronia

Out of all four scenarios, the food forest projects in the Aronia quadrant are least commercially oriented. In this scenario, the legal form that is most likely to be found, will be a foundation that can be organized in different ways. For example, the owner of the land pays the foundations for doing the design for a food forest. The foundation can then use that income from the design to pay for planting material. The company is likely a non- profit organization.

One of the most important values in this scenario is community building, which implies that the maintenance of the food forest is likely to be done by volunteers. Some of the people in the foundation can get a management fee for the establishment of the food forest. However, in general, the money that is earned by the foundation, should stay in the foundation. Next to volunteers, sponsors can also play a role for food forests in these scenarios.

"We educate our own volunteers. If they show progress and they know what they do, we can hire them and they get a payed job."

There are a lot of possibilities to generate profit in this scenario, where all of the earlier mentioned revenue streams can be part on this scenario as well. However, the most important profit in this scenario is the exchange knowledge and education. The amount of labor needed for these project will increase with the running time of the food forest, as the production will increase within the years. Because of that, the entrepreneurs can make the decision to give the experienced volunteers a payed job as soon as the amount of labor increases. If a food forest does this, the company will shift over to the honey berry quadrant.

5.5 Stakeholders

The last part of the transformative business model is about external influences, which includes the stakeholders that have an influence on the project.

5.5.1 Possible stakeholders

A food forest has a lot of stakeholders, which can be categorized into internal, connected and external stakeholders (figure 5-9). The internal stakeholders are different for each food forest. For instance, the managers could be the owners as well. On the other side, if the food forest is initiated by a board, then the board is part of the internal stakeholders.

The connected stakeholders are directly related to the processes of a food forest. For a productive food forest, the clients will be consumers of the product. In a food forest based on experience, the client will be the user of the services. Of course, the specific and their importance stakeholder can be different for each food forest.

On the other hand, the external stakeholders are considered as more general. In the Greendeal, already a lot of external stakeholders have collaborated to reach a common goal that can boost the further development of food forest projects. On the governmental side, the ministries of Agriculture, Economics and infrastructure are important as well as the provinces and municipalities (Greendeal, 2017).

In the last year, more groups have expressed their interest related to food forests. At this moment, the most important stakeholders are 'Stichting voedselbosbouw Nederland', 'The Forest Farmers', 'Stichting Both Ends', 'Stichting Phien', but also the 'Groen ontwikkelingsfonds' and 'Kennis centrum natuur en leefomgeving' have some influence on the development of food forests. This sum of interest groups is just a small number of organizations which are related to food forests in the Netherlands. In general, NGO's working for the environment and sustainability express a great interest in the development of food forests.

Besides that, the agricultural sector reveals farmers as a connected stakeholders. A food forests poses an alternative for farmers to produce in a more sustainable way. Therefore, agricultural interest groups such as ZLTO and LTO are representing the interests of the farmers, where the influence of food forests on the agricultural sector is very important for them. At last, the research done by consultancy organizations and educational institutions play and important role to provide more information on the possibilities of food forests in the agricultural area.

Figure 5-9: Possible stakeholders for a food forest.

5.5.2 Stakeholder values

Stakeholders and shareholders will have some different values related to a food forest company. In table 5-1, the most important positive and negative value for each stakeholder is displayed. Based on social corporate responsibility, a company should not only deliver values for a shareholder, but should consider the values for a stakeholder as well (Roorda, 2015).

Table 5-1: Positive and negative stakeholder value for each stakeholder.

Stakeholder	Positive value	Negative value
Managers	way to earn money and thrive self-fulfillment	uncertain future; a lot is based on predictions
Staff	provides employment	The factual influence on labor is unsure.
Board	Way to earn self-fulfillment for board members.	Return for board members are low in the initial phase
Shareholders	A sustainable investment for the future	The first years, the financial result is limited
Clients	Delivers high-quality, fair-produced products	It takes a long time before big quantities are available
Suppliers	A important customer for high-value trees and fruit plants	No need for re-purchasing of plants or other inputs
Distributors	Provides work for new companies with uncommon products	Small amounts of product yield low efficiency
Processors	Opportunities; a lot of products are suitable for processing	If a product can be sold on fresh markets, that chain is preferred
Financiers	An investment for the future.	The payback time is based on a long timescale
Farmers	Gives opportunities for farmer to change their system	Gives concurrence from a not farm based side
Government	Provides solutions to a lot of governmental goals	Legislation should be adapted
Press/ media	Gives possibilities for media and press to talk about	The predictions make their news weaker
NGO's	Sustainable way of producing	Producing is not central is a formats of food forests
Interest groups	Diversification of food forests gives more knowledge	Because of the long timescale, a lot of predictions are taken
Agricultural interest group	Gives opportunities for farmers	Is based on other fundamentals than agriculture

Consultancies	New companies give new opportunities	The predictions make a strong advice difficult
Environmental organizations	The positive impact on the environment that a food forest delivers	There is currently no real example of the implications on the environment
Education	Food forests provides opportunities for possible research	Most of the research is currently is based on predictions
Community	Involvement of the community in projects	Food forests gives a big change in the rural area

In Appendix **III**, an overview of the relations between the subjects' environment, society and governance related to stakeholders is shown.

6 Business case Food Forest Schijndel

6.1 Introduction

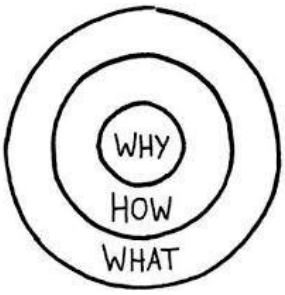
After the chapter in which the possibilities of food forests in the Dutch situation have been explored (5), the case study of Schijndel is analyzed to see how this project fills in these possibilities. A critical view is taken on the project in Schijndel, and gaps in knowledge have been filled in agreement with the entrepreneurs. The business case is formed using collected data that has been Retrieved from interviews with stakeholders of the project. The following starting points for the design of the business case are taken into consideration:

- The business case only focuses on the 17 ha of a simplified food forest, where in the standard hectare only 12 different species are used.
- The business case focuses on the goals **'to provide proof about the economic viability of a food forest system' and 'enriching of biodiversity in the area of Schijndel'.**
- The business case assumes that `Stichting Voedselbosbouw Nederland` (VBNL) will either form a limited liability company (LLC) or change their own legal form to LLC.

The 20ha food forest project of Schijndel has been initiated by Voedselbosbouw Nederland (for further reference VBNL), who presented the idea of creating the largest commercial food forest in the Netherlands to the Groen Ontwikkelingsfonds Brabant (for further reference GOB) and initiated the project in 2018.

To give an overview of the Schijndel project, the golden circle model from Simon Sinek is used. In this model, the questions why, what and how are answered.

6.1.1 Why?



The why question describes the purpose, cause or belief that validates the existence of the food forest project in Schijndel. The overall purpose of the project is:" *To prove that business development and operating a large-scale food forest poses a promising business model, while at the same time contributes to creating vital ecosystems with a large biodiversity.* The project should serve as a showcase for farmers and other 'green professionals', thus stimulate the development of food forest projects in the Netherlands. However, the starting point of any food forest is the restoration of ecosystem services and the inclusion of biodiversity in an agricultural context. The project therefore intends to show that food production can include high biodiversity and climate change mitigation.

Furthermore, professionalizing the food forestry movement and establishing a presence past pioneering is also a goal. During the runtime of the project, knowledge will be collected which will subsequently contribute to a broader understanding of food forestry.

6.1.2 How?

The `how` question describes the strengths and values of the organization. The entrepreneur of the project is VBNL, who is responsible for the design, maintenance and operating of the food forest Schijndel. They promote other food forest projects in the Netherlands while valuing food forests for more than the produced values it created.

In total, around 17 hectares of the project is 'productive', and 3 hectares are used for hedges, water features or pathways. On these 17 hectares, the economic viability and produced values of a food forest are in focus. Besides that, a small part included in the 3 hectares is designed as the educational/recreational food forest. This part has not been planted yet and

in cooperation with one of the main stakeholders of the project, Vitam, it will be designed and planted. The goal of Vitam and VBNL is to connect locals with how their food is produced. They will do this by organizing excursions for primary schools or creating an experience room where chefs can give workshops. This part is openly accessible for interested people and will develop a space where they can learn more about food forests. For the business case, only the 17 ha of the simplified, structured food forest is taken into consideration.

6.1.3 What?

The question `what` refers to the practical part of the project, which products and services are offered in the Food forest Schijndel. In the first place, the food forest Schijndel starts with the vision of having agricultural production without external inputs other than labor and planting material. In the system, diverse, fresh and healthy products will be produced. In addition, the design is made that the crops are grown in rows, which makes harvesting and managing the system much easier. The scale and production volumes are important to the project in order to prove that a food forest system can play a part in future agriculture. In the simplified part of the food forest, many different varieties of fruits, berries, leaves, and nuts will be produced. The main customer is food and beverage catering company Vitam, other customers can be local retailers or restaurants.

Vitam is interested in the food forest as it would give them a supply of fresh produce, grown sustainably, which they can supply their restaurant clients. These clients, chefs, will have the opportunity to work with innovative products with which they can create unique dishes and flavors. For the business case, the assumption is made that the food products will be sold to retail for NET wholesaler price.

Location

The food forest in Schijndel is divided into two locations: Boschweg (approx. 4 hectares) and Hardekamp (approx. 16 hectares). The distance between the plots is 5 kilometers. Both locations are directly bordering a forest area owned by the state forestry department, both of which are part of the nature network in the province of Brabant. This denomination makes it possible for the Project in Schijndel to be in the network of 'entrepreneurship with nature'.

Table 6-1: Locations of Food forest Schijndel.

Name of location	Name of field	Area	Location
Schijndel O 293	Hardekamp	14.4140 Ha.	Martemanshurk te Schijndel
Schijndel O 144	Hardekamp	1.6050 Ha.	Ben Peterspad te Schijndel
Schijndel K 733	Boschweg	1.8260 Ha.	Boschweg te Schijndel
Schijndel K 734	Boschweg	1.4045 Ha.	Boschweg te Schijndel
Schijndel, K 732	Boschweg	0.9980 Ha.	Boschweg te Schijndel

Figure 6-2 Food forest Schijndel location Bosscheweg

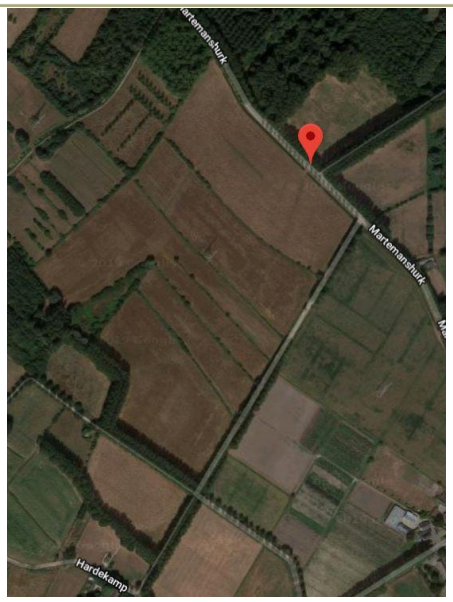


Figure 6-1 Food forest Schijndel location Hardekamp

6.2 Value proposition

The value proposition of Food forest Schijndel is described in the middle of the transformative business model and gives an idea of how different values are embedded in the project. The values of the project have an influence on all other aspects of the business model and give a description of how other parts of the business fulfill these values.

It is important to mention that the food forest Schijndel complies with the food forest definition that has been agreed upon in the green deal and mentioned in the background information. Already by using the principles that are part of the definition, the project is expressing various values.

To continue, it is important to keep in mind that the natural value is a pre-condition for the commercial value. This food forest is expressing this in their goals; to restore biodiversity in the agricultural landscape.

"Use nature as your partner and not as your enemy"

Through internal processes in a food forest, commercial value is created as the system starts to function and yield products.

As mentioned before, a food forest business model takes into consideration values that are acting on all four of the capitals. The business case of VBNL also recognized values that are linked to the four capitals. Through the interview with food forest Schijndel, a list of values has been established, which afterward were ranked on their importance on the different capitals.

After the scoring of the different values, it can be seen in which quadrant most of the values fall. The figure below clearly shows that the values of the project are mainly in the area between the produced and the individual capital, in the Pawpaw quadrant. The natural and social values are still of the importance of the project, but it is necessary to direct the emphasis of the business on the produced and individual capital. By doing so, the admiration to be a showcase for farmers and 'green' entrepreneurs can be achieved.

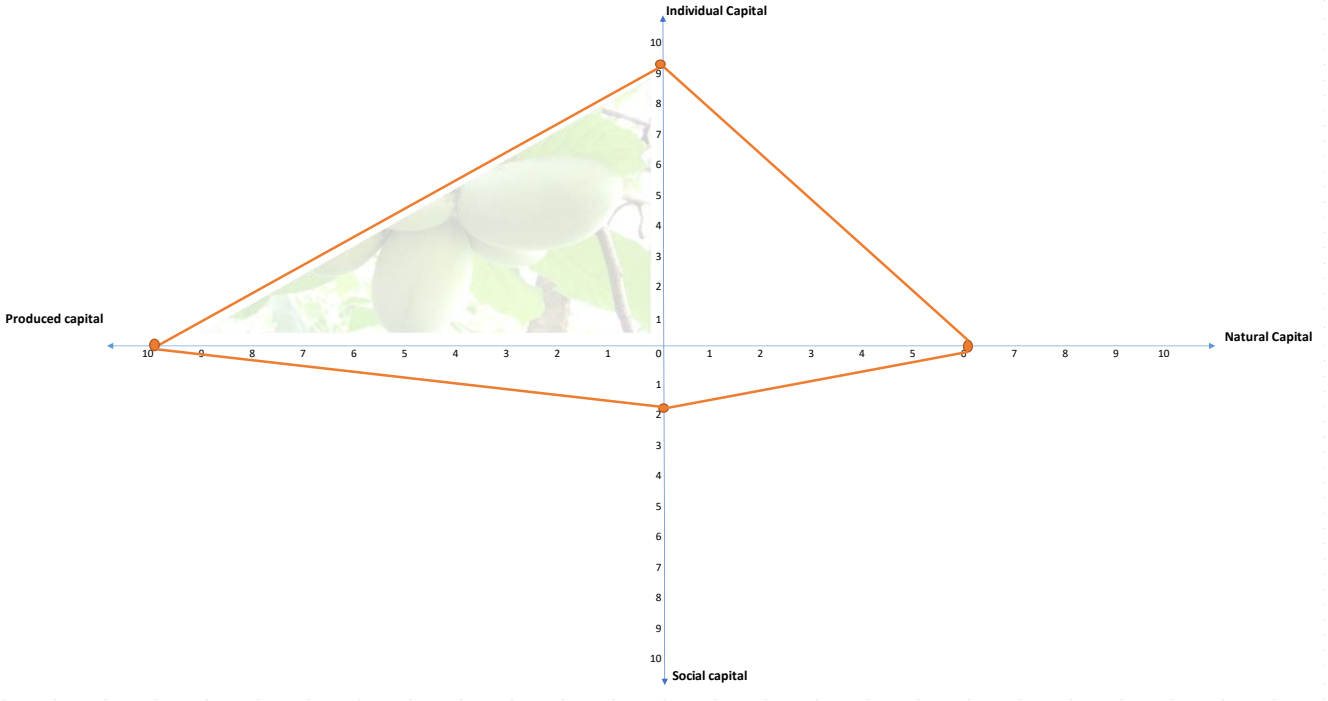


Figure 6-3: Spider web values of case study Schijndel.

Below, the most important values are discussed briefly. Appendix **VI** gives a total overview.

6.2.1 Pawpaw Quadrant

As illustrated above, the emphasis of the business is on the values that fall in between the individual and the produced capital, in the Pawpaw Quadrant. The specific values acting on produced capital, show equal or similar importance to the individual capital. The values discussed below will build the starting point of the business model, where all further activities of the business can be linked back to.

Showcase for farmers

Providing a showcase to farmers is important as VBNL wants to proof farmers that a food forest is an economically viable system. Furthermore, they want to provide inspiration for farmers, by showing that there is an alternative to common industrial farming systems. Being a showcase to farmers includes showing environmental benefits the system produces.

Proof of economic viability

As mentioned above, proving the economic viability of a food forest system is core to the project, to stimulate farmers to produce food in a food forest. This proof is also valued as it can potentially add to the future sustainability of the Dutch agricultural sector.

"We need to proof it and then people will come and see that is financially viable and they want to invest in it."

Simplified production of food forest products

The value of simplifying and structuring the production and organizing the plants in rows is an approach to show that food forests can also be designed in a more structured way in which harvesting, inspection, and maintenance can be done more efficiently. This value links back to the value of providing a showcase to farmers, as this approach is considered to be more attractive to a farmer, as he commonly works with large-scale production and mechanization.

Production of regular & specialty products

In terms of production, food forest Schijndel is intending to have a mixture of regular and specialty products. The food forest is a polyculture, and many different products can be produced. Many products will be novelty products, which can yield a higher price in the market. Currently, many food forest products are unknown in the market and food forests initiatives are trendsetting in the sense of experimenting with different products from unknown plant species. Within time, however, VBNL is expecting that these products will get better known in the market and will eventually change from specialty to regular products. This would also mean that the price for those products will decrease.

Production of value-added products

The idea of food forest Schijndel is to create value-added products, which means that value is added through the approach of growing products under local conditions, using a food forest system. They are intending not to sell to the anonymous market but to sell in the local market, to ensure the added value of sustainably-sourced food can be communicated and maintained.

Research and Consultancy

Another core value of the project is to provide proof through research that this approach to a food forest is viable in environmental and economic aspects. VBNL will research different designs, in order to add to the research that has been done on different designing approaches of food forests. Besides, through collecting data in the runtime of the project, it enlarges and improves the body of practical knowledge on the basis of which farmers can be informed on how they can transition towards a food forest system.

6.2.2 Natural Capital

The natural values and the values discussed above are interdependent since the concept of a food forest is creates these individual and produced values. It is vital to the project to use the ecological principles that are part of a food forest production system to create the ecologic and economic benefits. As the system starts to produce and becomes more stable, the produced and individual capital will become increasingly pronounced. Some identified values in the natural capital were also mentioned by VBNL:

Restoration of ecosystem services.

This value is in the category of nature capital since the food forest intends to restore ecosystem services and inclusion of biodiversity in an agricultural context. By using ecological principles in the design and maintenance of the land, ecosystem services are enhanced and restored.

Enrichment of the landscape

The restoration of ecosystem services is strongly connected with the creation of high biodiversity and the enrichment of the Dutch landscape. This can be achieved by using hedges and wind shelter in the design. This will not only make the landscape more attractive for the local community but also positively affect increase biodiversity. This also implies that non-food producing species will be used in the design, which do not necessarily provide a yield of food product but provide an important service to the entire food forest system e.g. bee-attracting plants.

Connection with the structure of the surrounding landscape

As said in the multi-level analysis, there is a large gap between agriculture and nature and one of the main goals of food forest Schijndel is to reduce this using a food forest. In this way, the food forest is seen as a mean through which high biodiversity can be created and which can also blur the line between the agricultural landscape and nature conservation.

Low- input agriculture

Another value of this food forest is low input use in the system. Since the increase of food forest projects in the Netherlands, there are different approaches to how such a system can be managed. In this subject, opinions are divided since some entrepreneurs use a wider range of external inputs than other.s Such inputs are for instance wood chips, mycorrhizae, and volcanic rock. In food forest Schijndel, the approach is to mimic the natural process as close as possible, a/o to minimize the expenses. Therefore, other external inputs besides the planting material will not be applied to the system. In their opinion, there will form a balance that provides all the necessary services that are needed for the system to function. For example, the control of plant diseases and plagues.

6.2.3 Social capital

One main value was mentioned that is acting on social capital:

Local production & community involvement.

The local production and the community involvement are building on the value of having local production and involvement of the local community in their food production. Food forest Schijndel recognizes the large gap between the producer and consumer and the urban and rural environment. The food forest in Schijndel wants to reverse the development by connecting with the local community and producing healthy food for regional consumers. For closing this gap, the project recognizes that direct feedback loops between producer and the local community should be re- established. This feedback loop will also close the gap between the causes and consequences of environmental damage.

6.3 Products & services

The food forest in Schijndel is simplified and clearly structured; the plants are planted in rows, only 12 species are planted on the standard hectare and harvesting is done much more efficiently. Furthermore, the scale and design of the project enables the production of a reasonable quantity of products and makes the application of small mechanization easier.

The food forest in Schijndel is designed to show farmers a promising business case. For this reason, a part of the products and services are known products and products that are easier adapted to a conventional market than, for example, monkey-puzzle nuts (*Araucaria araucana*). Furthermore, the system is simplified from the 350 species to a mere 50-60. There is a risk concerning oversimplifying the food forest system, and that biodiversity will be lost. However, this is considered, and biodiversity is promoted by ponds, a small river, and diverse hedges. There are many multifunctional plants in the system, which yield a product and attract biodiversity by providing pollen, providing shelter or provide the system with nitrogen.

The food forest in Schijndel will produce products such as apples, pears and plumbs but also less-known products such as the Toona leaves and quince fruits. They don't make a distinction in specialty and regular products as they believe the current specialty products will become part of our staples in the future. Furthermore, current specialty products do yield a higher price, but when there is an excess the prices drop, and the product can be adapted as regular. There are products that are very easy to grow and are easily integrated into the current food system, which have a high potential for going mainstream in the coming years. People need to get familiar with the products first, but due to the ease of adapting this is not seen as a problem. VBNL suggests that a perennial diet is more sustainable from an ecological standpoint, and an increasing amount of people is interested in this.

The design is based on the successful species of Ketelbroek, yet it is important to note that this 'success' is not only in their food production but also in their value for attracting biodiversity. Other parameters that influenced the design were:

- The practical usability and marketability of the products
- The cooperation with Vitam (to a lesser extent)
- The specific micro-climates, regarding warmth and soil depth
- The need for system plants (nitrogen fixers, fast carbon accumulators, etc.)

The field is set up in plots that are all manageable size, commonly one hectare. The fields are similar in setup and can, for that reason, contain different products. The field called 'H13', for example, is planted with rows of hazel, white walnut, currant, Aronia berry, quince, almond, Japanese walnut, sea buckthorn, and Worcester berry. All rows are planted in such a way that the eventual canopy trees will be the walnuts (in the standard hectare). The harvest of the crops is easily collected as all trees of the same species are planted in the same row.

6.3.1 Products

All the different plots will grow different products, but in general the same principles apply. The products can be collectively described in the three product levels (Kotler) as follows:

Core product

The core benefit is the actual need that is satisfied. For example, for food, this is almost always the supply of energy for the bodies' metabolism. This is the same for food forest products; supply energy. However, an argument can be made that the core benefit is more towards 'providing nutrition' and 'increase your health', as food forest products are generally more nutritious than normal products.

Actual product

The actual product is the food itself; the dimension, color, smell, etc.

The actual products produced by the food forest in Schijndel are numerous, but are generally different in appearance, smell and taste than conventional farm produce. For example, the apples produced in the food forest are of heritage varieties unknown to most consumers. The focus of food forest products is on unique flavors and food experiences.

"Lots of the products are very tasty which helps the consumer to get enthusiastic."

There is not yet decided exactly what products will be produced but the most likely products in the system will be: Chestnuts, walnuts, apples, plumbs, Aronia, autumn olive, hazelnuts, currants, rhubarb, ramson, daylily flowers, Siberian kiwi-berries, almonds, Japanese walnuts, sea buckthorn, Worcester berries, white walnuts, peaches, apricots, mountain-ash berries, rowans etc.

The list is still growing, but the consensus is that the enormous diversity will ensure the long-term sustainability.

Augmented product

The augmented level talks about every non-physical part of the product. This includes everything that is making the product unique and adding value to the actual product.

This added value in food forest products is found in the higher nutritional value, the system of growing and the local conditions. The system of growing is unique and poses a method of true environmental sustainability. This sustainability is validated by an organic label, but the actual result of the food forest method is much wider and aware of sustainability than the SKAL definition of organic. The food forest Schijndel plans to build a local market where this added value can be clearly communicated and maintained.

As for now, VBNL calculates their production based on a standardized hectare. This standardized hectare is a combination of uncommon and common products, where an ideal combination is sought for optimal use of space. The different species on this standardized hectare could be found in the table below. The yield is based on the yield after year twenty.

Table 6-2: The different varieties on a standardized hectare of the food forest.

Scientific name	Layer	Product	Kg/ plant	No. Plants per Ha.	Yield (kg)
Castanea sativa	canopy	chestnuts	25.00	11.00	275.00
Juglans regia	canopy	walnuts	50.00	10.00	500.00
Malus Domestica	sub-canopy	apples	27.00	52.00	1404.00
prunus domestica	sub-canopy	plumbs	7.00	48.00	336.00
Aronia melanocarpa	shrubs	chokechery	7.50	96.00	720.00
Eleagnus umbellata	shrubs	autumn olives	7.50	60.00	450.00
corylus avellana	shrubs	hazelnuts	9.00	57.00	513.00
sambucus canadensis	shrubs	elderberries	6.00	54.00	324.00
ribes rubrum	shrubs	currants	1.40	518.00	725.20
Rheum ssp.	herbaceous	rhubarb	1.40	512.00	716.80
Allium ursinum	herbaceous	ramson	0.02	7500.00	150.00
Hemerocallis	herbaceous	edible flowers	0.30	1350.00	405.00
Actinidia arguta	vine	kiwiberries	22.50	73.00	1642.50

However, this standardized plot is only used to make the model manageable. In practice, many different plots will form with many different species. As there is not yet a final design of all different plots, currently only a list of species is given, that is most likely to be in the system. For financial calculations, the standardized hectare is used. If they would apply this in practice, the high amount of the same products will most likely result in overproduction or lower prices. In the appendices, a full list of everything that is most likely going to be planted in the food forest can be found. (Appendix **VIII**)

6.3.2 Services

Regarding services, the food forest in Schijndel is considering the following services:

Selling sequestered carbon

There may come a system where farmers are paid for the carbon they sequester. This system is not yet in place in the Netherlands, but some interviewees suggested that such a system will be put in place in less than 10 years. This system is already in place in Austria, which is in the EU as well. In that country, farmers get paid 35 euros per ton of sequestered carbon for a period of five years (Bramer, Liere, & Boonen, 2019). When this system proves to be successful, it will be easier for another EU country to adopt such a system.

Research on food forest Ketelbroek showed that food forests have the potential to capture reasonable amounts of carbon dioxide from the air, which could generate some income for food forests.

Some interviews suggested that the EU is already working on this on an EU-wide level. The urgency is there, reaching the Paris agreements build up some pressure. Three - quarters of the EU territory is forest and agricultural land, and the EU recognizes that protecting carbon stocks in these territories can be a great tool to sequester carbon (European Commission). The framework for developing a system where carbon sequestration is awarded is REDD+. This framework is already used to determine the emissions by organizations and making these organizations pay for emission.

Tours

VBNL considers giving tours to anyone interested, as an income-generating process. They will be open for farmers that are interested in the system and want to adopt their own system, where VBNL can support them in the form of consultancy. As a first mover advantage, research collected is valuable. By giving tours, research can be shared. By collecting data, it will become possible to give better consultancy for farmers that want to transform their system.

The experience with food forest Ketelbroek is that there are a lot of people interested in tours, which is commonly more than there is time for the entrepreneur to organize them. VBNL doesn't want to have too many people visiting as this would disturb the system.

Workshops

In the group interview, the possibility of workshops was given. However, VBNL is hesitant to giving workshops as they see this as something the community will develop themselves. VBNL will not be the one giving the actual workshops but can provide a place where workshops can be given. There is expected that people giving workshops related to food forests, for example, processing produce, would like to do this on the location of food forest Schijndel.

There was a consensus that the main revenue-creating process is the sales of the food products. Any other revenue-creating processes are a side-income. VBNL sees opportunities here for locals and think they should limit themselves to their expertise; the system itself.

6.4 Production & chain

The logistic part of food forest Schijndel poses an interesting case to study; while there won't be any products coming from the food forest for the first five years, they have already 'designed' quite a part of it. The design has mainly come from their approach and the cooperation they agreed on with Vitam, this limits the need for a long chain. The production & chain is designed by describing the primary processes, where the physical products are followed, and the secondary activities, not directly related to production but essential to the process. After this, the nature of the industry is described using the 5-forces model of porter.

6.4.1 Primary processes

Inbound logistics

Inbound logistics include all relations the food forest will have with suppliers. The biggest part of this relationship will already be at the starting point of a food forest, planting. After that, the only relationship with suppliers will be the replanting. Besides the plants, there a no other inputs and therefor suppliers needed. Any relations that can be in place are relations with recruitment agencies, for ensuring labor for harvesting. Inbound logistics in the food forest in Schijndel are limited. There are policies in place for when a supplier of plants is shipping something to the food forest, but the delivery of plants is commonly close to the date when planting will happen, limiting the need for inbound logistics other than covering some of the bare-rooted plants to minimize damage.

Operations (production process)

The objective of operations in the food forest is producing food for cash and regeneration. Operations to ensure this are as follows (based on predictions of VBNL, after 20 years).

Table 6-3: Needed labor regarding to the operations.

Operations	Days calculated
Prior to operating (one-time only) Developing a business plan and design	32
Managing the surroundings	20
Prepare the field, Preparing the planting and overseeing the planting	200
Project management	15
After establishment (annual time spend) Inspect and measure	1
Maintenance	2
Harvesting & collecting of harvest on central site	60
Organization and logistics, collecting and transporting	5

Reaching customers

Food forest Schijndel has a limited number of customers for now and are planning to supply one customer with the larger part of the harvest. Food forest Schijndel current planned customers are the following:

- **Vitam**

Vitam is a catering company in the businesses, hospitals, universities and government sectors. They put it as their mission to seduce the end consumers to make a responsible and vital choice in food. They value sustainability, vitality, responsibility and corporate responsibility. These values show in the food they serve, fresh and healthier choices available (Vitam, 2018). Vitam has a wide range of specialized chefs to who the company would like to give them more freedom to decide what they want to cook with the products. The value of education finds an important place throughout the value chain since people need to be educated about the products that are supplied. This is also very important for the Food forest.

The logistics involved are limited as Vitam is in the proximity of the food forest. The only logistics Vitam expects from the food forest is collection spots, where they can easily pick up crates filled with produce and deliver these directly to the restaurants.

Vitam is an experienced partner on logistics and VBNL expects that both parties can help each other in this aspect; fresh, unique produce in exchange to little-hassle logistics.

Figure 6-4: Chain based on the relationship with Vitam.

- **Local restaurants (for example 'De Schaapskooi')**

As food forest Schijndel will have limited production in initial years, they see local restaurants as an opportunity to sell the first fruits. The restaurant mentioned has already expressed interest. Logistics to these restaurants will also be a little hassle, as all are not far away from the project and the quantities are low. Chefs in these restaurants need to be innovative and are open to trying new products. They notice their consumers look for healthier alternatives and restaurants recognize the need to respond to this trend. As people start to eat the products, they become interested and will learn about where it comes from and how it has been grown. The possibility of bike-transport to the restaurants is under consideration.

Figure 6-5: Chain based on other local retailers.

- **Traders of processed oils**

Food forest Schijndel will produce nuts and is expecting that, at one point, this production will exceed the demand from the local market. However, this will only become apparent after 10-15 years when the nut trees come into production. VBNL expects that by this time, a cooperative of food forests can be formed to organize logistics and processing for these products centralized. However, there are already nut-presses in the country that can be rented. These products will be sold to the regional/national market, and as there is currently a

rising demand for walnut oil, VBNL doesn't see any problems regarding sales of these products.

The food forest is not investing in large facilities for the storage of products. All products have a limited shelf-life and should be sold as soon as possible after harvest. The Food forest is acting with a 'pull' strategy and will only harvest products when there is demand. When there is no demand for a product, they won't bother harvesting and leave the product for the benefit of the system and biodiversity. As they are practicing this, they don't need a large storage facility as they will only need to store the current day harvest.

Figure 6-6: Possible chain for the sales of walnut oil.

6.4.2 Secondary activities

Human resource management / Labor

The main labor for planting the food forest is coming from volunteers, as there is a large interest in the community to get involved. Secondly, there is a small educational part of the food forest where people can learn and most often get motivated to get to work on the productive parts. The first planting in the winter of 2018/19 was done with volunteers, supervised by members of VBNL, and the consensus was that it was a successful event.

The integration of volunteers for labor is part of the business concept because the volunteers are considered potential future consumers of the food forest projects. Besides, by engaging people in the production, the value of education will be put into practice. The planting days are a way to 'bond' with the local community and this benefits their business, in VBNL' opinion.

Other human resources are currently supplied by VBNL, in the form of designing, preparing, planning, etc. In the future, VBNL is planning to hire one person to manage the food forest farm continuously. This person should be educated about food forests and the management, monitoring and other activities that need to be done. As harvesting will increase, the organization can hire people for that as well.

Technology development

The food forest Schijndel has put soil regeneration central to their business and implementing large machines that compress the soil is something none of them consider. Any machinery they are investing in should be efficient, durable and making the process go easier. There are certain small machines that are now in development that can be used to harvest certain berries; however, these machines are financially out of reach for now.

Time will tell whether the mechanization of harvesting is necessary. These decisions are depending on the financial position when production is considerable. Small tools can already minimize the harvesting time considerably, for example, the nut wizard. This nut wizard is rolled along the forest floor, picking up nuts as it rolls. Another example is having a small knife and basket on a stick, where the fruit is cut with the knife and caught by the basket. For the most part, forest management and harvesting are done manually. They will invest in harvesting crates.

Procurement

Procurement describes the process of obtaining raw materials. In this instance, the raw materials are planting material. The procurement of this material is under progress, as the food forest will be planted in the coming three years. VBNL has close contact with growers from earlier projects and cooperates with the agroforestry research trust in the UK. All planting material needs to be ordered from very specialized nurseries, and for this reason, the process of procurement is expected to take three years. After procurement, the plants are planted and left to grow. For replanting, the procurement part will stay important. To maintain the food forest, a minor part will have a nursery for propagation. This nursery can also give possibilities to supply the plants needed for replanting when certain plants at the end of their lifespan or have withered.

6.4.3 Market description

For describing the nature of the market, the competition and the competitive advantage of food forest Schijndel, the five forces of porter are described. The model is effective in showing the current situation of competition in the market and what the attractiveness of the industry is. The five forces in the model are; threat of new entrants, threat of substitution, bargaining power of suppliers, bargaining power of customers and competitive rivalry.

Threat of new entrants

The industry of food forest products is new, yet the fruit industry is not. The threat of new entry in this segment is low, as the food forest production method has not yet proven itself. There is no other large-scale food forest that is planning on producing on the scale of food forest Schijndel. There is no actual risk of new entrants, as food forest Schijndel is in a unique situation for financing and the most present player in the field of food forestry.

Bargaining power of supplier

There is a limited number of nurseries that can supply a food forest. The needed plant material is highly specific and diverse. Also, the food forest wants to buy organic plant material, but when there is no material available, they will buy inorganic. The power of the suppliers, however, is limited as there is only one-time supply and not a constant need for plants. However, in an interview, the issue was put forward that at one point, there won't be any of these plants available anymore and they will need to contact nurseries from abroad.

Bargaining power of customer

The power of the customer to push prices down is very limited as demand is increasing more than produce. The more food forests will come up the higher power a customer will get. At this moment, the power of the customer can see as limited because of the first mover advantage. Wouter from Eck has seen that people are very interested to buy his products and the demand is higher than the production. The market for organic products is growing heavily (Heinze, 2018) and food forest products are a niche that is increasingly popular.

Threat of substitution

There is no real threat of substitution as food forests products are produced in a way that is not easily copied. The people that buy the food forest products are interested in buying food from regenerative agriculture, and there is currently no other company in the Netherlands active in food forestry. As food forests Schijndel is meant to be a showcase, on the long time frame the threat of substitution will become higher as well. As more and more people get interested, also people of that should become competitors.

Competitive rivalry

There are no other large-scale food forests in the Netherlands at the current time. Even if there would be, VBNL promotes the farming system and would be very happy with other players adopting their method. Competitive rivalry is very low.

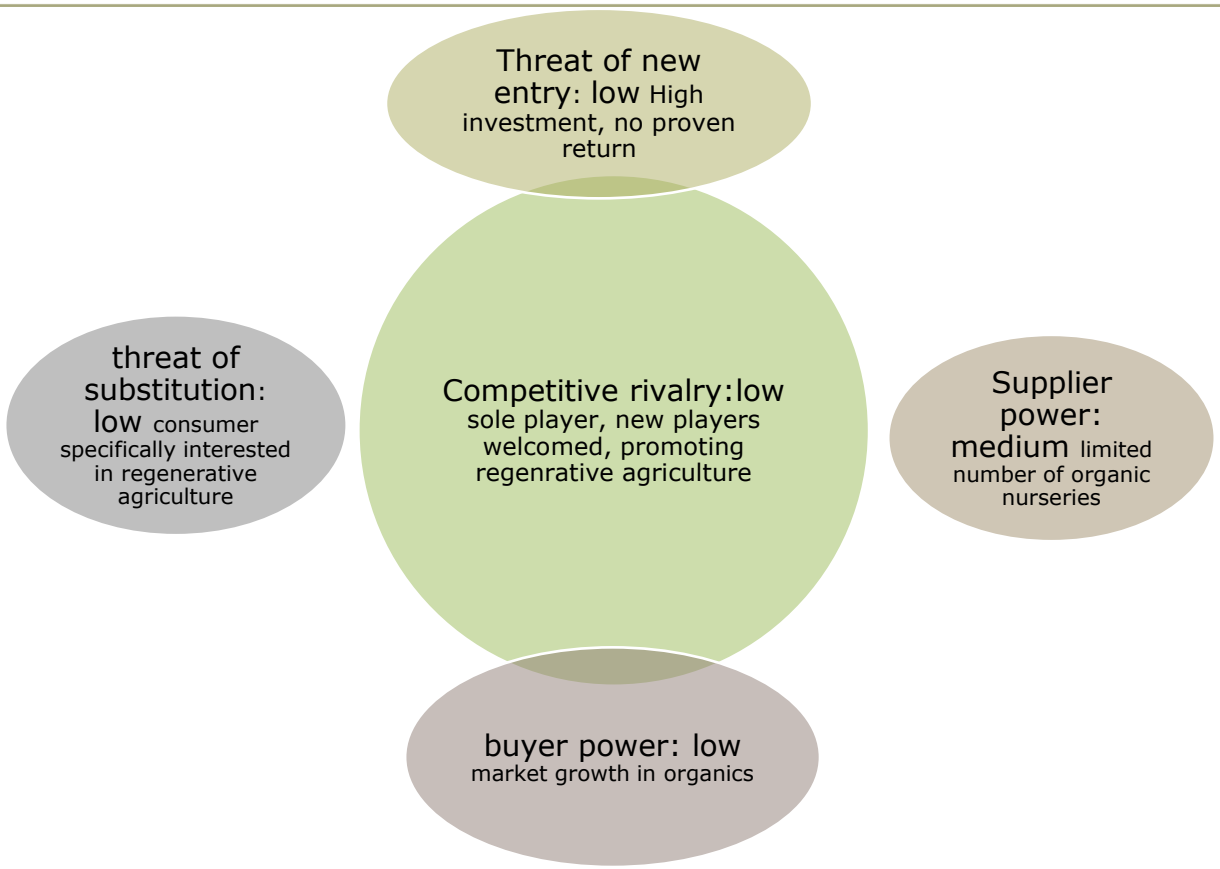


Figure 6-7: Market description based on the five forces of porter.

6.5 Valuation

In this part of the report, the valuation part of the business case is described. The subchapter starts with a microeconomic analysis for year 20, where afterward the financial situation from year 1-20 will be analyzed. To check how the business would perform under a given set of assumptions, a sensitivity analysis is performed. In the end, some financial risks are described.

For this part, some appendices are attached to the report. Appendix **X**, gives an overview of the microeconomic calculations. Appendix **XI** about the financial ones. And at last, Appendix **XII** provides calculations of the sensitivity analysis.

6.5.1 Microeconomic analysis year 20

To get insight into the rentability of the project, it is important to investigate the microeconomic situation after 20 years, the moment when the system has reached full potential. The assumption is made that replanting will happen in phases. For example, currants have a lifespan of 13 years. In these calculations, every year 1/13 of the currants will be replanted. This calculated assumption is called the going concern rate and is described in the economic methodology.

When these calculations are done for all crops, the total turnover for one standard hectare will be €15,800 per year. This NET revenue calculates a harvest loss of 25% which is due to birds, damaged fruits, spoiled fruits etc. In the standard hectare, thirteen varieties are included in the calculations of which about 40% carry around 50% of the total revenue. Effectively, this means that the differences in revenue between the species are quite low. Chestnuts have the smallest influence on the total turnover of the company.

Besides the turnover, it is important to investigate the balance calculation for a one-hectare productive food forest. The business balance of one-hectare food forest is 40% of the total turnover. Subsidies and tenancy are related to the land and company-specific, and for that reason taken out of this calculation.

Micro economical Result per hectare			*Year 20*
Turnovers			
Food products	€ 15,794.49		100%
		€ 15,794.49	
Related costs			
Inspection	€ 280.00		2%
Maintenance	€ 400.00		3%
Harvest	€ 7,200.00		46%
Organisation & logistics	€ 1,600.00		10%
		€ 9,480.00	60%
Bussiness Balance		*€ 6,314.49*	40%

Figure 6-8: Balance calculation for the standard hectare food forest

The total business balance is around €6,300 per hectare. The total project has a business balance of around €107,000 on 17 hectares. With this gross revenue, the company should be able to pay the company costs. For this business case, the expected company costs are around €30,000, excluded from this number are depreciation and interest costs. If the company can manage these and reach year 20, the figures show that the food forest of Schijndel is rentable.

6.5.2 Investment

Before looking further into the financial analysis, it is important to get an insight into the investment. These details are shown in table 6-4. The only missing investment on this table is the land because the GOB is the owner of the plot and the land is leased to VBNL. In the calculation, tenancy for the use of land is included. Furthermore, the GOB is paying for planting material and hard landscaping investments as well. In the first year, they invest €315,000 which is considered as investment. The field stock will remain property of the GOB. 'Returning costs' are costs for planting material every year, which initially is not nursed by their own small nursery.

The investments of VBNL are mostly based on the time they put in the project. For this reason, these costs are considered as starting costs. To show a comparable business case for farmers, the food forest LLC will need to pay consultation costs to VBNL. These starting costs will be mentioned under result of the first years. Besides this, according to regulations, the VBNL must invest a starting capital of at least €18,000. With this capital, the company can start an LLC (BV) (Kamer van Koophandel, 2012).

Table 6-4: Investments GOB & VBNL related to food forest Schijndel.

Investments Food Forest Schijndel					
	Assets	**Field stock**	**Starting costs**	**Returning costs**	**Total**
GOB	€ 99,956.75	€ 170,000.00	€ 27,960.00	€ 17,000.00	€ 314,916.75
Stichting VBNL	€ 19,741.92	€ 108,416.00	€ 72,503.20	€ -	€ 200,661.12
Total	€ 119,698.67	€ 278,416.00	€ 100,463.20	€ 17,000.00	€ 515,577.87

6.5.3 Financial analysis year 1-20

As a result of the microeconomic analysis, it became clear that the project is profitable for the long term. The second step is to investigate how to get to that point. Therefore, a financial analysis for the first twenty years is performed. At the starting point, the Foundation and the GOB have signed a tendency contract for 20 years, which is considered in the analysis. In figure 6-9, the operational results are visualized.

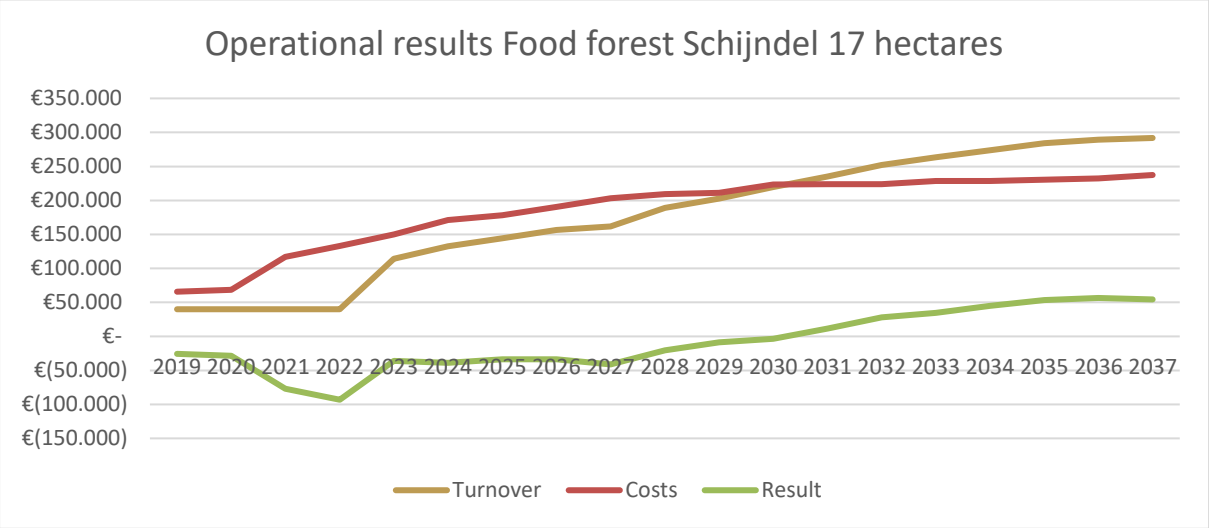


Figure 6-9: Operational results food forest Schijndel 17 hectares.

As presented in the figure, the first product turnovers are realized in year six. Initially, the only turnovers are the subsidies from the CAP and the payments by the GOB for planting material. The costs and turnovers are based on the calculations in the project plan (Stichting Voedselbosbouw Nederland, 2018). Following these calculations, a balance sheet and profit & loss account are built up. The foundation and the project will be split and VBNL will be the one owner of the LLC that is running the food forest. The figure shows that the project will become profitable in the year 2031. In the years following, the revenue will stabilize.

Besides that, it is important to investigate the cash flow situation of the food forest. This can be seen in figure 6-10. As said before, VBNL is the owner of the LLC (BV). Because of this, they are benefiting from the profit of the company. For that reason, the equity position of the company is also shown in the figure. In the first years, the only equity in the company is the invested capital by VBNL. One side-note should be made that the GOB, as the owner of the field stock, has a part of this capital after twenty years. The valuation of the field stock in year twenty is estimated to be €600,000.

The food forest will see a positive bank account after twenty-seven years. After that, the cash flow will increase to two million in thirteen years (after a total of 40 years). This also means that the cash flow position is not a problem when the long-term return is considered. In the process to get to a positive bank account, an allowed negative cash flow position of €800,000 is needed in 2031. With this negative cash flow, the company must pay interest which has a negative effect on the cash flow position. In these calculations, an interest percentage of 3% is used.

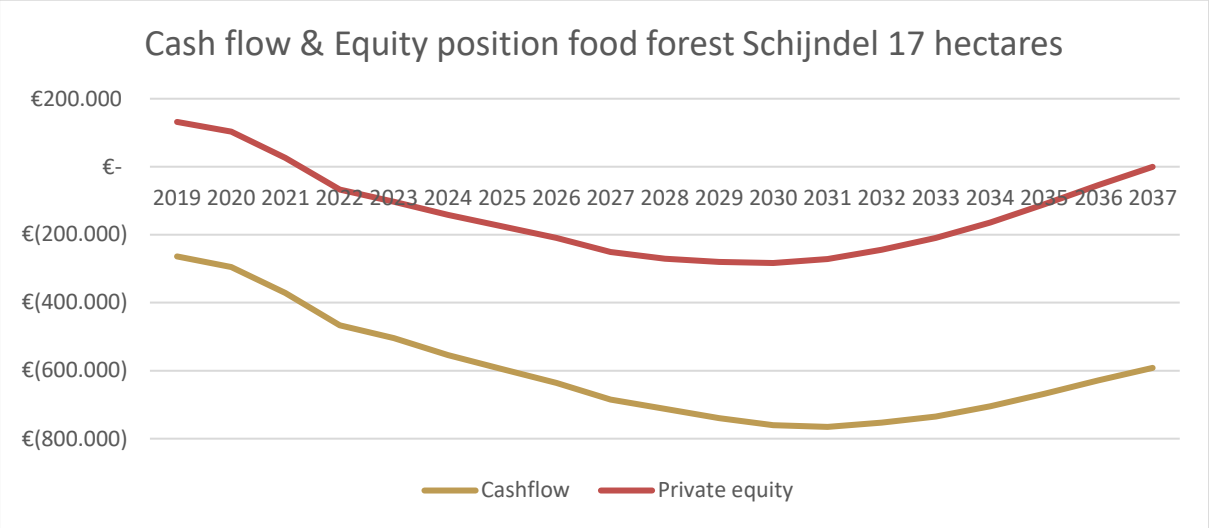


Figure 6-10: Cash flow & private equity position in 20 years.

6.5.4 Sensitivity analysis

After the microeconomic and financial analyses, a sensitivity analysis is performed. Firstly, the effect on the balance calculation under different scenarios is presented in figure 6-11. For revenue and costs, five different scenarios were made and combined with each other to form in total twenty-five scenarios. (See figure below). The price, which the food forest will receive for the products, has a big influence on the balance calculation for one hectare. For example, using normal costs and agricultural prices, the balance calculation will show to be around breakeven, a difference of -92%. Having a side income of €30,000 will have a positive influence on the balance calculation of +475%.

The influence of the labor costs on the balance calculation is less. For example, a 10% higher labor price will decrease the balance position of the company with 15%. If the company use 25% more labor days for harvesting, the difference of the balance calculation will be -53%.

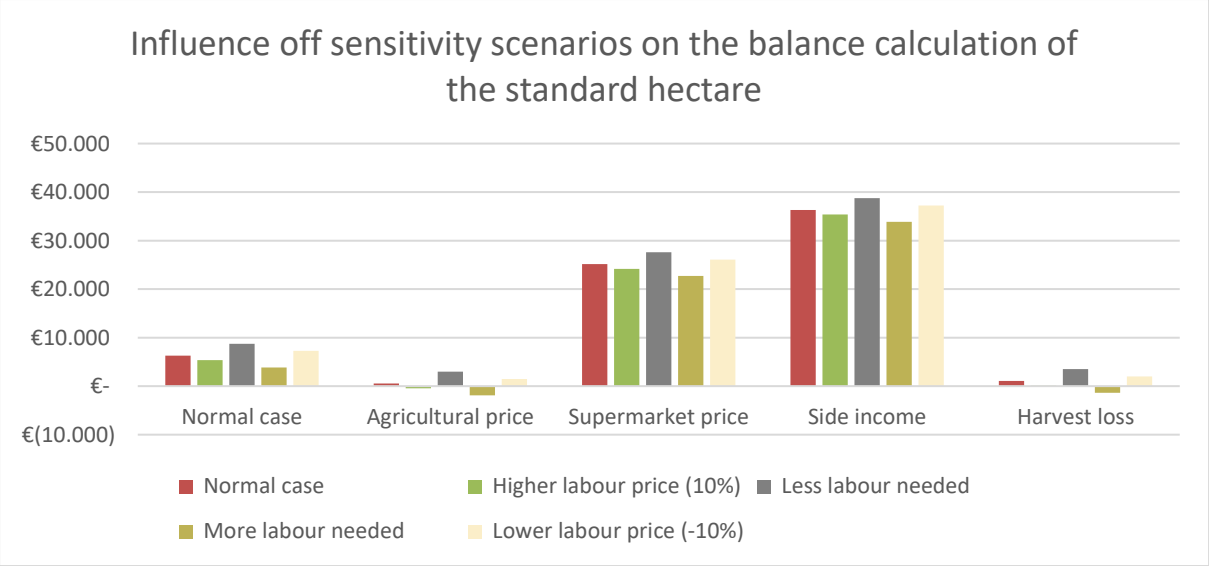


Figure 6-11: Influence of sensitivity scenarios on the balance calculation of one hectare.

The influence on the balance calculation will also have an influence on the cash flow position of the company. This can be seen in the next figure, in which the following scenarios are considered: normal case, normal costs/ agricultural prices, normal costs/ supermarket prices,

normal costs/ side incomes, normal costs/zero cash flow prices. Due to the low influence of the costs part and the harvest loss, these aspects are not considered in the next part of the analysis.

This influence on the cash flow is exponential. For example, the difference between the cash flow in year twenty for agricultural and supermarket prices is around €5,000,000. The price is, for that reason, one of the most important factors in the company that determines rentability. In the zero cash flow scenario, prices needed for the product are calculated to reach a zero cash flow in year twenty. In that scenario, the prices are calculated as 119% of the NET wholesaler prices. In the standard scenario the balance calculation after year 20 will be €7,700 (per hectare per year). Established side-revenue can also have a positive effect on the cash flow. In this scenario, the total needed negative cash flow is €350,000.

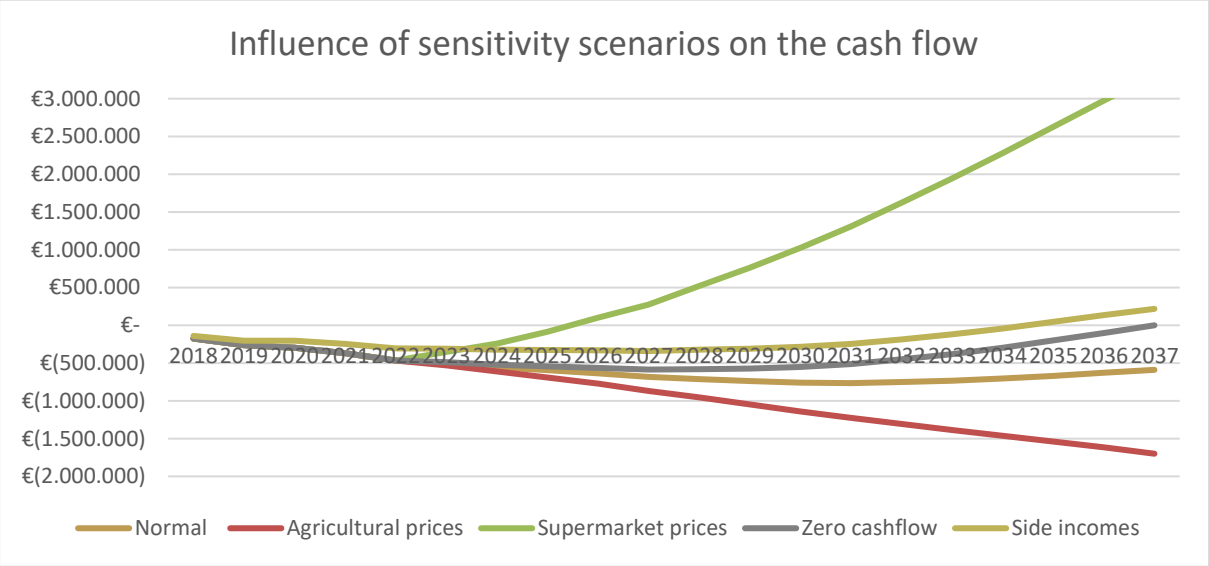


Figure 6-12: Influence of the sensitivity scenarios on the cash flow position.

6.5.5 Financial risks

Within the project different financial risk can be seen. Firstly, the biggest financial risk is the long time frame the food forest is operation on. Before knowing the exact profitability of the project, a lot of money is already invested. The idea of a productive food forest is quite new, so a lot is unknown right now. The time plays a big role in the project. The interest on the negative cash flow has an exponential influence of the feasibility of the project.

Besides that, it gives some risks for the VBNL. The project is just one of the projects from the foundation. For that reason, the analysis is taken into consideration that the foundation will start a BV for the food forest. Firstly, it faces the commercial side of the project. On the other hand, it gives some more certainty for the foundation. In case this project will be unsuccessful, it will not have an influence on the other project the foundation is running.

6.6 Stakeholders

Schijndel is the first large-scale productive food forest in the Netherlands which is why many organizations are interested and involved in this project. In this stakeholder analysis, the most important stakeholders will be described.

6.6.1 Internal stakeholders

Food forest Schijndel is initiated by VBNL, which is an important stakeholder in the project. Currently, the foundation is thinking about splitting their activities into two companies. The food forest Schijndel will be a commercial company whereas the foundation will remain a

foundation. It is an option to start a company called Food Forest Schijndel BV, where the foundation is the entrepreneur in this company. By doing so, financial and personal risks are spread. Besides that, the foundation has installed two managers, one for each plot. These are currently the most important volunteers. Later on, these volunteers can change into employees.

The foundation is cooperating with the Green development fund Brabant (GOB) and HAS University of applied sciences. The GOB is the owner of the land. Their aim is to get more nature in the province if possible combined with agricultural activities. A food forest fits well with this aim. The GOB is also partly financer, as they are paying the investment for planting material. The HAS University of applied sciences taking care of the research and educational part of the project. Their interest in the project is high, yet their power is low.

6.6.2 Connected stakeholders

The most important connected stakeholder is Vitam, who will be the biggest customer of food forest Schijndel. They signed an agreement of mutual intentions with VBNL and are connected both professionally as personally. Their interest in the food forest is high. Because of the booming topic of food forests, a lot of customers for sustainably sourced produce are interested as well. This makes the power of Vitam and other customers low. Other customers are restaurants in the area of Schijndel.

At the beginning of the project, the supplier is important as well. At this moment, the Netherlands has only a few organic tree nurseries. This gives the supplier a bit of power. Some general suppliers are interested in the problem as well and see a market for themselves. A problem that was mentioned is that it is the difficulty to build a market in this segment; food forests are just a one-time customer. Maybe, not all products can be used by Vitams' restaurants. For example, walnut oil can be processed and sold to a broader market. The precise relationship is unknown yet, but a processor can play a role as a stakeholder as well. Besides that, the situation of distributing is unknown. Vitam would like to get the products directly from the food forest to the restaurant which proposed a role for distributors as well.

The province of North Brabant is a connected stakeholder as well, as the GOB is within the regional government. As the province has a big influence on the GOB, the power of the province is high on the food forest. The food forest is running on a long-time frame while the politic situation at the province- house can change every four years; this is seen as difficulty for food forest entrepreneurs.

6.6.3 External stakeholders

Another governmental institution related to this project is the municipality of Schijndel. Even though the municipality is not directly involved in the project, they have expressed their interest. Therefore, the municipality is considered as an external stakeholder. The community of Schijndel also plays a role related to the project, because part of the project is open for public. However, on the productive parts of the food forest, the role of the community will be smaller. Other external stakeholders are neighbors, which are farmers and civilians. As the farmers are part of larger cooperatives and organizations, the power of the cooperatives is higher than the farmers' power. Besides that, some NGO's are considered stakeholders. For example, nature organizations like IVN. Their power on the project is low unless they show high interest. Press and media have a bigger power, related to their influence on public opinion.

Other stakeholders in this project are all other parties who signed the green deal. (Greendeal, 2017)

6.6.4 Importance of the chain partners

Each stakeholder has their own power and interest in the project. In figure 6-11, the importance of each chain partner is shown.

Internal stakeholders
1= Stichting Voedselbosbouw Nederland
2= Plot managers
3= Volunteers
4= Green development fund
5= HAS University of applied sciences
Connected stakeholders
6= Vitam
7= Other customers
8= Suppliers
9= Distributors
10= Processors
11= Province of North Brabant
External stakeholders
12= Municipality of Schijndel
13= Community of Schijndel
14= Neighbours
15= Farmers
16= ZLTO/ LTO
17= Nature NGO's like IVN
18= Press/ Media

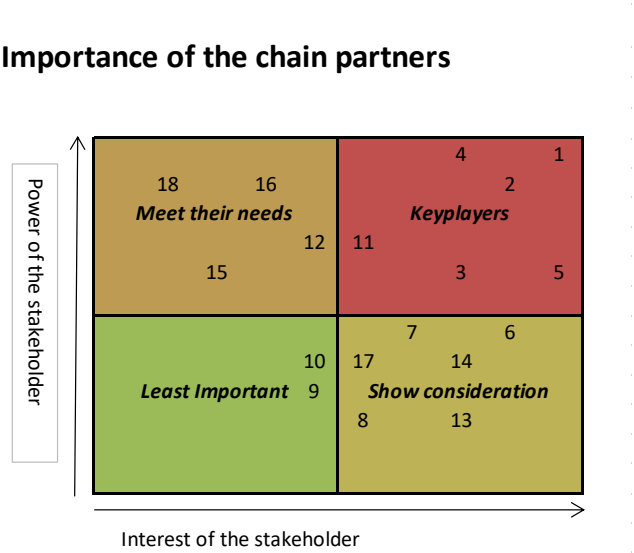


Figure 6-13: Importance of the chain partners.

All internal stakeholders are key players. Another key player is the Province, due to their key role in the GOB. The two least important stakeholders are the distributors and processors, as the exact relationship is unknown, and they don't have much power. In the quadrant meet their needs, the farmers and farmer organizations are seen. The project should be an eye-opener for the farmers. For that reason, farmers and their organizations are important stakeholders. The same is applicable for the press/media and the municipality. The parties with lower power but a high interest are in the quadrant 'show consideration'. For example, customers, suppliers and the community are there.

6.6.5 Stakeholder values

Besides the power and sense of each stakeholder, every stakeholder will also have stakeholders' values. In table 6-5, one positive and one negative stakeholder value are described shortly.

Table 6-5: Positive and negative stakeholder values of the project.

	Positive value	Negative value
VBNL	Earn self-fulfillment for the board members	No financial return for the board members
Plot managers	Happiness and challenge	No financial return in the first years
Volunteers/ employees	Happiness and knowledge	Investment of time
Green development fund	A good investment for the future	High investment with high uncertainty
HAS University of applied sciences	Provides educational research and knowledge	Research is a lot based on predictions

Vitam	A way to provide their sustainable aims	Uncertain number of products
Other customers	Good and special products	Second place because of the agreement with Vitam
Suppliers	Big customer for high-value trees and fruit plants	One-time customer
Distributors	Efficient and direct chain	Unknown relationship
Processors	Provides a lot of different products to use	Unknown relationship
Province of North Brabant	Good initiative for the future	Big investment by a governmental institution.
Municipality of Schijndel	Places Schijndel on the map of sustainable farming	Planning permission should be adapted
Community of Schijndel	More sustainable living	More external people in the area
Neighbors	Living with natural surroundings	Hassle and not everyone interested
Farmers	A very applicable system for farmers to change	Concurrence from a not farm based side
ZLTO/ LTO	A good example of more sustainable farming	Not based on conventional farming principles
Nature NGO's	Provides high biodiversity and a healthier environment	Exact implications are unknown
Press/ Media	Provides an interesting case to write about	News based on predictions is weaker

6.7 SWOT Schijndel

As a conclusion of the chapter, a SWOT is done in which the internal strengths and weaknesses and the external opportunities and threats for the food forest Schijndel are described. In this context, the strengths and weaknesses refer specifically to VBNL, whereas the opportunities and threats describe more specifically the external influences.

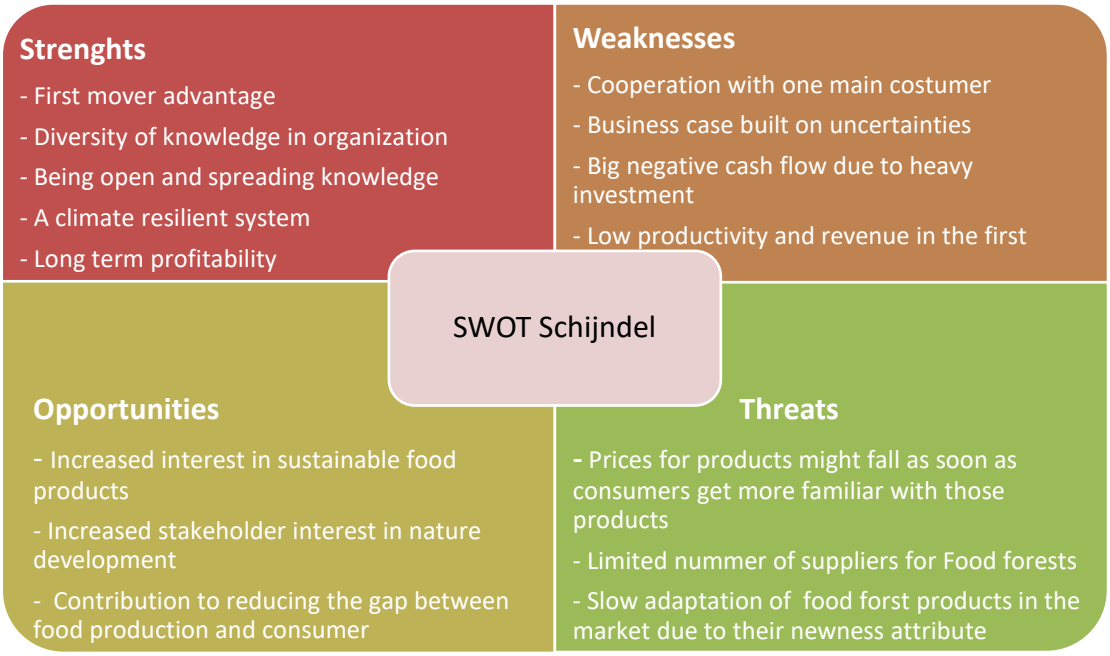


Figure 6-14: SWOT diagram of Case study Schijndel.

Since VBNL are the entrepreneurs in the project, the internal strengths described above refer specifically to the foundation. One of their main strengths is the diversity of knowledge in the organization, which gives the project a great advantage in avoiding risk and dealing with uncertainties. Besides, their main goal of providing a profitable showcase to farmers through producing regular and specialty products gives the foundation a first mover advantage. There is not any other initiative in the Netherlands, who are directly addressing farmers and has implemented a food forest on the 20Ha scale using the simplified approach. Subsequently, the foundation is open to sharing knowledge, which is seen as the main strength, as it will boost the further development of food forest projects. At last, the microeconomic analyses have shown that the projects offer a long-term rentability.

In comparison to the strength, the weaknesses of the project are built on the uncertainties which the food forest project is posing in the first years of establishment, including the initial negative financial position. Even though the business case is built on certain assumptions and uncertainties it is however of importance for the project to consider these weaknesses and take measures to manage those risks.

The external opportunities and threats reflect the position of the food forest in the market. As it has been seen in the multi- level analysis, current trends such as the increased interest in sustainable food forest products and the increased interest of stakeholders in nature development, pose important opportunities for the project. On the other side, since food forest has started to become increasingly popular in the NL, certain threats are arising for the project in Schijndel. In this sense, the project might need to deal with a limited number of suppliers, falling prices and the slow adaptation of food forest products by the consumer.

7 Business case Food Forest by Phien

7.1 Introduction

After the case study of Schijndel, the business case of Phien is analyzed. As in in the business case of Schijndel, the business case of Phien is designed by taking a critical point of view. In this sense, the data collected in chapter 4 and 5 and the data that has been collected through interviews with important stakeholders will be used to develop this business case. As a starting point the following aspects are taken into consideration:

- The business case focuses on the scale of 1 ha food forest, where one family of four is staying
- Annuals and animals are considered as they are valuable for reaching self-sufficiency
- The goal of the project is to show that a family of four can live from 1 ha of food forest and thrive towards self- sufficiency (in food consumption, building materials, water, electricity)

The project initiated by Phien has the main objective to show the possibility to produce food using a food forest, to provide an alternative lifestyle for families and the community. In this sense, the emphasis lies on the self- sufficiency rather than the production of food products for economic gains. On the other hand, both projects value the ecologic value of a food forest and thus consider the food forest as a mean through which environmental and societal issues can be addressed. As in the case study of Schijndel, the golden circle model from Simon Sinek is used to introduce the project. In this model, the question of why, what and how will be answered.

7.1.1 Why

The reason why Phien is initiating the project is to promote a truly sustainable way of living where people living on the land are not just living to pay their bills but are truly living their passion. This is reached by eliminating most costs of living, one part of which is sustaining their food needs by the 1 hectare of land. By eliminating part of the general living expenses, the inhabitants can invest the time in other parts of their being.

7.1.2 How

The how question describes the strengths and values of the organization, which is in this case Phien. The foundation is working with 4 basic principles, which are essential for the food forest projects. These principles are:

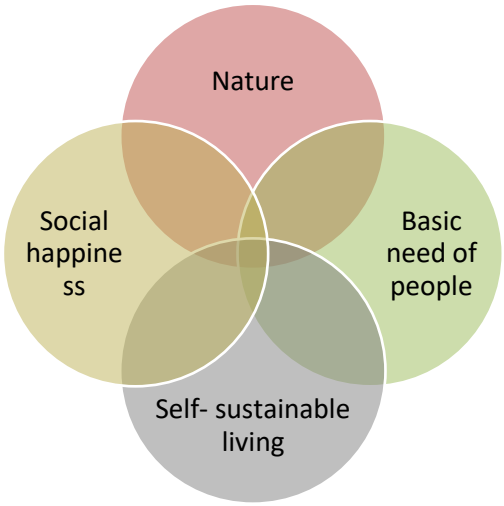


Figure 7-1: The four basic principles of Stichting Phien.

These basic principles resonate with the values which will be mentioned in the value proposition and present the main principles of the project. Important to mention is that these principles are inspired by the permaculture principle to build a sustainable human culture. Phien feels that the community and happiness, which is created through the project, will result in a better quality of life. The sustainable human culture further refers to the concept of living off-grid, which is an approach to achieve autonomy through becoming self- sufficient in the basic human needs; food, shelter, and energy. To reach self-sufficiency, Phien prefers to have people on the land who do not rely on social wages, unless they are social wages related to their physical or mental well-being of the person. By full-time staying at the estates, the people can invest all their spare time to work on the project and steadily achieve self-sufficiency.

7.1.3 What

The 'what' question refers more specifically to the products and services offered. At this moment, Phien is piloting the project on three estates. The concept is that each family uses 90% of the land for a food forest and the remaining 10% for building a house and other buildings. Opposed to the food forest project in Schijndel, Phien has a rather flexible definition of a food forest. Their project is also including animals and annual crops in the design.

Currently, the project is still in the process of attaining a permit to build houses and reside on the land. The aim is that every family can build a house on their own hectare. What is grown in the food forest can be decided by the family who is living on the land. However, some basic rules have been set by the foundation such as the prohibited use of agro-chemicals. There will most likely form a community between the different families where people can exchange knowledge, learn from each other and create social happiness, but this is not the primary goal for Phien. Later in the project, it might also become an opportunity to establish a store where crafts from the freelancers and excess food forest produce can be sold.

The concept of self-sufficiency in food

The main goal for Phien is to proof an alternative for living. Self-sufficiency is a part in that, and self-sufficiency in food is for many people the first step. Self-sufficiency in food is something many people strive to do to have upmost control on the way their food is produced. Furthermore, it is a countertrend to the increasing complexity of current food chains, and the related decreased transparency.

Whether overall self-sufficiency is possible is often debated, as this would also mean leaving out medicine, technology and building materials. This way of living is self-sufficient but characterized by high mortality and infections. The individual desiring to live self-sufficient should first figure out their goals before they start. Self-sufficiency in food is for many the 'doorstep' to a more sustainable way of living.

The amount of land required to reach self-sufficiency in food differs per situation, and depends on the following factors;

- The climate
- The state of the soil
- The amount of sun on the property
- The amount of rainfall
- Your diet and lifestyle

Depending on these factors, the amount of land required is between 0,2Ha and 20Ha. A strong weighing factor is the diet, as livestock requires a much higher amount of land. Different sources give different amount of land required. John Seymour, writer of the book 'The new complete guide to self-sufficiency' stated that no more than 5 acres is enough for a family in the UK (Seymour, 2009).

Food forestry might be of interest for people that are trying to reach self-sufficiency; perennial vegetables are often much faster to grow in spring and fill the gap between the last winter vegetables and the first spring vegetables. Furthermore, perennial vegetables are more reliable in their production as they are often much sturdier than their annual counterparts. Also, they don't require as much labor to produce a crop, where annuals do need a lot of labor.

The vision of Phien on self-sufficiency and how food forests fit into the aspect of food is that the food forest is the ideal agricultural system, as it doesn't need any inputs. In their opinion, food forests can contribute to food stability and security. Phien will provide the land and a loan for the establishment of the food forest and educate the people how to live self-sufficient.

Legislation

The land of the three estates is property of Phien and each property has their own foundation. Currently, the project is in the process of defining what is possible on the land, as there are issues to get planning permission to build houses on agricultural land. This is one of the reasons that is currently holding back the project. Phien has an investor for this project and is aiming to get more investors to give more people the chance to be part of the project and launch similar project in future.

7.2 Value proposition

As mentioned earlier, many of the values that are recognized in the project resonate with the permaculture principles theorized by Bill Mollison and David Holgrem in the 1970s. Permaculture is a conceptual framework for sustainable development that is finding its roots in ecological science and system thinking. The approach aims to create a sustainable human culture, where people, their buildings and the way their organize themselves is central. The design principles that are used in permaculture projects are grounded in 3 leading ethics, which are; earth care, fair share and people care. It can clearly be seen that the project in Limburg recognizes these three ethics and aims to build this `sustainable human culture`.

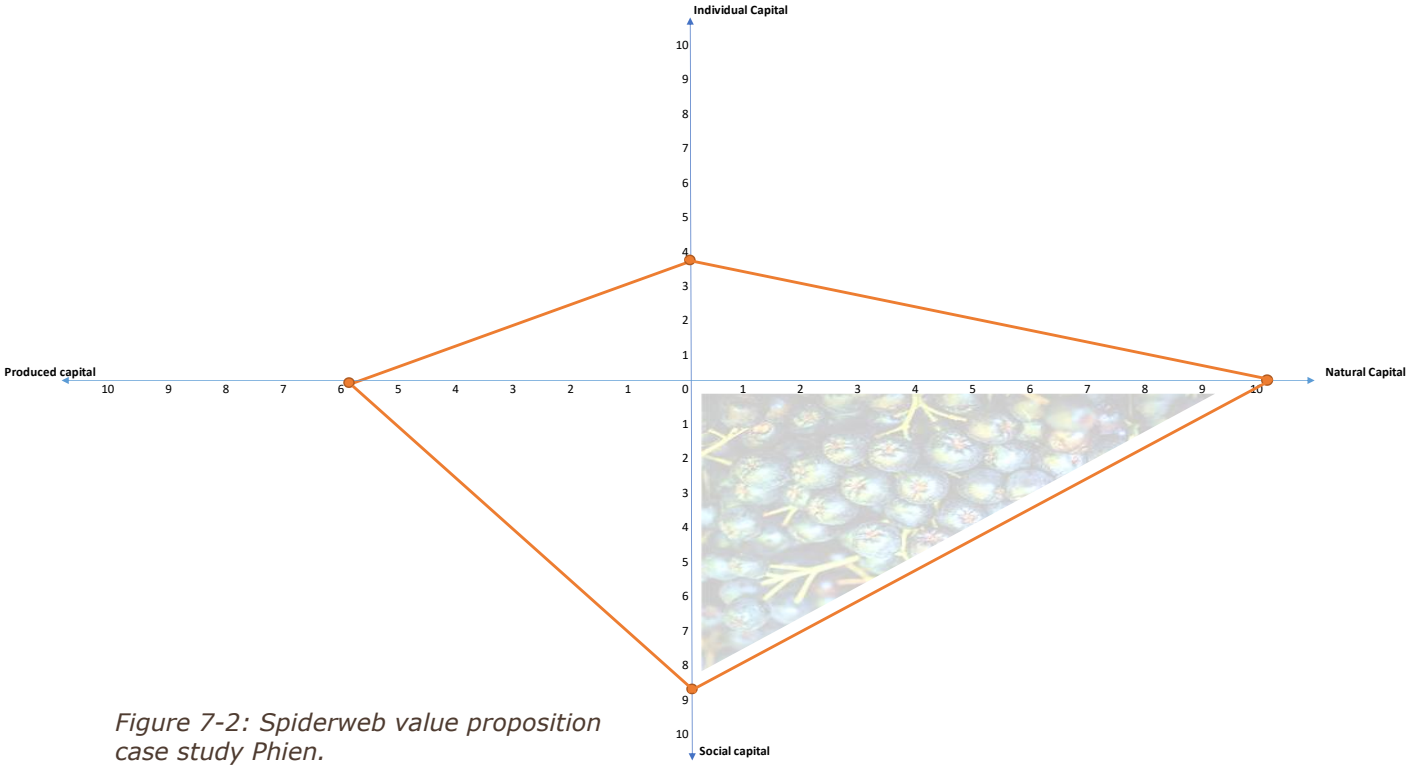


Figure 7-2: Spiderweb value proposition case study Phien.

During an interview with representatives of Phien, their most important values were discussed. These values have been ranked on how they act on the 4 capitals. The emphasis in this project lies in between social and individual capital. The business would therefore be positioned in the Aronia quadrant. The figure shows effectively that, while the emphasis is on the aronia quadrant, individual and produced values are also of importance.

Below, the most important values for the project are discussed briefly. Appendix **VII** gives a total overview.

7.2.1 Aronia Quadrant

Self- sufficiency of food

This is one of the most important values for the project and resonates with the ethics described in permaculture. Phien wants to give people the chance to live from the 1 ha of land, which should ideally enable a family of four to be self-sufficient in terms of food. In this way it becomes of lower importance for the individual to have a full- time job and the time that is saved can be reinvested in working with the land and the community.

Living in the green

Living in the green refers to the value for nature, living with nature and to be in an environment that is stimulating mental and physical health. Phien believes that if people can live more with nature, less health issues are occurring, and healthcare costs are saved. Living in the green is also connected to the principle of `social happiness` and 'nature' which has been stated by the foundation.

Conscious use of resources

The projects' aim is to grow towards 100 percent self-sufficiency in terms of food and building materials for the house. In other basic needs such as energy, water and sewage the project is exploring opportunities to reach full self-sufficiency. Any resources used are used as efficient and consciously as possible.

Community building

Even though each family is living on their hectare of land, the community value is still of importance to the success and development of the project. Exchange of resources in, for instance, labor or products is seen as important. Phien recognizes that the community is stronger than in individual, which is why there will also be a common area in which the inhabitants of the estate can meet, discuss ideas and spend time together. Phien is of opinion that a new sense of community will form when there is time and space for it. Although they value this, they also think space for the individuals is important.

Restoration of ecosystem services

As seen in the project in Schijndel, the nature value plays an important part in the business, where restoration of ecosystem services is vital. Even though Phien provides each family with a high degree of freedom, there are certain guidelines which should be followed in order to have a positive environmental impact. Therefore, the use of agrochemicals is forbidden, and monocultures should not be part of the design. Nature value should be respected, and a food forest is a way to respect this while producing food. The food forest system should have a closed nutrient cycle and organic matter should be promoted for mitigating carbon and improving the water storage capacity of the soil. Overall, the place must be people, plant and animal friendly, where permaculture design principles are guiding to achieve these goals.

7.2.2 Individual Capital

Autonomy

Autonomy is seen as a very important value, as they believe every family should decide themselves on which products will be grown in the 1-Ha food forests. Providing the people

with the freedom to decide themselves what they want to grow and how they organize the project, it is expected to create confidence and mutual trust within the community and towards Phien.

7.2.3 Produced Capital

Production of healthy and fresh food

The production of fresh and healthy food builds on the value of self- sufficiency, where Phien wants the inhabitants of the land to be able to cover their food demands using the 1 ha of land. Creating food for adults and children is part of the vision to create a sustainable human culture and to increase the well- being of the people living on the land.

7.3 Products & services

The food forest of Phien is primarily to provide one family with food that will feed them for the bigger part of the year. Whether full self-sufficiency is possible will be discussed in the following paragraphs. In the interview with Phien, different values were mentioned and by plotting them in the graph we found that this food forest values biodiversity highly. This also showed in the small food forests already present on the site, all of these were designed without using the structural lines. The food forests present also showed great diversity, where many different species were planted to ensure food for a longer amount of time.

A practical example of this is found in the variety of apples planted; differently ripening apple varieties were selected to ensure that fresh apples can be enjoyed from ending July to winter. Other products in the food forest are pears, plumbs, cherries, Goumi (*Eleagnus multiflora*), autumn olive (E*leagnus umbellata*), elder, cornelian cherry, Pea shrub, mountain ash, hazel, rose hips, sea buckthorn, alder and pecans.

Phien is focusing on the value of the products produced in the food forest with a very broad perspective. They value the products, but more so the whole augmented product. In the following paragraphs, the 3 levels of the product are described (Kotler).

7.3.1 Products

The products in the Food forest by Phien are numerous. Because the emphasis for Phien is on self-sufficiency, there was chosen for a much more diverse forest. Furthermore, there are much more vegetable crops included. The diversity of this food forest makes for a diverse supply of produce, which is most efficiently used in a diet with a much higher share of fruits.

Core benefit

The core benefit is the actual need that is satisfied. For example, for food, this is almost always the supply of energy for the bodies' metabolism. This is also true in this case, but in Phiens' philosophy there are more benefits. Other benefits of the food forest and their production are living in between nature, insuring the value of the human being and improvement of health and overall mood of people.

Actual product

The actual product is the food itself; the dimension, color, smell etc.

The harvest of this food forest is characterized by diversity. There are many known products, such as apples, plumbs, pears and cherries, but there are also numerous unknown products. Although the food forest is producing a lot of fruits, there are also a lot of leafy greens incorporated to make sure the family can support themselves fully from the food forest. Furthermore, some annuals and chickens are added to boost the productivity of this food forest and ensure that the family can sustain themselves year-round.

The food forest is not able to maintain livestock, as it's only on one hectare and producing the food for the cattle takes much space and fodder. For this reason, the food foresters are advised to follow a diet without dairy or meat. However, chickens can be maintained in the

system and can supply eggs and chicken meat. The calculation below shows whether the food forest system supplies all food needed, when a higher than average fruit intake is considered. Several studies suggest that a diet without meat or dairy would still be a healthy diet yet limits the need for resource-inefficient cattle (Marian Glick-Bauer, 2014) (Micheal S Donaldson, 2001). However, 'a healthy diet' is a heavily discussed topic and some people living at Phien consume a diet much higher in fruits, and much lower in grains. In their opinion, high intake of grains might not be very healthy and should be avoided. This also explains why they are not self-sufficient in grains; they regard this as essential.

Table 7-1: Needed supplied food forest products after year 20.

adjusted diet	total need (kg/year)	total supplied (kg/year)	Sum
bread/grains/oats/rice	227,76702	0	227,76702
Dairy	0	0	0
cheese	0	0	0
starches, potatoes or wholegrains	302,6	373,2	-70,6
vegetables	284,8	357,83	-73,03
fish, meat, eggs or legumes	124,6	255,5	-130,9
nuts	32,04	612	-579,96
lipids	42,008	0	42,008
fruits	772,62146	5889,116667	-5116,495207

As seen above, the food forest is still lacking the needed bread/grains/oats and rice and lipids. Growing bread/grains/oats can be developed in the future. There are systems designed where the production of grains is possible, for example with intercropping with biomass trees and fruits. There is currently a research ongoing that focusses on this by Ernst Gotsch. Also, some starchy nuts can be processed into flour for bread. Lipids are supplied by nuts, which are consumed as is or processed into oil.

A complete list of all species in the food forest can be found in appendix **IX**. The system that is planned supplies a very high excess of fruits, some eggs and legumes more than needed and a small excess of nuts. These products can be sold for a profit by the entrepreneurs. These products are shown in the graph below, considering the own use is based on a higher intake of fruits and no dairy. Other products from the food forest can also be sold, however, the products below the highest yielding and more familiar products.

Table 7-2: Harvest and own use based on the different varieties.

Scientific name	Product	Yield	kg/year/ha	Minus harvest loss (25%)	Own use (kg)	Sales (kg)
Malus domestica mid-stem	Apple	Fruits	240	180	49.13	130.87
Malus domestic highstem	Apple	Fruits	600	450	122.81	327.19
Ficus carica	Figs	Fruits	90	67.5	18.42	49.08
Diospyrus kaki 'Dunaj'	Fruits	Fruits	240	180	49.13	130.87
Pyrus communis mid-stem	Pears	Fruits	270	202.5	55.27	147.23
Pyrus communis highstem	Pears	Fruits	180	135	36.84	98.16
Sorbus aucuparia	Rowanberries	Fruits	500	375	102.34	272.66
Malus domestica low-stem	Apple	Fruits	150	112.5	30.70	81.80
Prunus armeniaca	Apricot	Fruits	120	90	24.56	65.44
Sambucus nigra	Fruits	Fruits	300	225	61.41	163.59

Prunus domestica low-stem	Plumb	Fruits	304.8	228.6	62.39	166.21
Prunus domestica mid-stem	Plumb	Fruits	304.8	228.6	62.39	166.21
Prunus avium	Fruits	Fruits	150	112.5	30.70	81.80
Vitis vinifera	Grapes	Fruits	100	75	20.47	54.53
Actinidia arguta	kiwi berries	Fruits	225	168.75	46.06	122.69
Juglans regia	Nuts	Nuts	300	225	20.03	204.98
Corylus avellana	Hazelnuts	Nuts	180	135	12.02	122.99

Augmented product

The augmented level talks about every non-physical part of the product. This includes everything that is making the produce unique and adding value to the actual product. ‘

The non-physical parts of the products in Phien would be the social aspect of living self-sufficiently. They believe, by living this way, they can develop different aspects of themselves. Without the burden of a mortgage, life is no more about survival but about living. The augmented value these products stand for are social living; cooperation, cohesion and security.

The augmented value can be different for different stakeholders. For example, for anyone interested in nature, the augmented value is carbon dioxide mitigation, water retention, biodiversity, soil improvement and catchment of particle matter.

For governments, the augmented value is the savings on the basic needs of people. This type of living decreases financial burdens, promotes ecological living, conscious use of resources, use of bio-based materials, water retention, Co2 neutral electricity, recycling and a stable food supply.

For people who would want to live self-sufficient, the augmented value is for cooperation, income by sharing labor, knowledge or a trade. Furthermore, the value is in purposeful entrepreneurship and cooperate rather than compete.

For people who are searching for social happiness, the augmented value is in the positivity in the environment, in the low stress level, in the cohesion and participation of everyone in the food forest.

7.3.2 Services

The food forest by Phien is located on the plots owned by the people living on the plot. For this reason, they will most likely be closed for the public. Services they do consider are workshops, but this is something Phien will have no part in. The people living on the estates currently are not giving any tours, and most likely will not in the future.

It would be possible that people living on the food forest plots make a small living by giving tours on their own plot. This income is for themselves and is listed as freelance income. These tours can be about the design of the food forest, products produced in the system, processing produce or biodiversity, this is depending on the expertise of the owner of the food forest.

Another service that the entrepreneurs can start is giving workshops on living off-grid. The entrepreneurs are very motivated themselves to start living self-sufficiently off-grid, and there are people interested in this way of living that lack the needed knowledge. Other workshops can be on, for example, processing certain products from the food forest.

7.4 Production & chain

The production in this food forest is primarily meant to feed the family. However, the leftover produce, mainly fruits, can be sold for a profit. The part of the produce taken by them for self-sufficiency is described in the products & services. The chain for the produce is very short. The value chain is done by describing the physical chain of produce (primary

processes), after which supporting activities are mentioned, followed by a description of their market using the 5-forces model of porter.

7.4.1 Primary activities

The food forest in Limburg has main objective to feed the family. As the products & services showed a lack in some parts of the diet, annuals are also included. The maintenance, seeding and nursing of these annuals is estimated to take one day a week, respectively 52 days. The leftover produce is sold, of which the how is described using the value chain model by Porter. In this model, only the primary activities and secondary activities are described. These secondary activities are human resources, technology development and procurement.

Inbound logistics

Inbound logistics include all relations with suppliers. Relations with suppliers of planting material are of different nature as it is a one-time only purchase. The food forests by Phien are supplied by nurseries close to the food forests. When an entrepreneur orders plants for the 1-ha food forest, they are picked up and planted right away by themselves. There is little need for inbound logistics.

Operations (production process)

The main operation for this food forest is supplying food for the family. All activities can be summarized in the following graph:

Table 7-3: Needed labor days for each operational activity.

Operations	Days calculated
Prior to operating Developing a design and simple 'savings' model	3
Managing surrounds	1
Preparing the field for planting	5
Project management	5
After establishment inspection	12
Maintenance	5
Seeding, transplanting and nursing annuals	52
Breeding chickens	2
Harvesting produce and collecting eggs	52
Organization & logistics	5

Reaching customers

In the case of Phien, a logistic chain for products is not applicable for the first years of the project since the production will be low and all the harvest will be consumed by the family. This decision resonates with the values of self- sufficiency, where each family should be able to live from the land. Once the family has reached a high degree of self- sufficiency and overproduction starts to occur, an opportunity can be to trade within the community, but also outside of their community. Products that are likely provide an overproduction are fruits and nuts, since other products are needed to cover the families' dietary requirements.

- Farm store

One opportunity is connecting to a local farm store (greengrocer). This farm store should be closely located to the project, preferably in the next village, so that the organization of logistics is easily organized. Choosing for a short value chain enhances the social value, since also the community around the project can learn more about the food forest initiative and benefit from the produce. In this way, Phien can raise awareness for the project and people are educated about alternative production systems.

Figure 7-3: Chain option one with local store.

- *Restaurant/farm store on site*

It can further be suggested, that once the food forest has reached its maximum production capacity and the local community has become more informed and involved in the project, a local store and/or restaurant can be established on the estates. In this way the community around the project would become even more involved in the project and is able to not just benefit from the products as such but also from the green environment that has been created in through the project. In this way, the value of connecting the consumer to food production will become of importance as well. In such a scenario, it will not be assumed that the consumer will directly become involved in the production since the land is managed by a family and the interaction might interfere with the family's privacy. In case a local store or restaurant is set up, the building should be placed, where the privacy of the families is not disturbed. A local store and/ or restaurant means that a direct chain to the costumer is established, in which the costumer can get an idea on how the food is grown, where it comes from and which effect it has on the environment. Phien has already invested in a small nearby shop that can serve as a store for crafts and produce from the projects, but the shop is not yet in business.

Figure 7-4: Chain option two: Direct chain.

7.4.2 Support activities

Human resource/labor

This part of the transformative business model refers to the way the labor is organized in the project. For the food forest project in Limburg, it is not applicable that labor must be hired as all activities will be carried out by the people who are living on the plot. Each family has the responsibility for their piece of land. On a longer timeframe, it might occur that labor is exchanged between experienced food forest farmers and new community members.

Technology development

This food forest is using small machinery such as mowers and tractors on their field, but minimal use of these is important to not compact the soil. They are not researching more mechanization as on their scale, they don't think this is something that would be interesting. Also, the people living on the plot value the manual labor and are happy to do it. They are interested in using smart tools to make their harvesting easier and less straining on the body.

Procurement

The entrepreneurs on the one-hectare plots are also encouraged to grow their own plants to reduce the costs for planting material. A system for self-sufficiency in nursery stock is also

theorized, but for now, all stock is bought. As the entrepreneurs are practicing self-sufficiency, there are no key suppliers other than the nurseries and Phien.

7.4.3 Market description using the 5-forces of porter

In comparison to Schijndel, it is seen that the food forest in Limburg focuses less on the commercial income from produce. Nevertheless, it is important to describe the market description of Porter, in order to compare both cases with each other and give an idea about the current situation of competition in the market and the attractiveness of the industry. The five forces in the model are; threat of new entrants, threat of substitution, bargaining power of suppliers, bargaining power of customers and competitive rivalry.

Threat of new entrants

As described in the case study from Schijndel, the overall risk of new entrants of food forest projects is rather low due to the high investments and slow return of a food forest. Above that, the previous chapters (7.2) have shown that the project in Limburg requires strategic planning due to the many values that are addressed and the time in which a food forest does not reached a high productivity. Till now there is no other project as it has been initiated by Limburg. Besides, as the main objective for the project is self- sufficiency, there are will not be a focus on having to compete in the market. Only as soon as the food forest in Limburg reaches an overproduction and can sell the products, the risk of having to compete with other food forest products, which also supply local stores or have set up their own shop or restaurant, might increase. Nevertheless, it can be expected that the food forest in Limburg is able to sustain its unique selling point, which makes the overall threat of new entrants considerably low.

Bargaining power of supplier

In this case, the bargaining power of supplier is the same as described in the case of Schijndel. The issue of having only a limited number of nurseries which supply the food forest, especially organic products, is also applicable for Limburg. In this way the power of the supplier is also limited as the plants will be supplied only once. Throughout the running time of the year, the project will mainly get in contact with suppliers, in case replanting must take place.

The food forest in Limburg will additionally source a small part of annual crops, which means that supply of these products needs to take place more frequently. Nevertheless, since the percentage of annuals is rather small when compared to the perennial species, and there are many nurseries which supply annual transplants, the suppliers' power will remain medium.

Buyer/customer power

Potential customers for Limburg will be only become of importance as soon as overproduction takes place. In this case the risk of costumers pushing the prices down is also very limited. Besides, the market for organic products has grown which shows that there is a high demand for the products. A food forest adds additional value to organic products, which means that the products will even have a competitive advantage above the products that come from organic certified farmers.

Threat of substitution

Same as for Schijndel, there is no real threat of substitution. The project in Limburg is unique especially since it is grounded in nature and social value which means that many non-monetary values are produced. Above that, a food forest system is generally not easily copied since it requires a lot of planning and knowledge.

Competitive rivalry

Competitive rivalry is very low since there is no other food forest project in the Netherlands as it has been initiated by Phien. Besides, Limburg wants to stimulate the further development of

food forest project that are focused on the same or similar values as presented by Phien, which means that projects which are focused on the same or similar values, will not a be threat to the project.

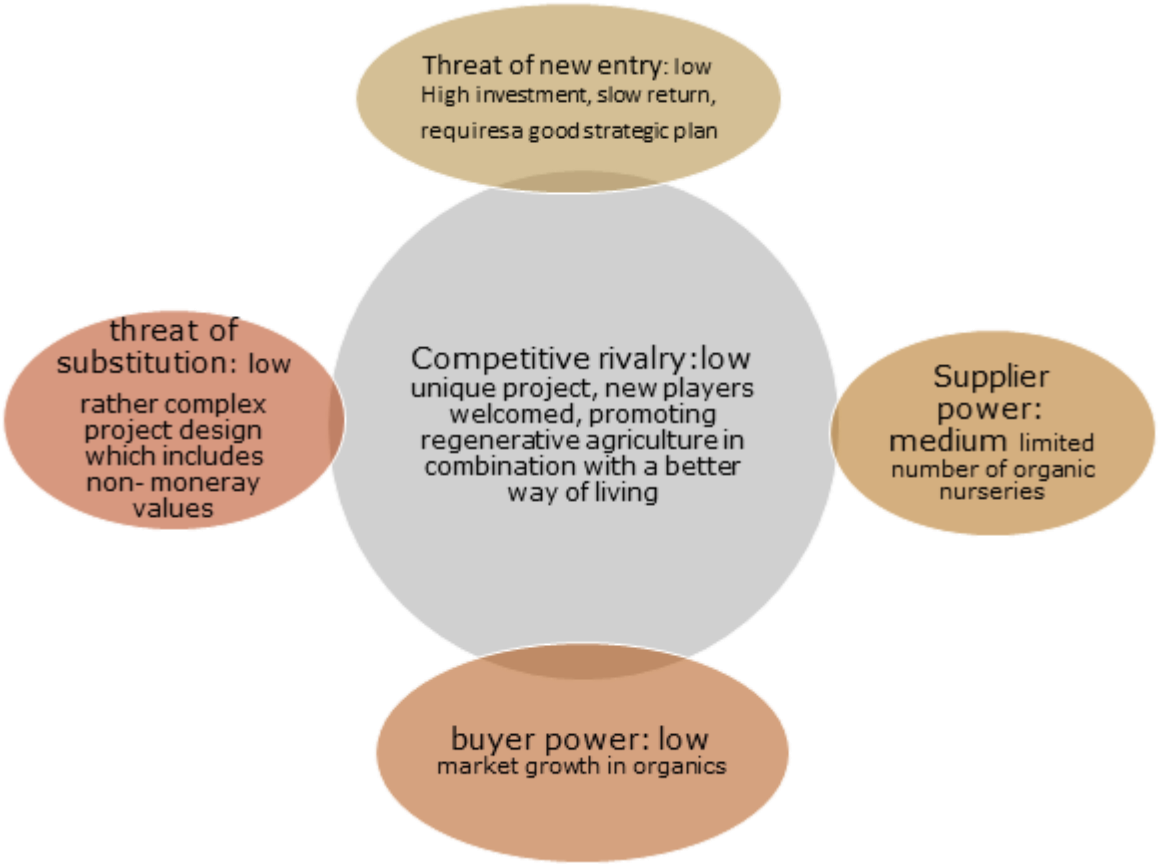


Figure 7-5: Market description based on the 5-forces model of Porter.

7.5 Valuation

In the following sub-chapter, the valuation of the project is described where the 1Ha food forest is analyzed to see how much cash flows the entrepreneurs need to sustain themselves. Assuming they reach self-sufficiency, the food costs are saved. Other remaining costs are considered. Firstly, the rentability on microeconomic principles in year twenty is analyzed, and after, the needed cash flow in year one till year twenty is analyzed based on financial principles.

For this part, some appendices are attached. Appendix **XIII**, gives an overview of the microeconomic calculations. Appendix **XIV** about the financial ones. And at last, Appendix **XV** provides calculations of the sensitivity analysis.

7.5.1 Microeconomic analysis year 20

On the micro-economic side, the calculated costs are included. For Phien, the main calculated costs are calculated labor, supplied by themselves. In figure, 7-6 is shown that the business balance of the company is around €-3,500. In this calculation, the food sales and their own food use is calculated. In year 20, the family is assumed to have reached self-sufficiency in terms of food. For the self-sufficiency aspect, the microeconomic turnover for own use is calculated using supermarket prices. The other food sales are based on NET wholesaler prices. The calculated costs are based on the time the family must invest.

Micro economical Result			*Year 20*
Turnovers			
Own use food	€ 9,061.15		60%
Food sales	€ 6,117.78		40%
		€ 15,178.93	100%
Related costs			
Inspection	€ 3,360.00		22%
Maintenance	€ 1,000.00		7%
Annuals	€ 6,240.00		41%
Chickens	€ 240.00		2%
Harvest	€ 6,240.00		41%
Organisation & logistics	€ 1,600.00		11%
Phien (10%)	€ -		0%
		€ 18,680.00	123%
Bussiness Balance		*€ -3,501.07*	-23%

Figure 7-6: Microeconomic result of one hectare by Stichting Phien.

Besides the microeconomic costs, it is important to investigate the (general) living costs. The result of these costs minus the income should be zero. The freelance income is a flexible parameter and is used to find the balance. To be self-sufficient and being able to pay the costs, an income from freelance of €7,500. - is needed. These calculations are based on a family composed of two parents and two children. By living on the plot, the family is also saving costs. The most important 'saved costs' are food, housing and electricity, gas and water.

7.5.2 Financial analysis year 1-20

For Phien, two questions are needed to reach an answer. Firstly, 'how much negative cash flow occurs?'. The second question is 'how much income is needed every year to get net cash flow of zero?'. The result of the first analysis can be found in figure 7-7 on the next page. Including all costs for living, the people in the food forests will have negative savings because of high private expenses. These costs for living are considered and for that reason are influencing the cash flow. This negative cash flow is the costs related to self-sufficiency; they are costs that can't be avoided. In year 20, the total needed labor hours of 1,024 are needed. In earlier years, this will be lower. Based on full- time work hours, there is time left to earn a side income. This could, for example, be a freelance income. The aim of this project is to have every year a freelance income with which the cash flow position will stay zero.

The family will be fully self-sufficient in year ten. In this figure, there is considered that the family sells the excess production of the food forest.

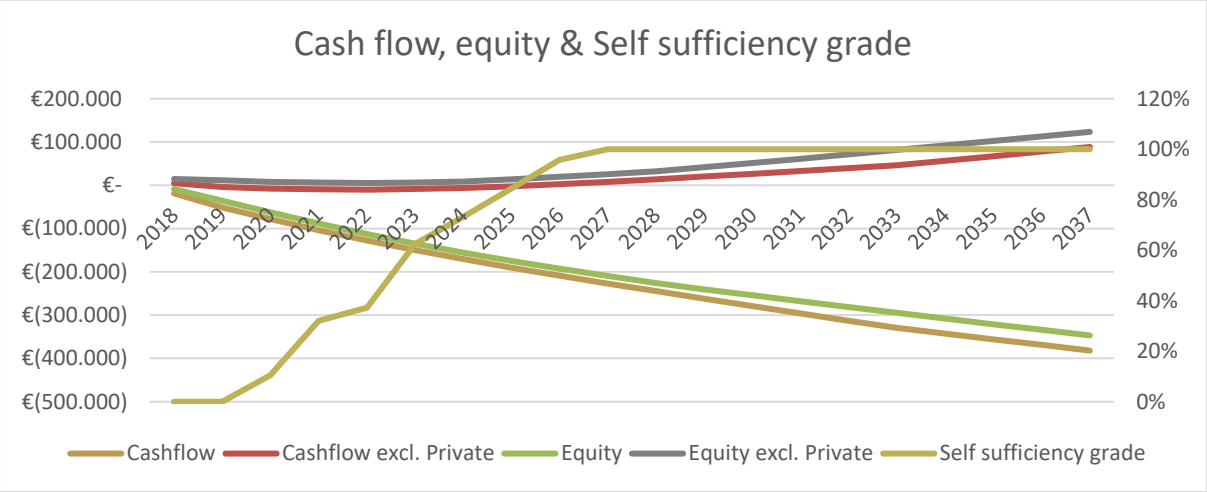


Figure 7-7: Needed cash flow related to self-sufficiency.

In the financial analysis, the depreciation and repayments to Phien are considered. According to the contract, Phien will provide every family with a liability with a running time of fifteen years (Stichting Phien, 2019). The three main investments are as follows:

- A house of €50,000, invested in the year 2018. Depreciated with 5% per year to €25,000
- Materials of €5,000, invested in the year 2019. Depreciated with 20% per year to €0.-
- Plant stock of €10,000, invested in the year 2019. Value constant because of replanting by the owners. The investment is financed by Phien and is given to the entrepreneurs as a gift.

7.5.3 Sensitivity analysis

Every company has factors that influence the rentability of the business. In this case, the most important factors are the price the entrepreneur receives for the products and the percentage of his own food use. In the earlier part, the own use of products is based on the diet of the family. On the microeconomic side, more own use means a higher turnover because the own use turnover is based on supermarket prices. On the financial side, more own use means fewer sales and less income. In figure 7-8, the influence on microeconomic side is shown. In the normal case, the balance was negative. When an agricultural farm-gate price is given for the product, this balance will be more negative. The highest balance is around +€11,000 and the lowest is around -€11,000. The price level is identified as a considerable risk.

Besides the revenues, labor has a big influence on the calculated costs of the product. The family is only using their own labor, and for this reason, the labor costs are only calculated costs and not actual paid costs. In the figure is shown that a difference in needed labor days has more influence on the balance than a price difference in labor of 10%.

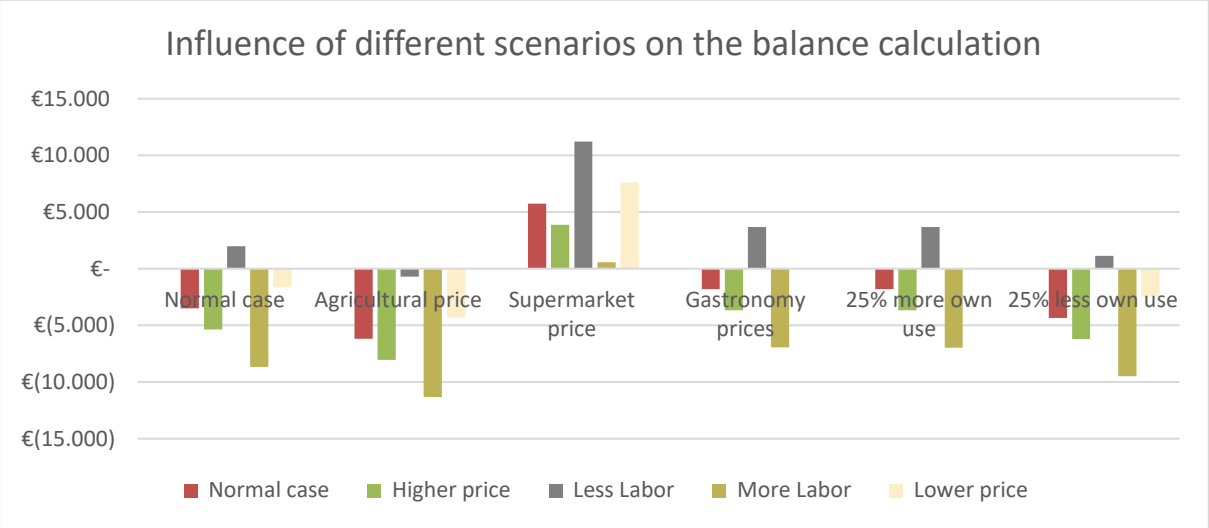


Figure 7-8: Influence of the different scenarios on the balance calculation.

As labor is only calculated and not paid on the financial side, it doesn't have a significant influence on the balance calculation. The different price levels are however important to consider. In the financial analysis, the influence of the price levels on the needed cash flow is calculated and presented in figure 7-9. Due to the small scale on which the food forest is operating on, the price level doesn't have the biggest influence on the cash flow position as the living costs will remain the same. However, with supermarket prices, financing will be easier. Based on the analysis, it would be advisable for the company to consider the current status of their farm shop and determine their side-income accordingly.

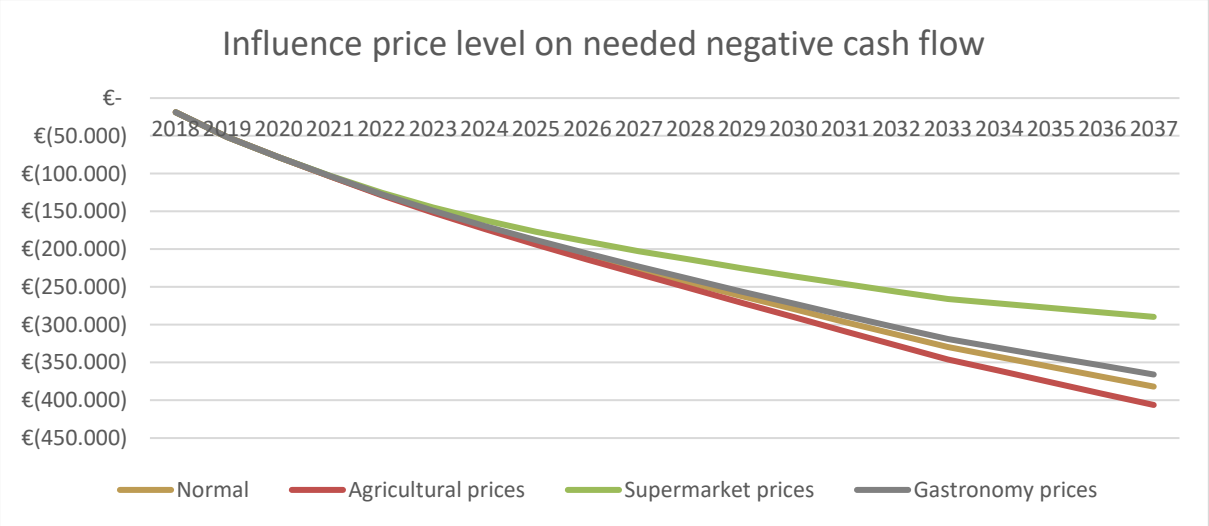


Figure 7-9: Influence price level on needed turnover freelance.

7.5.4 Financial risks

At Phien, financial risk mainly refers to investing a considerable sum of money and time in the project. By doing so, Phien follows their goal and makes it possible for people to live this way. Currently, they want to start with twenty families living on the estates. In the future, they want to upscale and give more families the chance to be part of the project. The risk is that it is not a proven case yet and the need for freelance income turns out to be higher than initially expected. There is uncertainty on how much revenue the food forest will yield, considering the yield is depending on the season and the price they yield is depending on demand.

For the families on the plot, the financial risk is limited. One issue can be that they don't reach self-sufficiency, and they still must pay for food products, meaning the expenses will be higher. Following this, they would need to have a bigger freelance income. The actual financial risk depends on the starting point of the different families. For example, a family with a decent amount of starting capital will have a lower financial risk. There is a risk in the unreliability of the system in the first few years, however, this can also be managed if the entrepreneur has some savings.

7.6 Stakeholders

In this subchapter, the stakeholders of the food forests in Limburg will be described. This stakeholder analysis is made from the view of an entrepreneur on the 1-ha plot. Initially, the different stakeholders are described. After this, the importance of the stakeholders is displayed. At the end of this part, every stakeholder is given a positive and negative stakeholder value.

7.6.1 Internal stakeholders

The people living on the estate only have one internal stakeholder, namely the household. The assumption is made that most families living on the estate are 4-people households; parents and two children. The 1-Ha food forest should provide food for this family. The family is borrowing money from Phien on which they have a low liability interest. The family is living in a small house property of the household.

During May 2019, Phien was working on the contracts between them and the people living on the estates. The idea for the organization of the plots is based on an apartment complex, where people own the apartments but can't re-sell them and the community areas are paid for by the whole group of owners. Phien has written down conditions, including that every people should have a VOG (behavior standard) and BKR (income statement). Besides that, the people should have worked out their own dream and prove their capabilities (Stichting Phien, 2019).

7.6.2 Connected stakeholders

The most important connected stakeholder of the 1-Ha food forest is Phien. Phien is investor of the project and owner of the estate. Phien has also taken the initiative for this project, with the goal of creating more social happiness by giving people a chance to live the way they desire. Besides Phien, there is a foundation for each estate in the project. For example, this would be the Peppelenhof foundation at Peppelenhof. These foundations are initiated by Phien to serve as cooperation between the people living on the separate estates. The people are paying a small amount of money to the estate-foundation. The foundations use this to pay back a loan to Phien for the community spaces.

Besides the self-sufficiency aspect, the social aspect is crucial for this project. Because of this, family and neighbors are playing a big role. Neighbors are also important stakeholders, which are most likely similar families. They have influence on the community aspect of this project.

A less important role can be seen for connected stakeholders such as customers and suppliers. The most important suppliers for the food forest are the tree nurseries and suppliers of building materials. Whether the household has customers for the food products is depending on the way they develop the concept. In case they are starting a restaurant, the customers will become more important. For now, self-sufficiency is the primary focus. Because of that, suppliers and customers play a less important role.

7.6.3 External stakeholders

Besides internal stakeholders, there are a lot of external stakeholders. The most important external stakeholder related to this project is the government. Firstly, the municipality, which

has a big role related to the planning permission. For the buildings, the municipality should, for location Peppelenhof, give thirteen planning permissions for living. Currently, there are only three. In an interview, it was mentioned that the population in Limburg is decreasing and every municipality should decrease the number of houses they were planning to build. This makes it difficult for the municipality to give these planning permissions for new building project. The province of Limburg, on the other hand, is very enthusiastic about the project. More people are becoming enthusiastic of the project, also within the province.

Another governmental institution is the water authority. There is a little river around the estate, of which they are responsible. The water authority is researching what the benefits of a food forest can be and can be very open for food forests. The influence on water quality and management is their focus point.

Besides that, there are some other external stakeholders.

The first group are the farmers surrounding the project. In the beginning of the project, Phien organized an info evening for the people around the plot. A lot of farmers came and were interested in what was going on. They are not actively promoting the project but are curious to see how it develops. For them, it is important that the project doesn't interfere with their company management.

Institutions promoting the project are NGO's. For example, the natuur en milieufederatie Limburg. On educational side, Kenniscentrum natuur & leefomgeving is promoting the project. This institution is forming an educational project/curriculum about food forestry. Besides them, the press and media also play a role on the promotion of the project. These parties are increasingly enthusiastic about food forestry.

7.6.4 Importance of the chain partners

In the first part of this paragraph, each chain partner is described. In figure 7-10, the importance of each chain partners is visualized. The two most important stakeholders are the households and Phien. Another stakeholder with a high power is the municipality. The reason for this is their power to give planning permission for permanent stays on the area.

Internal stakeholders
1= Household
Connected stakeholders
2= Stichting Phien
3= Stichting Peppelenhof
4= Family
5= Neighbours
6= Customers
7= Suppliers
External stakeholders
8= Municipality
9= Province
10= Water board
11= Farmers
12= Natuur en milieufederatie
13= KCNL
14= Press & Media

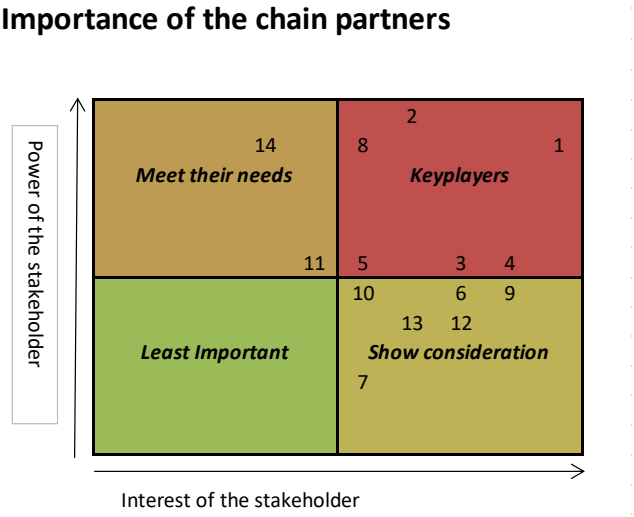


Figure 7-10: Importance of the chain partners.

The food forests by Phien are one of the first food forests focusing on self-sufficiency on such a scale. In the figure can be seen that a lot of stakeholders have good intentions for the organization. As they are pioneers, a lot of stakeholders are interested in the project. The

only two stakeholders with a bit lower interest are the Press & Media and farmers. Their interest is below average.

7.6.5 Stakeholder values

It is important to investigate stakeholder values. This is already a bit done in the chapter about possibilities (5.5.2). In table 7-4, the stakeholder values of this specific project are made visible.

Table 7-4: Positive and negative stakeholder values of the project of Phien.

	Positive value	Negative value
Household	Self-sustainable living	First years, they need to have a side income.
Family	Happiness, joy	Patience because of long-time frame.
Stichting Phien	Sustainable investment for the future	Stichting needs to find new investors to reach their goal
Stichting Peppelenhof	Self- sustainable living with social aspect	Stichting is dependent on Stichting Phien
Neighbors	Social improvement	Living close together can give irritations
Customers	Good quality food products	Low productivity in first years
Suppliers	Big customer of fruit plants- and trees	Only one-time customer
Municipality	Puts the municipality on the map	Living permission on a countryside area
Province	Sustainable initiatives in the province	Decreasing number of citizens; prefer a decrease of houses
Water board	Improvement of the water quality	maintenance might be needed
Farmers	new innovative business cases	scarcity of land
Natuur en milieufederatie Limburg	Sustainable initiative which is creating similar values as nature	A lot is unknown about the implications on environment
KCNL	Gives new education possibilities.	A lot of research now is based on predictions
Press & Media	New possibilities to make news.	Because of the predictions it is difficult to give hard data

7.7 SWOT Phien

This chapter presents a SWOT for Limburg in which the strengths and weaknesses are shown. These strengths and weaknesses refer specifically to the families who will be part of the project. The opportunities and threat refer more specifically to the external influences on the project as such.

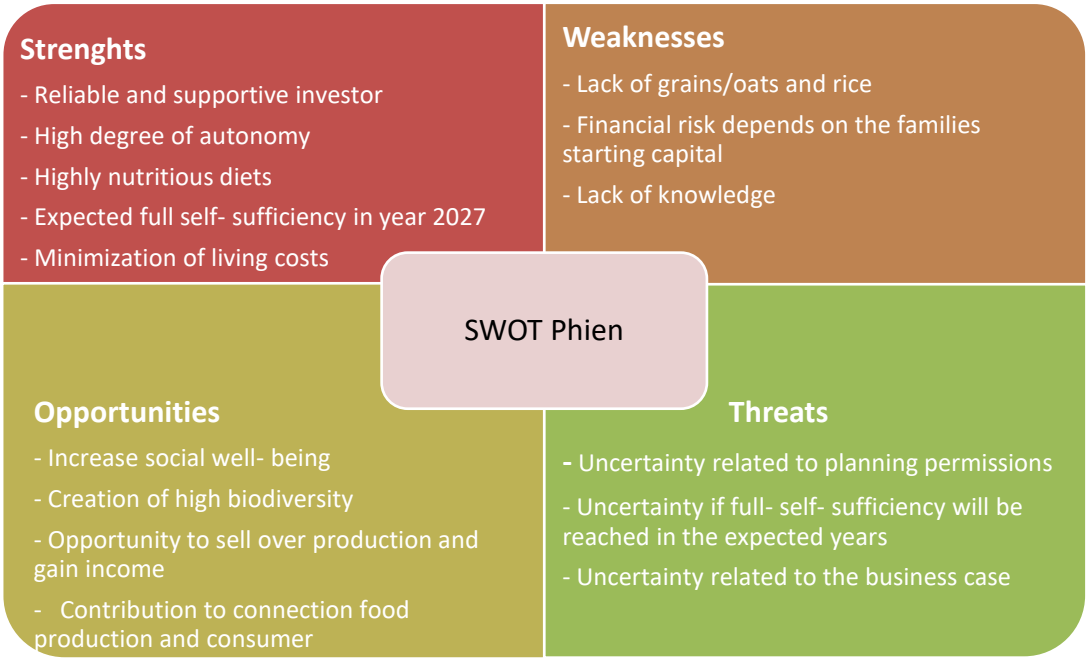


Figure 7-11: SWOT Matrix of Case study Phien.

The strengths listed above reflect the potential outcome of the project in case the project meets its goals and expectation. Therefore, families will directly benefit from these outcomes. Among others, these are a high degree of autonomy, a healthier diet and a different way of living. To enjoy these benefits, Phien is supplying them with a loan and a mutually beneficial relation forms; this is seen as a strength in the project. By supporting families, Phien is creating and proving this alternative lifestyle and they can attract more families to the project.

The weaknesses show that there are still a few challenges that should be addressed in the coming years of establishment. The calculation in products & services has shown that the project is not supplying the needed amount of bread/grain and rice. These weak points can be addressed in future research. To conclude, as the project is based on natural and social values, there is a lack of knowledge on the practical but also commercial aspects of a food forest.

The external opportunities and threats reflect the food forests position in its external environment, which is mainly referring to the local community. As for Schijndel, the food forest in Limburg poses opportunities to positively address ongoing trends, such as the gap between producer and consumer. Besides that, the project seems to have a positive impact on society since social well-being is created. The research has further shown that as soon self- sufficiency is reached, overproduction can be sold, and an additional income can be obtained. Threats are mainly related to the uncertainties of the business case since the calculation is based on some assumptions.

8 Comparison of the different types of Food Forests with agriculture

In this chapter, an answer on research question four will be given. This chapter includes a brief social cost benefit analysis SCBA (Dutch MKBA), which is used for measuring the sustainability of a project/company. The economic value of a project does not only include direct revenues but also welfare flows that are created, such as recreational enjoyment and clean air (Ruijgrok, 2006). Previous chapters have shown that a food forest produces non-monetary values which can contribute to the society, the self- reliance of the farmer and the environment. If these parameters can be expressed in economic terms, the outcome can serve as an indicator for governments to evaluate different projects. In this way, decision making will not be merely based on the economic performance of the project, but also through the effect the project has on a community (external) or the created internal value. Next to the government, a farmer can use the social cost benefit analysis as an indicator for decision making.

The sub question will be answered through comparing the two food forest projects of Schijndel and Phien to a conventional farm. Therefore, the four environmental capitals are used to find suitable parameters that are measurable and can be expressed economically.

In order to develop a sound comparison, the parameters for each capital have been determined and described. Afterwards, the most important parameters have been chosen for the calculation. The parameters which have not been used for the comparison can be found in appendix XVII. The data used for this chapter consists of the baseline numbers in the MKBA, the two business cases (6/7), the KWIN and literature. At the end of this chapter, conclusions are drawn about the individual and the external benefits of the different systems.

It is of importance to note that this chapter presents a brief social cost benefit and is an example about how a comparison of a food forest and a conventional maize farmer can look like. The purpose of this chapter is to visualize the difference between a food forest and a maize farmer on all four environmental capitals in their specific area. In a different context, the outcome of the social cost benefit analysis will be different.

8.1 Determining comparison base

To compare the business cases, a comparison base is determined. Based on the geological distance, the two case studies can't be compared to each other, as parameters on natural and social capital can vary on different locations. However, the individual and produced capital values is similar in different localities, these two comparisons can be interpreted as more generic.

The project will be compared to a maize cultivation, a common agricultural crop in the Netherlands (Agrimatie, sd). Based on the 'KWIN arable farming 2018', there are three different types of maize fields; grain corn on sand soils, cut maize on good sand soils and organic sugar maize. As the type of maize cultivated before is unknown, the choice was made to compare based on a conventional farm growing grain maize on sand fields. The operational balance of this product is €1,045 per hectare.

The food forest in Schijndel will be compared with a grain maize cultivation of 17 Ha and the food forest by Stichting Phien will be compared with a 1-Hectare grain maize cultivation in Melderslo. In the calculations, the difference between the outcome of the food forest projects and the maize farm has been determined as the result of the calculation. The calculations can be found in Appendix XVII.

8.2 Comparison on the determined parameters

Below, a description of the determined parameters for each capital and the outcome of the calculation will be described and discussed.

8.2.1 Natural capital

The way a natural area can be expressed on economic value is through the investigation of ways the area is producing prosperity for society (Ruijgrok, 2006). The figure above shows all parameters that can used for a comparison of different production systems. The chapter on the natural capital discusses the parameters of carbon sequestration, air quality and soil fertility and monetizes these for the three systems. A general description of the other parameters that can be used for the comparison, can be found in the Appendix **XVI**.

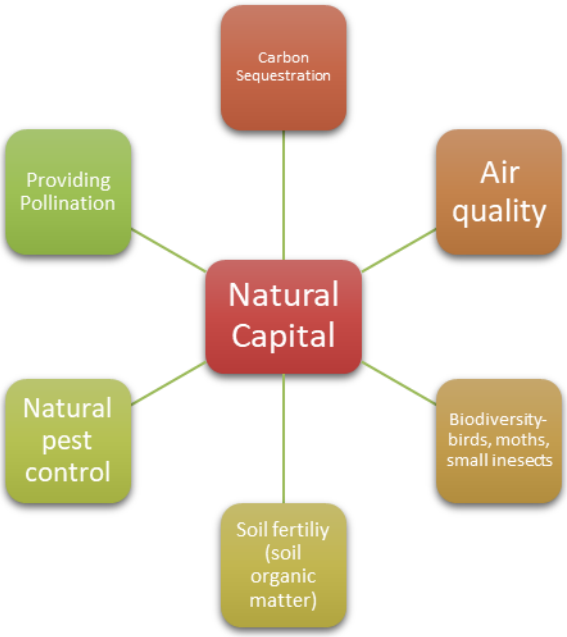


Figure 8-1: Different parameters on the natural capital.

Carbon sequestration

In a forest, trees are working as a carbon sink, where carbon dioxide (CO_2) is pulled out of the atmosphere and fixed as carbon (C) in the wood during the process of photosynthesis and tree growth (USDA, n.d). Trees can store the carbon for long term and therefore contribute to the reduction of greenhouse gases in our atmosphere, which are causing global warming. The amount of carbon dioxide, which can be sequestered by a tree, called net storage of carbon, is an outcome of the species genotype x environmental interaction. Therefore, the amount of carbon that is being sequestered in various agroforestry systems, is depending on the species and the environment. Furthermore, the amount of carbon sequestered, is constantly changing with the growth, death and decomposition of the vegetation. (Gorte, 2009)

In general, agroforestry systems are said to have a great potential for sequestering carbon. It is estimated that in an agroforestry system, carbon storage ranges from 0.29 to 15.21 tons of carbon per ha per year aboveground and 30 to 300 tons per ha belowground. (P.K.Ramachandran Nair, n.D.) In another study, which compared the sequestration rate for different land uses, the multi strata woody polyculture was classified as the system with the highest rate of carbon sequestration. (Toensmeier, n.D.)

A study in the US has investigated the degree of carbon sequestration in a maize field and concluded that the carbon stored in the corn plants (short term storage) ranges from 3 to 7 megatons per hectare per year. The carbon that is stored in the plants will not be considered in the calculation, since no carbon is sequestered in stable carbon sinks. The carbon in the stalks will contribute to replenishing the organic matter of the soil, and the maize harvested is in the short carbon cycle, with no net impact on sequestration (University M. S., 2017). For this reason, it is of greater importance to a stable sink for carbo; soil.

The calculation of the carbon aboveground can be found in the Appendix **XVII** and reveals that the food forest in Schijndel is estimated to sequester a maximum quantity of 258.57 ton per year. The MKBA proposes a price of € 49.50 per ton of C. The result for carbon sequestration above ground is **€ 752.90 per hectare per year** in both cases.

The calculation for the carbon sequestration belowground has revealed that annual accumulation of carbon is 369.98 t/C/year in Schijndel, while Limburg would sequester 21.76 t/C/year on one hectare. Therefore, Schijndel would have a benefit of **€ 15,261.84** (€897 per hectare) and Limburg will have a benefit of **€ 897.43.**

The amount of carbon that can be found in maize field belowground is significantly lower when compared to a food forest, which is due to the low SOM in a maize field. On a 17-ha maize field carbon sequestered belowground be 61.66 t/C/year with a benefit of € 3,052.17 (€180 per hectare). For a one-hectare maize field the sequestration belowground would be 3.63 t/C/ha with a benefit of € 179.69.

The benefit of the maize farmer has been deducted from the benefit of Schijndel and Limburg. The overall amount of carbon above and below ground, and the benefit in euros per ha can be found in the figure below.

Table 8-1: Monetized benefit of carbon sequestration.

System	Number of ha	t/C	Result (€)	Result/ha (€)
Food Forest Schijndel	17	628.55	28,060.99	1,650
Limburg	1	36.97	1,650.33	1,650

Air quality and quantity

In general, an agroforestry system removes atmospheric dioxide, produces oxygen, reduces wind velocity, limites wind erosion, reduces noise pollution, mitigaties odor from concentrated livestock operations (Wolde, 2015), absorbs pollutants and intercepts harmful particulates from smoke and dust. In this way, air quality increases and it helps to alleviate the problem cause by chronic respiratory disease. (Townsend, 2010)

In comparison to this, a conventional cornfield is said to increase the nitrous oxide levels due to the excessive use of nitrogen. (Ignacelab, 2015)

Fine dust collection (PM10)

The amount of fine dust in the air leads to health problems such as chronic bronchitis and emphysema. The collection of fine dust takes place through the leaf surface on which the dust particles adhere. These particles are than rinsed by rain and will accumulate in the soil. Natural ecosystems are producing the benefit of clean air through the catchment of dust particles whereas projects that cause a change in the forest, cause the loss of this benefit. (Ruijgrok, 2006) The calculation outlined in the MKBA shows that a tree can absorb 17.5 kg of fine dust/ha/year. For comparison, a one-hectare reed field absorbs 10 kg of fine dust/ha/year. For the calculations these parameters have been used and it shows that 17 ha of the Schijndel project has a benefit of **€ 2,507,925** (€ 147,525 per ha), while the 1 ha field of Phien will have a benefit of **€ 210,000.**

Nitrogen dioxide collection (NO2)

Trees capture nitrous dioxide from the air, which is a common air pollutant. The absorption of NO2 takes place through the stomata of the leaves and helps to prevent health problems in people. The social cost benefits analysis monetizes the collection of nitrogen dioxide based on the health damage that a kg of NO2 causes for humans. (Ruijgrok, 2006) The calculation for both Schijndel and Limburg can be found in the Appendix XVII and are compared to a maize farm using the numbers provided by the MKBA on reed fields. The result shows that the 17 ha in Schijndel can save costs of health damage of **€ 23,205** (€1,365 per ha), while Limburg can save **€ 1,435** per year.

Soil fertility (soil organic matter content)

Soil organic matter (SOM) are particles that have an effect on the chemical, physical and biological activity of a soil. A higher percentage of organic matter is closely related to soil fertility and yield (Patrick Musinguzi, 2015). Furthermore, a higher organic matter content is associated with better soil structure and water holding capacity (Osman, 2013). 1% organic

matter increase in the system effectively means 170,000 liter of water can be stored additionally per hectare. Capturing carbon from the air into the soil has as added benefit also the effect of carbon mitigation. This all contributes to a more resilient soil, less prone to weather extremes.

In agroforestry system, the core principle is to nourish the soil rather than the plants. The soil is nourished by managing the organic matter in the soil. In some agroforestry systems, there can be as much as 12% organic matter in the soil (Flevoland, 2014). For this reason, it is also assumed that both food forest in the case studies will also reach the 12% in time.

In industrial agriculture, soil organic matter is commonly around 2-4%. The biggest part of the biomass produced is sold and, in many systems, the only organic matter added to the system are plant roots and debris. In a continuous corn cropping system, organic matter content is maintained at 1.5-1.9% (Lowell Gentry, 2008).

There is currently no system in place for the monetary appreciation of soil fertility based on organic matter. However, several parties do see the need to create a system to monetize on soil fertility (Nick van Eekeren, 2008). To start establishing such a system, a manifesto was already signed by the LTO, Rabobank, Brabantse Milieufederatie, Biohuis Nederland, Vereniging from Afvalverwerkingsbedrijven, natuurmonumenten, Urgenda, De Waard eetbaar landschap, Nevedi and many more. To establish such a system, some bottlenecks have to be addressed in the future. (Annemieke Smit, 2005)

Monetizing the carbon for the aspect of carbon dioxide mitigation is possible and described under 'carbon sequestration'. For monetizing the value of fertility, only a + or – is given.

Table 8-2: Effects of soil organic matter in the different case studies.

Project	SOM content	Effect
Schijndel	12%	+
Phien	12%	+
Maize farmer	1.5-1.9%	0

8.2.2 Social capital

In the social capital, the employment, social happiness and quality of life, and the social cohesion are considered as important parameters. In the following paragraph, the employment and social happiness and quality of life are calculated.

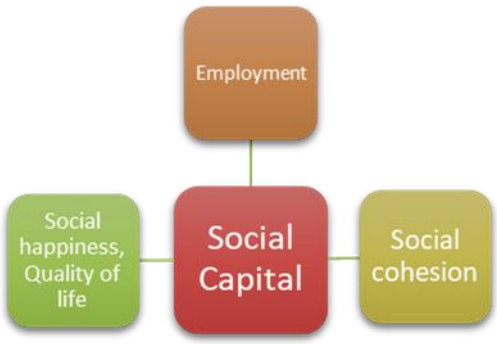


Figure 8-2: Parameters on social capital.

Employment

In the calculations the days of labor has been calculated which gives an idea on how much labor is required. Both food forests require a greater amount of labor than a maize farmer who is spending about 7.5 h per year per hectare in managing the field. The food forest in Schijndel is willing to employ one farmer on a long run, who is responsible for the maintenance of the forest and eventually hire extra people when harvesting is increased. In Phien, the family itself will be responsible for labor supply.

For a matter of calculation, the hours of work for both food forests are used to make some assumption about the employment that could be created in the area. Therefore, it is assumed that all needed labor will be employed by the project. In this way it becomes possible to draw conclusions about how much the government could save on unemployment benefits, which is excluding volunteers. However, it is important to mention that this number is constantly changing and that the saved calculated unemployment benefits can simply give an indication on the effect the project could have on the region.

The employment benefit is calculated by first investigating the working days for the specific project per year, which than results in a calculation of the saved unemployment benefits by the government. For 17 ha food forest in Schijndel, 5 employees will be needed while the food forest in Limburg only requires one person. To make a strong comparison for the three projects, the working hours for a maize farmer are deducted from the working hours of the two food forest projects (See calculation in Appendix XVII) The calculations than reveal that the saved unemployment benefit for the project in Schijndel will be **€ 118,065** per year while Phien can save **€ 12,917 per** hectare per year. As Schijndel is a 17 hectares project, the benefit per hectare will be €6,945. In the current labor situation, the unemployment rate is decreasing since 2014 to 3,4% in 2019 (CBS, 2019). For that reason, the real benefit for the government is questionable in the current labor market.

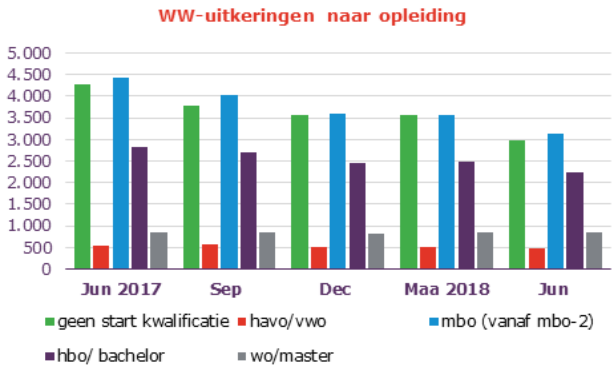


Figure 8-3: Unemployment benefits based on education level (werk.nl, 2018).

Another way to investigate the effects a food forest has on the labor market is by looking at the unemployment benefit by working level. The graph above illustrates the subdivision of the number of unemployment benefits to 5 educational levels in the region of North Brabant. (werk.nl, 2018) In the food forest in Schijndel, a lot of labor is needed for harvesting activities, which can require the work of people with a lower educational level. For instance, as the unemployment benefits for people with a MBO (trades) degree is highest, Schijndel could employ 4 people from this level, and the government could potentially save the unemployment benefit that would otherwise go to 4 people on that educational level. Since Schijndel has the idea to employ one person which can monitor and organize the production, an employee with a higher educational level will be needed. Therefore, the government could for instance save the unemployment benefits that would be directed to a person with a bachelor - degree.

Social happiness, quality of life

Social happiness and quality of life refer to the effect projects have on the well- being of people. It is said that by being in contact with nature and spending time outside, the amount of exercise increases and therefore the number of health complaints is reduced. This is especially applicable if green spaces are close to the people´s homes. A food forest carries the value of recreation with it, which can lead to a better health of the people around, not only mentally but also physically. (Ruijgrok, 2006)

On the other side, a conventional maize farmer does not create green space, which implies that people´s well-being is not affected in a positive way. As no green space is created, no additional physical activity is taking place and the value of the land does not increase. On the contrary, the health might even be negatively affected, since a conventional system emits pollutants such as fine dust and nitrogen dioxide.

In the social cost benefit analysis, the parameter of social happiness and quality of life is described as `public health by moving into the green'. Especially greeneries which are close to home, lead to more exercise and fewer health problems. Therefore, projects that are in or close to residential areas, bring benefits to the public health. Whereas projects that reduce the befit of the area, will decrease the public health. (Ruijgrok, 2006)

The calculations in the appendix are based on the saved health costs that would otherwise be paid for a doctors consult. As both projects are producing additional green places, the saved costs of avoided health problems are calculated as **€14,250 for Schijndel** (€838 per hectare) and **€1,500 per** year. The benefit is saved by the local community who are living in a radius of 3 km to the project.

8.2.3 Produced capital

For the produced capital, the parameters of rentability, return on investment and input use efficiency (more specifically fertilizer use efficency for N,P,K) are choosen as important parameters. Since rentability and return on investment have already been monitized for both food forest projects, the dutch social cost benefit analysis is not used for this chapter. The complete calculations can be found in the Exel sheet;.. which shows both outcomes, for the the food forest project and for the maize farmer. Below, the different parameters are being discussed. It has to be noted that the resource/ input use efficiency is expressed in + and –, and not in euros.

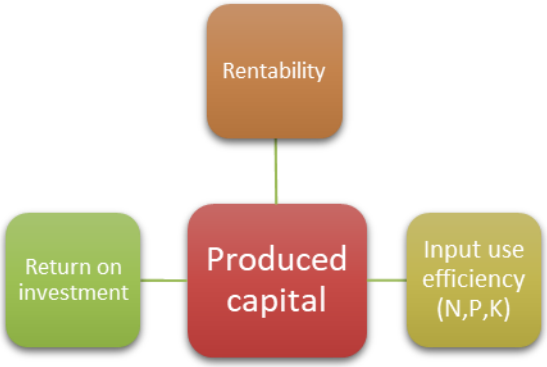


Figure 8-4: Parameters on produced capital.

Rentability

The long- term sustainability of a business includes aspects such as frequency of investments, level of debt, net income and risk management. Rentability therefore has an important influence on the long- term sustainability of a business. (EIP-Agri Focus Group, 2017) This rentability factor is compared on microeconomic aspects, in which the essential information is the balance calculation of a food forest and a conventional farmer. In case of the grain maize, the balance per hectare before labor is €1,045 (WUR, 2018).

Taken into account labor with a salary (including all social costs for the farmer) per month of €2,274.53 the balance after labor will be € 908.-.

This balance is comparable with the balances calculated for Stichting Phien & Schijndel in which labor also is included. Labor is an important factor in the case studies of Schijndel and Limburg. In both of them, no external inputs are needed, whereas the amount of labor needed is high. For example, harvest will take a lot more time in a food forest than harvesting one hectare of maize field. Because of that, it will be important to compare the balance calculation after labor costs. For the comparison, the balance of one hectare will be used for the comparison.

Starting point of the comparison is the balance calculation of the different food forests, which can be seen in the table below. Besides that, some different conventional agricultural crops are compared. The table clearly reveals that the balance for the food forest in Schijndel will be the highest per hectare. On the other side, the balance in Limburg will have a negative balance, which due to the high labor costs. In contrast to the food forest projects, the maize farmer needs to invest less time, which results in a much lower turnover.

Table 8-3: Balance calculation analysis between the different cases (WUR, 2018).

	Schijndel	*Phien*	*Maize*	*Potatoes*	*Strawberries*	*Spinach*	*Org. Maize*
Turnover	€ 15,794.49	€ 15,178.93	€ 2,040.00	€ 7,301.00	€ 38,285.00	€ 6,000.00	€ 4,200.00
Costs for inputs	€ -	€ -	€ 595.00	€ 2,859.00	€ 17,707.00	€ 4,794.00	€ 440.00
Balance before mechanisation	€ 15,794.49	€ 15,178.93	€ 1,445.00	€ 4,442.00	€ 20,578.00	€ 1,206.00	€ 3,760.00
External mechanisation	€ -	€ -	€ 400.00	€ -	€ 105.00	€ -	€ 665.00
Balance before labor	€ 15,794.49	€ 15,178.93	€ 1,045.00	€ 4,442.00	€ 20,473.00	€ 1,206.00	€ 3,095.00
Laborcosts	€ 9,480.00	€ 18,680.00	€ 137.00	€ 556.78	€ 17,750.00	€ 702.56	€ 491.79
Balance after labor	€ 6,314.49	€ -3,501.07	€ 908.00	€ 3,885.22	€ 2,723.00	€ 503.44	€ 2,603.21

Based on long term sustainability, the Food Forest in Schijndel is the most beneficial one. The payback time of Schijndel is 27 years, followed by an exponential cash flow growth. If the food forest has reached that point, the level of debt is not a problem anymore. Besides that, the investments are mostly done in the first years. Since food forests don't have any costs for external incomes, the net income after the year will be positively impacted.

Return on investment

The investment for a food forest is high due to the plant stocks and the land. On the other side, the land for a farmer is often already owned by the family for decades, which results in a much lower investment. The seeds that are needed for the production every year will include some costs, which implies that the farmer will have a lot of returning costs. Besides, if a farmer will have a high degree of mechanization, the money for tractors and other inventory will be added to the investment. In contrast, these investments are not needed for a food forest. Due to the long timeframe of a food forest, profit will be gained very late. This also implies that it can take a long time before the investments are payed back, which is for example illustrated by the long payback time of Schijndel. On the other side, Stichting Phien, has a shorter payback period due to the side incomes. For the maize farmer, the long- time span is not an issue. A farmer sows his maize and already gets his money back in one year, which directly implies that the farmer has some more certainty about his situation for the following couple of year. In case of the food forest farmer, the certainty of return of investment is lower.

Based on the comparison of the different systems, it will take some time before the food forests will reach the point of positive rentability. As already mentioned in the earlier chapter, the time span is an important factor for the food forest. In case of food forest Schijndel, a lot of negative cash flow is needed to reach the point of profitability, which is due to exponential influence of the interest.

Short term sustainability of a business includes short- term debt, cash flow, labor productivity and the costs of inputs. (EIP-Agri Focus Group, 2017) To get an idea about the short term sustainability of the food forest project, the food forest and the maize field are compared on the cumulative balance calculation including investment of the field stock (See figure 8-5) The investment of the field stock is included since the balance calculation of the maize field includes sowing costs as well. As illustrated in Figure 8-5, the cumulative balance for a maize farmer will be high in the first twenty-five years, which is why the maize field works well on

short- term sustainability. The crossing point for this return on investment calculation is found in year twenty-four.

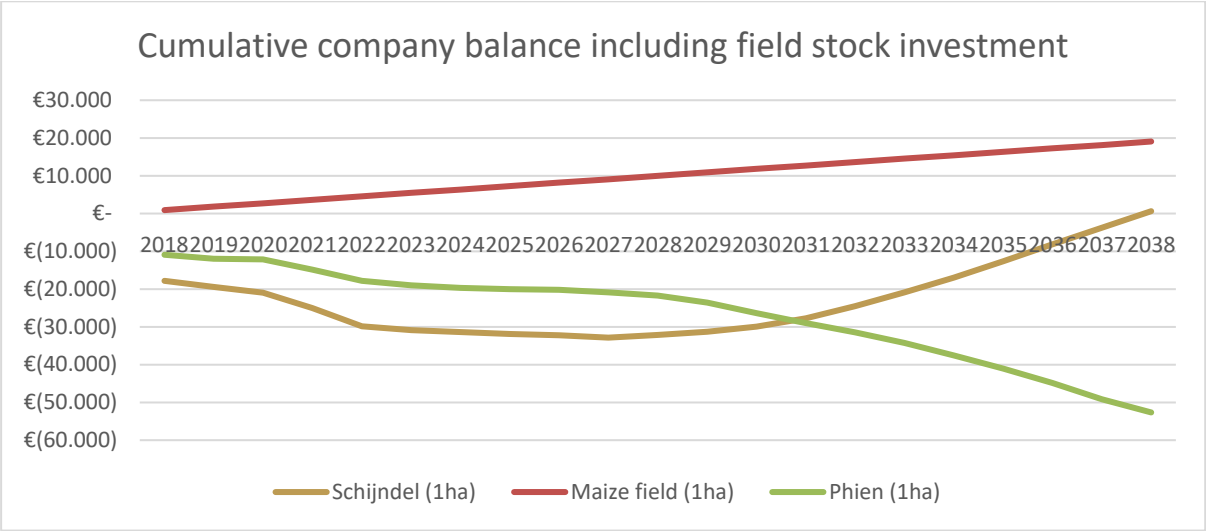


Figure 8-5: Cumulative balance including investment of the field stock comparison.

For the Phien project, the short-term sustainability will not be a big issue which is due to the low investment based on one hectare of land rather than seventeen. Based on the short term, the only problem is that the food forest doesn't reach self-sufficiency in the first years. In the cumulative balance, microeconomic principles are taken into account. If only own labor is used and the revenue of own use is taken out of the calculation, the cumulative balance in year twenty is around €50,000.

Input use efficiency

A conventional farmer needs to use a lot of external inputs such as fertilizers. Based on the grain maize balance calculation, €202 per year is spend on fertilizers. However, as said in the regime 4.1, farmers should deal with climate change and give attention of these parts of their businesses (Norton, 2011). In food forests, no external inputs such as fertilizers, are used and therefore costs for fertilizers can be saved.

Another big difference is output vs input use. For a conventional farmer, the following most important external inputs are seeds, fertilizers, chemicals and fuel (WUR, 2018). The output of one-hectare grain maize is around 12,750 kilograms. In the food forests Schijndel, a total of 7,000 kilogram of food forest products are produced on one hectare. For Phien, a bit more than 5,000 kilogram of food is produced.

For both food forests, the costs for the different external inputs are saved. But on the other hand, a food forest needs a lot of manual work which is also considered as input. The conventional farmer is working on efficiency and spend costs for external inputs while a food forest farmer chooses to have fewer external inputs but more manual work. In the latter case, a lower amount of output is produced.

Nitrogen

Nitrogen is, together with potassium and phosphorus, the most important plant nutrient. Nitrogen can be applied in concentrated forms, in the form of ammonia and ammonium, or in less concentrated forms, such as manure. Other sources for nitrogen are air (by root nodules, by deposition or by soil bacteria) and soil organic matter.

Runoff and leaching of nutrients is a big issue in maize farming, and is expressed in leaching of nitrogen and emission of nitrous oxide and ammonia. Sources suggest that agroforestry practices can effectively reduce runoff and leaching by 78%, and even near to 100% in a

mature system (Maurizio Borin, 2010). For calculations, 95% is used as nutrient leaching in agroforestry systems is based on the inputs; in food forestry there is only small input and most likely this will be taken up by biodiversity (K. Nerlich, 2013).

Nitrogen is also stored in organic matter, in the form of anions attached to a substrate of carbon molecules. The amount of nitrogen in carbon sources is often expressed as C/N ratio. The C/N ratio of pig manure is 6:1, whereas the C/N ratio of soil organic matter is 10/1. Any C/N ratio higher than 20/24:1 is a nitrogen sink, and any C/N ratio lower is a source through mineralization (Ward, 2019).

Nitrogen supply in a food forest system relies on the mineralization of the soil organic matter. Nitrogen in forest ecosystems is for 90% stored in the organic matter, which is poses a stable source for the plants demand. In succession, it is known that most N accumulation occurs in early stages and the pool will not decline in later stages (Jason P. Kaye, 2003). In the food forest, the principles of succession are used and most likely the same will occur.

The calculation in Appendix **XVII** shows that the soil organic matter in a food forest can hold 43,527.27 Kilo of nitrogen. On the other hand, the effective use of nitrogen on a maize farm is 78.2%, whereas in a food forest, there is no fertilizer used. Leaching nitrogen from mineralizing organic matter is reduced to 5%, making the effective use of nitrogen 95%.

8.2.4 Individual capital

In individual capital, lifestyle, risk attitude, workload and knowledge need are important parameters. All these parameters are difficult to quantify and monetize as the MKBA focusses on community benefits, and these factors are not concerning the community but rather the individual. Therefore, these parameters will be compared on their effect rather than in euros. Below, the parameters of lifestyle/diet and workload/ spread are presented.

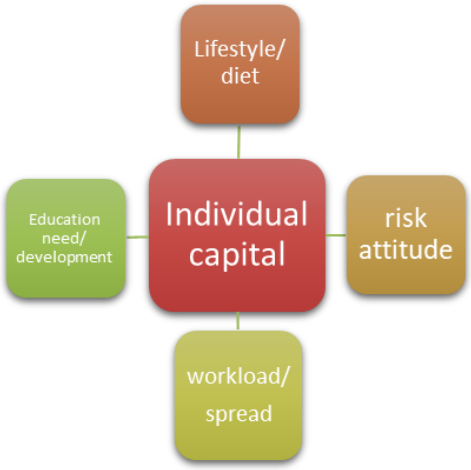


Figure 8-6: Parameters on individual capital.

Lifestyle/diet

Food forests are based around perennial species trees and shrub mainly. Currently, most food in the supermarkets, especially vegetables, is provided by annual species. When any entrepreneur considers a food forest for self-sufficiency, they should consider that many annual plants are excluded and are replaced by perennial counterparts. In the food forests of Phien for example, chestnuts are grown. These chestnuts can be used as nuts but are more often used as starch supplement in stews and can even be processed into bread. Annual grains can't grow in the food forest as they won't yield much under no-input systems. Another consideration is regarding fruits; a high diversity of fruits can be grown in the food forest. In the food forest of Phien, a much higher percentage of fruits is included in the diet. This is partly because they are easier grown, and partly because they feel this is essential for a healthier diet.

In the Schijndel project, a large diversity of produce is grown for the market. The standard hectare of this food forest includes a higher amount of fruits and nuts. However; the farmer is not intending to live self-sufficiently, and it won't have any influence on him. A maize farmer is also not intending to live self-sufficiently from his maize; for him, the maize also has no effect on him.

Measuring this diet can be done by describing the diet and how it differs from the standard diet.

For quantification, merely a +, 0 or a – is given.

Table 8-4: Effect of lifestyle/ diet in the different cases.

Project	Diet influence	Effect
Schijndel	None	0
Phien	Diversified and high fruits	+
Maize farmer	None	0

Workload/spread

The workload for farmers of annual crops is commonly concentrated around two periods; sowing and preparation of the land and the harvesting and processing period. These two periods are busiest for the farmer, and during the rest of the year, little labor is needed.

In maize farming, the need for labor is concentrated around soil preparation, where 3.1 hours of labor/Ha is needed, and the harvesting period, where 3.3 hours per hectare are needed. Other operations that need labor are fertilization, sowing, irrigation, crop protection, weeding, (WUR, 2018)

In food forestry, planting is only done once. Other activities where labor is needed are inspection, maintenance, harvesting, organization and logistics, administration and marketing and sales. The total labor need is higher, but the spread is much more even.

In the food forest in Schijndel, they are not planning to include annuals or livestock. Because of this, the labor peaks are avoided. However, there is a peak when harvesting; but the different crops don't ripen at the same time and this peak will most likely not be very pronounced.

In the food forest by Phien, there are annuals and livestock. For this reason, they will most likely have a labor peak in spring and a second one in fall during harvesting.

The spread of work can be expressed in needed labor/season and is shown in the figure below. Here, needed labor is shown as a percentage of the total needed amount of labor.

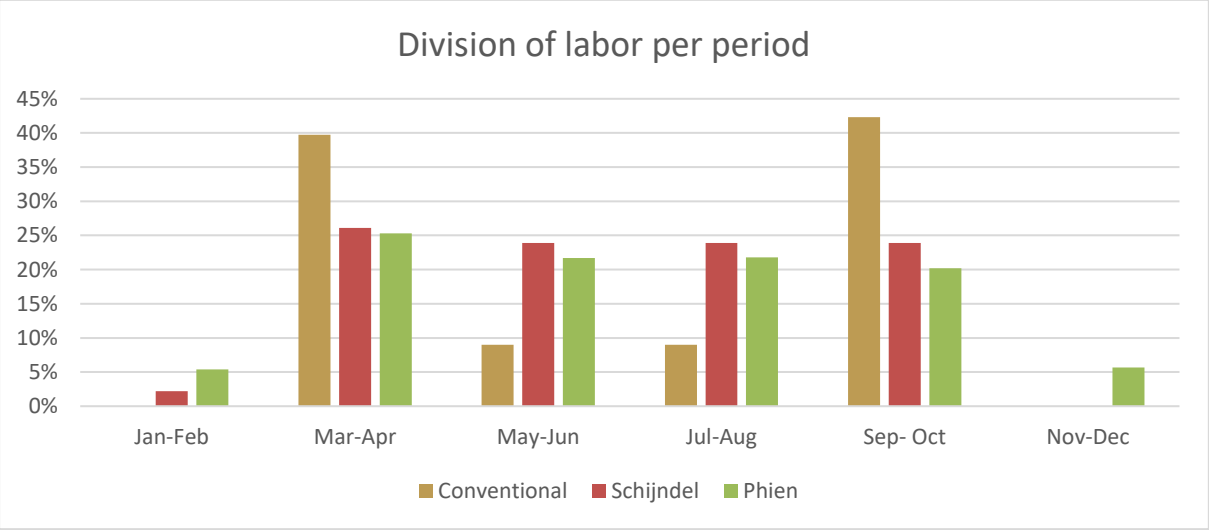


Figure 8-7: Needed labor per period as percentage of the total needed labor.

As can be seen, the division of labor in a food forest is better than the division for a conventional farmer. For a conventional farmer, two peeks can be seen; one during the seeding season in April and one for harvesting in September. Besides that, a conventional farmer needs only 7.8 hours of labor per year, while food forest Schijndel needs 544 hours. In

the Phien project, were annuals are also taken into account, a total amount of 1,024 labor hours is needed. Unless the needed labor is more divided in a food forest, the needed labor hours in the peak periods is higher. This has influence on the scalability. Conventional farmers have in general more hectares than a food forest which will have an influence on the needed labor hours.

8.3 Overall Comparison overview

The table below presents the overall results of the social cost benefit analysis in which the two food forest projects have been compared with a conventional maize farmer. From the figure below various conclusion can be drawn. However, it is important to keep in mind that the calculations are based on the situation after twenty years, meaning that the timeframe of how to reach that point, is not included in the overview. Below the most important conclusions can be found:

- The benefits that are calculated on the natural capital of food forests is significantly higher when compared to a maize farmer. It shows that a food forest has an overall positive impact on the environment and poses an important possibility to respond to previous identified global trends, such as climate change. The overview clearly shows the high natural value of the produced ecosystem services (carbon sequestration, fine dust and nitrogen dioxide collection), which can be used as an indicator for governments to support food forest projects.
- The outcome of the social capital shows that a food forest has a greater impact on the society than a conventional maize farmer. Due to the additional creation of green spaces and potential employment, the food forest projects have a positive impact on the society. The outcome of the employment benefit of food forest Schijndel must be considered with care since the labor market is tight at the moment. Besides, in the calculation it is assumed that the project will employ 5 employees.
- On the produced capital, the maize farmer has the strongest performance which is due to the high return of investment. A food forest has a rather weak performance on short- term which is due to the negative cash flow that is needed to reach the point of profitability. The research suggests that food forest Schijndel is the best option on the long run, on a timeframe of around 40+ years, which is due to the exponential cash flow growth after the 27 years. On the term from 0-20 years, the maize farmer poses the best option.
- On the individual capital, it can be seen that Phien has a positive impact on lifestyle and diet which due to the self- sufficiency attribute. Regarding the workload, a food forest requires a higher amount of labor than a conventional maize farmer. However, the workload is more evenly spread with less peak periods of labor than a conventional farmer.

In the figure below, the total result in year twenty is calculated, based on the benefits described in the earlier part of the chapter. This total result is the difference between the food forest and maize farmer as the different benefits are calculated in difference between both cases.

Table 8-5: Overview of the social results of both case studies.

Year 20	Schijndel		Phien	
Nature capital				
Carbon sequestration aboveground	€	753	€	753
Carbon sequestration belowground	€	897	€	897
Fine dust collection	€	147,525	€	210,000
Nitrogen dioxide calculation	€	1,365	€	1,435
Soil Fertility	+		+	
	€	*150,540*	*€*	*213,085*
Social capital				
Employment	€	6,945	€	12,918
Social happiness	€	838	€	1,500
	€	*7,783*	*€*	*14,418*
Produced capital				
Balance calculation	€	5,406	€	-4,409
Nitrogen use efficiency	++		++	
	€	*5,406*	*€*	*-4,409*
Individual capital				
Diet/ lifestyle	+/-		+	
Work load	+/-		+/-	
	€	-	*€*	-
Total benefits	*€*	*163,730*	*€*	*223,094*

As the cumulative balance calculation presents the financial position in the first period of 20 years, the results are present apart in the figure below. In this figure, the difference between return on investment for the food forests with the conventional farmer is calculated.

Table 8-6: Overview of difference in cumulative balance.

Return on investment	Schijndel		Phien	
Food forest	€	625	€	-52,656
Maize field	€	19,068	€	19,068
	€	*-18,443*	*€*	*-71,724*

9 Applicability on individual farm-level

The following chapter will address the takeaways/interpretation of the previous chapters to formulate statements on the practical applicability of food forests on farm level. The focus is directed on food forests that lie within the Pawpaw quadrant and emphasize the produced and individual capital. The project in Schijndel therefore poses a reliable and generic base to provide insight on how a food forest can be applied on individual farm- level.

The applicability on the individual farm level is depending on two factor; the rentability and the scalability.

9.1 Rentability

First, the rentability is described and includes the balance calculation and the aspects which have an influence on this balance. The results on rentability per hectare are described in the paragraphs below and is based on the following aspects; the microeconomic side, climate resilience and the role of changing stakeholder values in the discussion regarding micro-economics.

9.1.1 Balance calculation

With implementing a food forest based upon the design of Schijndel, a farmer will have the possibility to get a higher rentability per hectare. In general, less hectares are needed to be able to pay the company costs. A food forest based on production value has a higher long term rentability than an agricultural company. However, in the first years, the balance calculation yields a negative outcome. Only after year six, the balance calculation will become positive and the result will grow exponentially until reaching going concern in year twenty.

Every entrepreneur has a couple factors that can influence his balance calculation. Below, a couple of these are described.

Influence of price

The prices a farmer receives for his products will have a significant influence on the rentability. For example, with agricultural prices the rentability of the food forest will decrease. Therefore, the higher the prices, the better the rentability of the project on the long run. The difference between supermarket prices and agricultural prices on the balance calculation is around €25,000. As presented in both case studies, premium prices are necessary for a rentable business case. Price is the most uncertain factor in the business model, which is why it is important for a farmer to know the influence of the price level and how to deal with it.

Influence of short chain

A possibility to receive premium prices can be achieved by operating on short chains, in which a farmer directly sells the products to a retailer or consumer. The normal agricultural chain, as presented in the regime, includes multiple chain partners that all calculate a margin. A lot of steps result in the actual retail price and only a small percentage of that price is going to the farmers. When a farmer establishes a short chain, it will become possible to receive higher prices for the products and thus a higher profit margin. If supermarket prices can be reached, the sales price per kilogram will be on average 226% of the NET wholesaler prices.

Due to the flexibility of harvest and the inconsistent flow of products in a food forest, a short chain is considered as an easier way of selling. Supermarkets, for example, aren't aiming to rely on fluctuating product supply, as they have stable sales. Also, the risk for product loss is lower in short chains, and the communication within the chain will become easier and transparent. In this way, a food forest can communicate the value of the products and the benefits of producing these products in a food forest system, more effectively. Through a short chain, it becomes easier to introduce new products to the consumers, while the

timespan between the introduction of a new product and the adoption of the product by the consumers, will become shorter.

Earlier research has shown that the maximum sales of short chains are reached in a scale of 45 hectares. The higher the production of a company, the more difficult it will become to receive premium prices, also in a short chain. For example, the gross margin of a one-hectare farm is higher than the average gross margin per hectare on a twenty-hectare farm. For a food forest, the same price influence can be seen, which makes the choice for short chain mainly recommendable for small scale food forests. (Nijenhuis & Bruggen, 2018).

Influence of design

Another important button to turn on to influence the balance calculation, will be the design of the food forest. For example, the design of Schijndel is simplified and is planted on rows for ease of harvest. There are food forests based on twelve species of plants, but also based on 100+ species. The complexity and way the food forest is structured has a big influence on the balance calculation. It is also possible to make a design were the canopy trees are planted closer and a part is harvested for wood in the 15th year. By doing so, the food forest will firstly have a higher initial investment, however, on the long run, the balance calculation of the food forest will become higher and with that, the rentability as well. These factors have a significant influence on the return on investment of the project as many costs are related to complexity and structure. In a simple design as Schijndel, the payback time can also be limited by other factors, for instance the integration of chickens and annuals in initial years. These annuals will generate some cash flow in the first years, which might boost the rentability.

9.1.2 Climate resilience

As described in the multi- level analysis, a food forest poses an alternative to current farming systems. As agriculture is a significant contributor to climate change, farmers will have to cope with more frequent and extreme weather events. Besides, scarcity of resources, global change and transboundary pests will, in time, force him to change his cultivation. For a farmer that is not adapting to this, this can lead to an instable harvest in the future, and therefore a negative effect on his rentability.

A food forest as a resilient farming system can help a farmer to cope with the future risks of climate change and can effective reduce the risks of farmer to have a negative effect on his rentability.

9.1.3 Changing stakeholder values

Broader value approach

In a food forest, value can be created in a broader sense and other income than production is also possible. For example, the possibility to receive income from carbon sequestration, cleaning water and cleaning air. As of 2019, no system is in place for monetizing on these values. However, from the interviews and desk research we can conclude that a system for monetizing on carbon sequestration may be developed in the timespan of 1-10 years (Bramer, Liere, & Boonen, 2019). The greater interest in receiving additional income through the creation of more than just produced value, reflects the greater attention and support from connected and external stakeholders on the overall development of food forests in the Netherlands. Furthermore, consumer values are changing as well. Consumer are demanding more authenticity, have a bigger interest in nutrition and health and are more consciously making decisions about their diet. In this context, this development poses promising possibilities for a farmer to integrate food forestry on farm level.

Regulations are shaping opportunities

When a food forest is used in a commercial context, there are certain regulatory aspects that are of interest related to rentability. Sometimes, these show a positive or negative influence, but it could also make commercial operating of a food forest possible or not possible.

One challenge is for example the lack of a national-wide definition of a food forest, which leaves the interpretation of nature/agricultural value to the independent municipalities. This interpretation results in planning permission conflicts, which could result in not being allowed to develop a food forest on plots designated as 'nature' (Nalini Mahesh, 2018). When the food forest is developed on a plot designated as 'nature', this can be limitations on the use of certain non-native plants. Research has shown that food forests include high biodiversity (Jeroen Breidenbach, 2014) and an argument can be made for the recognition of the ecological value of the food forest. For this reason, in some province's exemptions are made for food forests from replanting duty, allowances for tree felling and exclusion of non-natives. However, there are regulations protecting breeding areas and these should be considered. An EU-wide network of nature is called Natura2000, where breeding areas are described for protected species. The designation determines the land value, which influences the investment and thus profitability of the system.

Another opportunity is the crop code that was theorized in 2017 and implemented in 2019 (Greendeal, 2017). For farmers, it is made possible to use a crop code called 'food forest' which they can use to apply for subsidy from the common agricultural policy. This can have a positive influence on the rentability, in case the farmer complies with the green deal definition of a food forest.

As described, social values are important for a food forest. However, permanent stays can pose problems in the planning permission. On nature-designated plots, it is not allowed to build a (semi-)permanent house. On agricultural plots, it is possible but restricted to one residence per farm. This can have an influence on the profitability as it either limits or provides opportunities for diversifying revenue streams.

The province of Noord-Brabant grants subsidy for changing the designation of a plot from agricultural to nature. Also, there are subsidies for developing and maintaining nature. This should be considered, as it can reduce the investments thus improving the profitability.

9.2 Scalability

Another important subject in applicability on farm level, is the scalability of a food forest. As stated in the multi-level analysis, upscaling is a growing trend in the agricultural sector. However, there is not much known yet about the scalability of a food forest. An analysis of scalability issues is given in the subchapter below. In the subchapters, finances, labor & mechanization and risk management is described. Finances/cash flow dynamics in a food forest

A project is up-scalable if the benefits of a bigger scale are higher than the (cumulative) increase of investment costs. As some investments are not linear, it poses an interesting case. The payback time is an important indicator for the scale advantages. When scaling up a food forest, the balance calculation per hectare will be the same. As said before, the food forest will be in going concern after twenty years, meaning the system is stable. The difference in scale is on the financial side and the non-calculated costs. If it is possible to divide these costs on twenty hectares, they will be much lower than when they can't be divided on multiple hectares. At the same time, the investment for twenty hectares of food forests will be much higher. The payback time and needed cash flow for this can pose risks for the company. As the interest is exponentially growing when more negative cash flow is

apparent, the higher scale poses a much higher risk. Therefore, the cash flow position is an important indicator for the scalability. (For calculations, see Appendix **XVIII**)

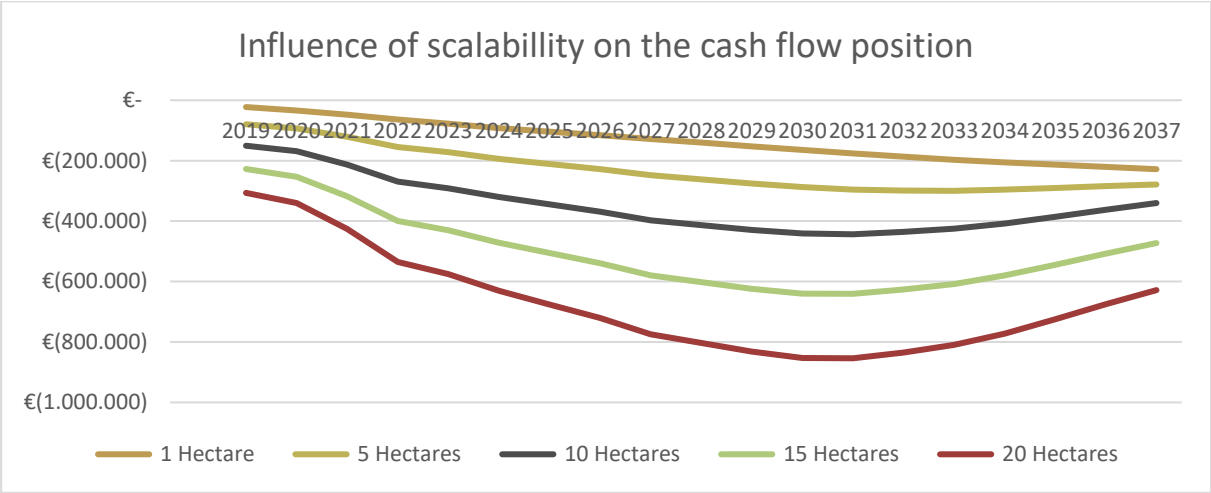


Figure 9-1: The scalability factor of a food forest (based on case study Schijndel).

As shown in the figure, the scalability of a food forest has a big influence on the cash flow position. The difference, based on this figure, is not so much on the payback time but more on the total needed negative cash flow. The bigger the food forest, the more negative cash flow is needed. For a one-hectare food forest, this will be around €250,000. While, in a ten-hectare food forest this number is €450,000. In a twenty-hectare food forest, the total needed cash flow is around €850,000.-. Because of that reason, there are some scalability benefits for a bigger food forest as the cash flow is faster getting positive when the food forest starts producing. Nevertheless, the total needed cash flow is still increasing. Depending on the risk management way of financing, the most beneficial size is company depending. Based on the total needed negative cash flow, the most beneficial scale is the ten-hectare food forest, which is due to the benefit of exponential interest on that scale. The difference between a ten-hectare food forest is not on the return on investment, but on the side of the total needed negative cash flow.

9.2.1 Labor & Mechanization

Based on the agricultural trends, two important factors that are influencing scalability are manual labor & degree of mechanization. Earlier calculations are based on costs for manual labor, disregarding mechanization. In a conventional maize farm, all processes are mechanized, and little manual labor is needed. In a food forest, there is a much higher demand for manual labor and mechanization. Heavy machinery is undesirable as it influences the soil negatively.

The highest labor-demanding process in the food forest is harvesting. In a well-structured food forest, there are possibilities for mechanization of this aspect. For example, light machinery can be used to collect and transport the produce on the field. The actual picking would still need to be done by hand, but there is already a large reduction of labor possible when the collecting is mechanized. From interviews, it can be also concluded that small mechanization, for instance a nut wizard, will also become available. There is potential for mechanization, also in this aspect. However, it can't yet compete with a maize field which only needs 7.8 hours of labor per hectare per year. The case study of Schijndel was calculating with 544 hours per hectare per year, almost all of which is manual. In the case study of Phien, because of the annuals, 1024 hours per year are needed.

Because of that labor need, the influence on scalability is big. If a farmer works forty hours a week all year round, one year has 1836 working hours. In the analysis, the needed labor per peak period are calculated. Based on that, one food forester can manage around 2 hectares of food forest. Of course, experience, time allocation and scale advantages can influence this, but it doesn't compare to a maize farmer. Based on their peak period, it should be possible to manage 95 hectares per farmer. However, one interviewee stated that one food forester can manage four hectares of food forest by himself, it is still not as scalable as the maize farm. Regarding scalability, this high labor need and mechanization should be considered as they have a big influence on upscaling a food forest.

9.2.2 Risk management

Starting a food forest gives a couple of risks for a farmer. As said in the earlier parts, most important risks are in the slow return on investment and influence of labor. For this, some risks management measurements can be taken.

Cash crop products

In the rentability part, the design is already described as having a strong influence on the food forest. An important risk management measurement to consider there is enough cash crop products in the food forest. The product range in a food forest is divided into regular and specialty products. The price and demand for specialty products is unsure, as there is little data available on their yield and not many consumers know about the product. When in implementing enough cash crops are included, a more accurate rentability can be made. Because of that, the return on investment will be more accurate as well. Whether a specialty product will be profitable is depending on the price the consumer pays for it, and the attitude of the individual farmer.

Diversification and step by step development

Another risk management measurement is the way a farmer is adapting on the food forest. For example, it is an option to have a dairy farm with eighty cows and expand with two hectares of food forest. With that, the profit of the dairy farm will stay, which can be invested in the food forest. Because of that reason, the farmer would be sure about his income the first years. Another option is to do step by step development. If a farmer would like to change twenty hectares of arable farm into a twenty-hectare food forest, it would be more beneficial to change one hectare every year than changing everything in one year. Firstly, the pressure during planting period will become lower with that. Secondly, the farm will, again, have a sure incoming from his arable farm in the first years.

Other ways of financing

The interest on negative cash flow has a big influence on starting a food forest. Because of that reason, it will be important to look more into other ways of financing. An option is crowd funding. With that, people invest venture capital. Firstly, this can help integrating the local community in the project. Secondly, it isn't needed to pay them money before getting profit. With that option, the total needed negative cash flow will be much lower. Based on a seventeen-hectare food forest, this can save €340,000.-. Another option would be to investigate other options for liabilities. In the calculations, an interest rate of 3% is considered. A lower interest rate will therefore give benefits. This solution is based on risk averse capital. Besides that, it can be an option to get payed from subsidies/ stakeholders. If they get capital in return, this will be venture capital. As said in the analysis chapter (8), getting payed for carbon sequestration will also give benefits.

9.3 Steps to take

After analyzing some practical points that are of relevance for the farm- level applicability, some steps are described and can be used as advice to farmers that are interested in starting a food forest.

The current agricultural sector can be divided into four main orientations based on the agricultural roundabout. These four are; world market, quality market, niche market or quit farming. (Groot & Woudenberg, 2017). Farmers who would set the first step in the further development of food forestry will be the farmers in focusing on the niche market, as these already have established a market for their niche products and have customer relations. For entrepreneurs focusing on the global market, the step towards a food forest system is very large.

In earlier parts is already concluded that food forests are working on a long timeframe, where the return on investment (ROI) is relatively long. Therefore, farmers should have a good financial position before starting on a food forest project. This financial position is an important risk measurement. For dairy farms, when in an unsure position due to environmental regulations, it will become much more difficult to start up a food forest project. For fruit farms or arable farms, which have already an established local market, the step is smaller.

Scalability has shown that a food forest of ten hectares gives the most beneficial situation based on the cash flow. Because of that reason, some scenarios are based on these ten hectares, while the niche market farmer is chosen to be an organic maize farm. These both assumptions give an idea on which steps an organic maize farmer can take to integrate a food forest system on his farm. Even though the calculations are based on the numbers of an organic maize farmer, most figures are applicable for other farmers as well.

In figure 9-2 the cumulative balance including investment is visualized. In this figure, three different scenarios are considered. Firstly, a nine hectares organic maize farm with one-hectare food forest (diversification). Secondly, an organic maize farm which switches over one hectare each year until ten hectares of food forests (step by step). At last a scenario of total ten hectares food forest.

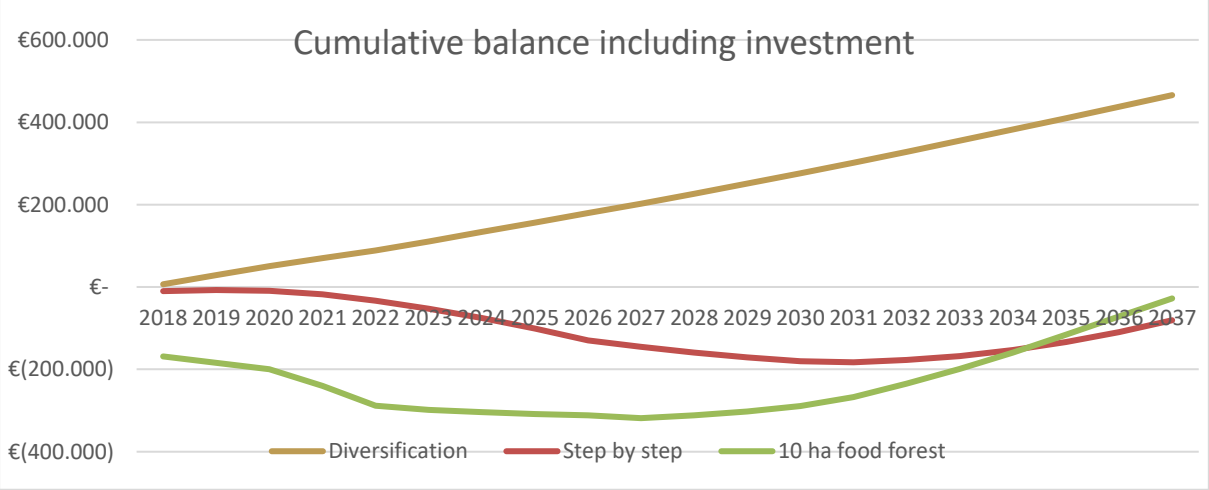


Figure 9-2: Cumulative balance including investment based on different scenarios.

As presented in the figure (Appendix **XVIII** for calculations), the diversification option will give the highest return on investment in twenty years. Unless the high investment and needed negative balance, the ten-hectare food forest will have a higher return on investment than the step by step scenario. Even, the risk of investment is higher there as well. In the

step by step scenario, some income of the maize field is considered the first years. In the ten-hectare food forest, this stable income is missing.

This figure is based on short term sustainability. As said before, the long-term sustainability of the food forest project will be much higher than the diversification scenario. Besides that, these last two scenarios will also give a higher benefit to the natural and social side. Therefore, the ten-hectare food forest will give these benefits earlier and will be the best option for long- term sustainability. The diversification scenario will give the lowest benefits on that perspective.

Below some more specific recommendations for the farmers are given, based on the different scenarios.

9.3.1 Scenario diversified agricultural production

The first possible scenario can be seen in using a food forest as diversification as part of the current system. As said in the regime, a lot of agricultural farms are already working with this principle, where daycare or recreation are examples of that. Food forests are also an option for that. The benefit of using food forest as diversification is that the risks are much lower. Firstly, there is lower initial investment and secondly, the income of the main products of the farm will remain. To get the food forest part profitable, it is recommended to operate in a short chain to yield a higher margin.

9.3.2 Scenario step by step

The first option for a farmer to change his current agricultural system fully into a food forestry system is to transition step by step into a 10- hectare food forest. With the step by step approach, one hectare should be changed for ten years every year. The risk for this scenario is lower because of the spread of investment. Besides that, a part of stable income stays in the first years. Both measurements have a positive impact on the needed cash flow in the first years. The smaller steps a farmer takes, the lower the needed cash flow will be. At the same time, it will take longer to get profitability and nature/social benefits.

9.3.3 Scenario ten-hectare food forest

The second option can be to start a ten-hectare food forest and stop other agricultural activities. On the long- term sustainability side, this will be the best option because the long term rentability will be faster at the highest point. Besides that, the positive impacts on climate will also appear earlier than in the step by step scenario. The problem with this project is short-term sustainability. The initial investment, and with that the needed cash flow, for this scenario are high. Strategic thinking on how to finance the project is therefore highly needed. For a farmer with a lot of savings, it will be easier to start this variant. Another option can be, other ways of financing, as mentioned earlier. Crowdfunding or subsidies are examples for that. Besides that, the price risk is the highest in this variant. Therefore, it will become necessary to start operating on the niche market to get higher margins.

9.3.4 Scenario simplified agroforestry

A fourth and last scenario will be to consider principles from the food forest and integrate them into the current agricultural system. With this, the farm will not become a food forest but a simplified agroforestry system. As these calculations are not part of the research, exact numbers are not known and for that reason not shown in the figure above. But the expectation is that the system will end up between the lines. There can be chosen to integrate ten-hectare agroforestry in one year, or to spread it as well. The biggest benefit of this system is the staying income of agricultural activities in the first years.

10 Conclusion & recommendations

In this part of the report, answers on the research questions will be given. After that, some recommendations will follow.

10.1 Conclusion

What is the potential of a food forest in the future agri-food system?

The multi- level analysis in chapter 4 has revealed that a food forest responds well to the identified trends by fulfilling multiple niches. There is a large overlap between current and future stakeholder values and the social and ecological principles of a food forest. In this sense, a food forest poses a sustainable alternative to the current agri-food system by being a resilient farming system that creates multiple values. The ecological principles of a food forest provide promising solutions to create high biodiversity in an agricultural setting, while the creation of social values of a food forest also reacts to current consumer trends.

What are the possibilities of a food forest in the Dutch situation?

Interviews with food forest entrepreneurs and other important stakeholders have revealed that there are great possibilities for a variety of food forest projects. Each of the already established projects is unique and is based on multiple values, where some values are more emphasized than others. A food forest project starts with the high valuation of ecological principles as part of the food forest production system, but will eventually direct an additional focus on more values. This makes the development of food forest in the Netherlands extremely dynamic and capable to respond to current and future trends. Therefore, it can be concluded that all four quadrants have promising possibilities in the Dutch situation.

What does the analyzed business case of Schijndel look like?

Food forest Schijndel is a structured food forest which values are focused on the individual and produced side. Climate resilience and diversity of knowledge are the main strengths of the business case. An opportunity for the project is the contribution to creating high biodiversity in an agricultural setting. Besides, as a diverse system with a lot of different products, the company will have a high and positive rentability in the long term. Nevertheless, due to the high investments and low productivity in the first years, a lot of negative cash flow is needed. For that risk, good risk management is needed to bring the case study to a successful business case.

What does the analyzed business case of Phien look like?

The food forests initiated by Phien show values that mostly reflect on the natural and social side. With the food forest, Phien strives to establish a system where one family of four can be self-sufficient in their food needs. In the calculations, it became apparent that side-income would be needed but the food forest has the potential to eliminate all food costs and generate some income for the family. Hence, the strengths of this project are regarding autonomy and high-quality nutrition. Weaknesses of the project are that there are currently no grains/oats, rice or substitutes grown. Opportunities are for creating social value and connecting consumers with producers, threats are regarding the uncertainties related to planning permission, self-sufficiency and the performance of the system.

How do the two food forests compare to a conventional maize farm, keeping in mind the four capitals?

Conventional maize cultivation was compared with both food forests (Schijndel &Phien) based on parameters guided by the 4-capitals. Based on the social, natural capital, both forests score higher than the maize cultivation. Regarding global trends, these are of increasing importance. On produced capital, when expressed in balance calculation the food forest Schijndel appears to be the best option. However, when comparing to return on investment the maize farmer is the better option. On individual capital, the parameters show that the food forest in Schijndel poses some benefits, and Phien shows most benefits.

The cumulative balance of a maize field shows very clearly that a food forest acts on a much longer timeframe, as on a 20-year timeframe the balance of the maize farmer is much higher. However, further analysis shows that on a timeframe of around 40+ years, the food forest yields more than a maize farmer.

How could the developed business case be applied on individual farm level?

On individual farm level, the food forest system gives promising possibilities. Based on the scalability factor, the most beneficial situation will be to operate on a ten- hectare food forest. On long term sustainability, the food forest gives a good rentability as well as a climate resilient system. However, the prices will have a big influence on the rentability of the project. Therefore, operating on a niche market with a short chain is necessary. There can be seen some different scenarios for a farmer to start with a food forest. For example, if a farmer rebuilds ten hectares of agricultural land into a food forestry system, the step by step approach gives more short- term benefits than switching the system in one time. Other options are to use a food forest as diversification or using a simplified agroforestry system.

Main Question:

During this research, an answer on the following main question is research:

"What could be a successful business case for a temperate climate Food Forest in the Netherlands?"

Depending on intrinsic motivation and values of the entrepreneur, there are a lot of possibilities to build a promising business case of a Food forest in the Netherlands. Both Schijndel and Phien can be considered as promising examples. The ecological principles, and therefore the restoration of ecosystem services and inclusion of biodiversity in an agricultural context is a precondition to start a food forest. Besides, another precondition is on the financial side of the project. Based on that, a premium price is needed to bring a food forest to a successful business case. There are a couple of possibilities to receive that premium price, of which, operating on a niche market with a short chain can be considered as most important. Other important factors to turn on are; ways to finance, labor & mechanization or diversification. All these factors are possibilities to manage the return on investment. On the environmental side of the project, getting paid for carbon sequestration can be of benefit to the business. These measurements or potentials can boost the cash flow positively and bring a food forest project to success.

10.2 Recommendations

The research describes the potential of food forests in the temperate Dutch climate, which shows that they pose a promising food-producing system. The multi-level analysis tells us that the food forest responds to certain trends and that certain niches for food forests can give interesting possibilities. Furthermore, the potential value for the biodiversity of the system, created through food production, are important to consider in a situation where climate change is becoming increasingly apparent.

As the research has shown, the rentability of the system in the first years after the establishment is not significant. To manage this, and also to boost the rentability in the long run, the following recommendations are made:

- The influence of price received has a big influence on the rentability, premium prices should be aimed for.
- Using short chains should be very important to the food forest entrepreneur; taking out chain links improves the margin for the food forest farmer and makes it easier to transparently and easier communicate his approach to the consumer. Also, feedback loops are much closer
- The design is leading in the business case; the complexity of the system determines many aspects of the business

Regarding the scalability of a simplified-design food forest, the following recommendations can be given based on several options. These three options are: broadened agriculture, step by step transforming the farm or starting a 10-ha food forest right away. Based on the finances, the transforming of the whole farm at once is the least attractive option. The financial risk in food forests is substantial, and by slowly adapting this can be managed. Regarding labour and mechanization, food forests demand more labour than a conventional maize cultivation and this should be considered when upscaling. However, there is research ongoing on developing tools for mechanization in the food forest. Based on our calculation, one employee can manage two hectares of a food forest. Regarding risks, a higher scale will pose more risks, the most pronounced ones being financial.

For further research

This research has shown that it is unclear what price for food forest produce can be earned. It is therefore of importance to investigate what the `added value ` of food forest products is worth and how this price can be of benefit to the financial position of the project. The research has further shown that food forests are still a new topic, where more education is needed to keep the development going. In terms of natural value, a food forest poses an interesting case for carbon farming, which requires additional research about the environmental benefits of a Dutch food forest on a long timeframe. For this research, the system for carbon payments should be researched in-depth. Besides the natural and produced capital that proof to pose great possibilities in the Dutch situation, the social and individual values of a food forest seem to be underestimated. Therefore, more research should be directed to which benefits a food forest can bring on social and individual level.

Discussion & epilogue

As the research has revealed, a food forest poses a successful business case in a long run, however still a lot of farmers are skeptical when it comes to integrating a food forest in their system. Reasons for this can be seen in the high investment and the technical drawbacks, uncertainties related to the market and the possible devaluation of land.

Uncertainty of return on investment

The research has shown that a food forest requires a high investment with a long return on investment. There are possibilities for an entrepreneur to finance the business by his own savings or through financial support from other stakeholders. In this sense, Noord-Brabant is forerunner as the GOB provides financial support to projects that combine nature with a business model. Other provinces are behind in this development, as there, it can be more difficult to receive financial support from connected and external stakeholders. Besides that, the business plan of Schijndel is based on the rent for nature land, while the rent of agricultural land is higher. To make a food forest business case a successful and thus boost the adoption of food forest by farmers, the business case needs to prove itself on economic viability.

Technical drawbacks of the system

Research has shown that the development, as well as the maintenance of a food forest is knowledge-intensive. The system is based on ecological principles which requires not only a mind shift towards more nature-inclusive farming systems, but also a basic understanding of the ecological processes on which a food forest system is based on. The further development of food forests will require the education of farmers on the basic principles of a food forest. A cooperation of food forest entrepreneurs, where knowledge can be shared and used for the systems continuously improving can be considered as a way in which farmers can approach this.

Uncertainties related to the market

This research has been carried out the pioneering phase, where some aspects are based on predictions which results in uncertainties. The question arises on what will happen if the amount of food forests in the Netherlands will increase and which effect this will have on the food forest businesses and their markets. At this moment, the product/production method combination is a novelty, which justifies asking for a premium price. However, in case more food forest initiatives are emerging, and consumers start to adapt the products, the prices might decrease. As consumers become familiar with the products, it will become of more importance to look for strategies how the value of the products can be sustained in the supply chain. On a point where food forest products have established a presence in the market it will become of greater importance to investigate strategies for food forests to sell their products on the market.

In this research, some different price levels are considered. For example: net wholesaler price, supermarket price and agricultural price. An important note is that a different price level also requires a different strategy for sales. Margin is related to the risk an entrepreneur takes, and when a food forest gets supermarket prices, it also takes the risks of a supermarket, and should also have the same level of services as the supermarket. A supermarket is focusing to unburden the consumer by providing all demanded food products at the same store. When the food forest wants to reach the same price level, these aspects are important to consider.

Devaluation of land

Another discussion point is the devaluation of land in the context of a food forest. There is a general discussion on the designation of land on which a food forest should be based on. In

the Netherlands, the municipalities are creating the rural development plan. For that, they use directives from province side and restrictions of the national government (Waard & Oortwijn, 2014). The problem at the moment is that there is a big distinction between the nature and agriculture planning permission. Because of that reason, it is difficult to have the perfect planning permission for concepts which blur the line between agriculture and nature, what a food forest does. As said in the report, agricultural land value is on average around €60,000 per hectare while nature land is only €15,000 per hectare (NVM, sd). What the best planning permission for a food forest is, is company and place specific. Both can give benefits as well as negative effects. According to a law teacher on rural planning an entrepreneur should not focus to much on the restrictions but talk with his environment and the municipality about the plans and found together the best way of operating. Nevertheless, these processes as was as re-designate the land are long processes. At the moment, there are possibilities to get paid for the devaluation of land for which reason it can boost the cash flow. Besides that, nature organizations as the GOB are providing subsidies to get more nature land. This aspect has been considered in the research but has not been research in detail.

Epilogue

This research provides a contribution to the development of agroecological farming systems. With a food forest, conventional farmers can choose for an alternative business case. This research contributes to the limited scientific data on the topic and visualizes the risks and opportunities an entrepreneur needs to consider when starting a food forest enterprise. By doing the case studies and comparing these with conventional farmers, the benefits of a food forest are visualized. By doing so, it became possible to give some advice on individual farm level for the applicability of the food forest as business case.

In a period of six months, this report was written to help entrepreneurs understand the potential of a food forest system, as a food-production system but also in a broader sense, as a method to tackle social and environmental problems.

We hope the research has provided inspiration, if not for starting a food forest, than maybe to stare a maize farm.

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