Comparative study of two organic farms in Alphen and Arnhem: Development of potential business model for agroforestry system

A research project submitted to Van Hall Larenstein University of Applied Sciences in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Production Chain Management specialization Horticultural Chain

Student name: Quynh Nhu Do

Student number: 000019441

Supervisor: Eurídice Leyequién Abarca

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Dedication

This work is dedicated to my partner and my daughter. They have been my inspiration and motivation during the research process and the master degree journey in The Netherlands.

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I would like to express my most sincere gratitude to the following people who have greatly contributed and made my journey of master degree a success:

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Executive summary

In the Netherlands, intensification of agriculture has led to doubled yield per hectare, but the production driven practice come with an alarming and irreversible effects on the environment. Pressure on land and natural resources is increasing, biodiversity is declining, and climate change is getting more severe. Farmers have to rely more heavily on external output and are more vulnerable to climate change. As population grows, so as the demand for food. Resolving the conflict of interest between agricultural production and nature conservation is not an easy task. At the same time policy makers are asked to set targets for nature conservation and sustainable agriculture. Agroforestry can be a possible pathway towards closing the yield gap and creating sustainable intensification because it can generate environmental, social and economic benefits. This study was conducted to explore the potential business model for agroforestry system of two farms in Arnhem and Noord Brabant, the first on is a small care farm and the latter is a normal agricultural farm with larger scale. The study evaluates the value chain that both farms are operating in and provides insight on strengths and weaknesses of each farm during the transition from conventional horticulture to more sustainable agroforestry system. The study also includes cost benefit analysis of hypothetical agroforestry design to help the farm owners to make decision and plan the implementation of the agroforestry system. Result of the study showed that in two farms, the adoption of agroforestry system requires high overhead cost and results in long payback period. For Klein Mariëndaal in Arnhem, the NPV is €28,155.09 and it takes for the system 11 years to be cashflow positive. For Kwaalburgse in Noord Brabant, the NPV is €(16,548.20) and it takes 19 years for the system to be cashflow positive. In both case, potential subsidy is also included in the calculation, however, it does not change the cashflow and breakeven point of the system. The main challenges to develop agroforestry system are the lack of expertise to plan and maintain such complicated system, lack of labor for harvesting, weak agroforestry supply chain and value chain, unclear legislation and policy and the low profit level and finance.

1. Chapter 1: Introduction

1.1 Background information

Agriculture activities in European countries were heavily influenced by the paradigm "green revolution" during the last 50 years following World War II. Intensification of agriculture were characterized by monoculture with high yield crop, excessive use of inputs such as fertilizer and pesticide, heavy machinery to increase labor efficiency and aggregation of fields. According to the European Commission, approximately 38% of the EU budget (equivalent to 0.4% of the Union's GDP) is spent on agriculture and rural development. The Common Agricultural Policy (CAP) plays an important role in promoting agricultural production and strengthening the role of farmers from the economic point of view. These major factors resulted in a big leap in agriculture productivity, with doubled yield per hectare (Schutter 2011, cited by Prins, 2017). However, the production-driven agriculture practice comes with an alarming and irreversible effects on the environment. Intensive farming has severely affected ecosystem services like soil quality, water resource and resilience to extreme weather events. It is estimated that from 1961 to 1990, CO_2 emissions caused by agriculture in the European Union (EU) had grown by 26.4% (FAO). Agricultural activities in the EU-28 generate about 10% of the Union's total greenhouse gas emissions. Each year, Europe loses 970 million tonnes of soil on average and approximately 11.4% of the EU's territory is affected by a moderate to high level soil erosion (Eurostat, 2017).
According to FAO (2009), there are more than 7 billion people on Earth in 2011 and it is expected to increase to 9.3 billion by the mid-century. As population grows, the demand for food and production is expected to increase by 60% to meet population demand. Resolving the conflict of interest between agricultural production and nature conservation is not an easy task. At the same time policy makers are asked to set targets for nature conservation and sustainable agriculture. In Europe, 44% of total water extraction and 43.5% of total land is used for agriculture purpose (Ajena, 2017). It is crucial to produce food and promote agriculture in a more sustainable way without exhausting nature resources. Agroforestry – growing annual crops with woody species (trees and shrubs) and/or livestock – can be a possible pathway towards closing the yield gap and creating sustainable intensification.

In the Netherlands, the interest in agroforestry has revived and increasing number of projects in the field of agroforestry have started since early 1990s. This is the direct consequence of a prolonged period of negligence from 1950s to 1990s, during which farmers under pressure of labor costs and land prices employed large-scale agricultural production (Oosterbaan & Kuiters, 2014). Even though the usage of fertilizers and chemicals were carefully administered and monitored, the intensive mono-cultural farming practices eventually caused negative impacts to the surrounding environment. As one alternative to curve the aforementioned issues, agroforestry nowadays is practiced in selected farms in the Netherlands, with experiments carried out to test and understand the possible upsides of the implementation of agroforestry systems.

In recent years, a multi-disciplinary team of researchers, experts and practitioners at Wageningen University and Research has carried out a series of experiments to advance the knowledge and

practice in agroforestry and agro-ecology in general, some of which are really at odds with current known practices in the Netherlands. The focus of the experiments is on resiliency and sustainability of the production system, against the drop in bio-diversity and increase in extreme weather.

- One of the ongoing researches at WUR is on strip cropping: growing different crops of leguminous plants in strip of three to six meters wide. The experiment tests the advantages of strip cropping: how different species interact for optimal and efficient use of natural resources such as water, light and nutrients; how biodiversity reduces disease and pest and how combination of the right crops could help decrease the use of plant protection products. The rotation that is tested is based on dominant crops from arable farmers in the Netherlands and local practice. The rotation consists of: grass clover - cabbage - onion - potato - wheat and carrot.
- ReMIX and DiverIMPACTS projects research what happens in the soil: soil fertility, productivity of main crops and the suppression of weeds, diseases and pests. The increase in biodiversity both aboveground and belowground is a consequence as the mixed crops offer food and shelter through the more diverse and enlarged biomass. Great insights have been acquired for certain species such as wheat field bean and barley pea.
- New research initiative to gain knowledge on the field of mixed crops of woody crops with annual arable and vegetable crops (Silvio-arable variant) has recently kicked off. The focus of the study is to gain knowledge inventory and understand the obstacles of an agroforestry system in terms of options for mixing various crops, its impact on soil fertility, biodiversity and disease pressure, and technical and economic feasibility of agroforestry. The use of robotics in agroforestry is also a key initiative: how precision agriculture, automation and robotization could assist the management of cultivation in such complex system of agroforestry.

In the other hand, food forest ("voedselbos") – one way of implementing agroforestry –is gaining significant traction by the public even though is a relatively new phenomenon in the Netherlands. Since the organisation Foodforest Netherlands was created in 2013 by the two pioneers Xavier San Giorgi and Wouter van Eck, more edible trees are being planted in the Netherlands whereby the Foodforest Ketelbroek is the main inspiration (Limavera, 2014). There has been a significant increase in the number of food forests in the Netherlands, from just 5 during the period 2000-2009 to over 45 between 2010 and 2016. Especially, in July 2017, the biggest food forest in Europe (30 hectares) was contracted and commissioned to six parties in Eemvallei Zuid, a public nature area in Oosterwold of the Flevoland province. The plan for Food Forest Eemvallei is to be a recreational food forest open to public, with economic profitability starting in 2026. Additionally, there will be support from the province of Flevoland for planting and landscape management during the first eight years of the project, although limited. Besides the usual harvests such as fruits, nuts, herbs and vegetables, the additional revenue sources of the project will come from the sales of processed forest products such as ciders, marmalades, smoothies and chutneys - to be provided for visitors of recreational services such as forest tours and leisure activities.

The challenges of increasing and multiplying the food forest practices in the Netherlands are well-recognized. Most food forest farmers will need financial support for the first few years, while the economic realization could only come at later stages. Also, there is a significant knowledge barrier for entrance - most food forests in the country are undergoing projects and the expertise is being developed. The timeframe and the reliance on volunteers and social entrepreneurs are other issues with replicating the model. In one particular project by Stichting Voedselbos Vlaardingen (SVV) at the

edge of the city of Vlaardingen, the food forest is expected to become productive after five years and reach full production after fifteen to twenty years, with some trees only reaching full production after 50 years.

1.2 Research problem

The Kwaalburgse Hoeve located near Alphen is an organic (SKAL) certified farm producing grains and cereal. The farm owner is looking at options to develop an agroforestry system with combinations of trees and shrubs (e.g. walnut, chestnut, hazelnut) and an underlayer of annual crops such as spelt and chicory as the current business only generates marginal returns. Potential organic products from the farm such as sweet chestnut, hazelnut, walnut and berries, among other will be sold as specialty products. However, there is no mainstream sale channel at the moment. Moreover, the farm owner is concerned about harvesting issues because agroforestry is a complex system that currently significantly relies on intensive manual labor with little space for the usage of machinery. With the support from the European Union project FARM LIFE, the owner is now developing agroforestry system. FARM LIFE is a project that develops inclusive sustainable rural networks in which farmers and relevant stakeholders can learn together how to transition from a landscape with conventional monoculture systems to a climate-resilient landscape with diversified agricultural production systems, i.e. agroforestry. These stakeholders include farmers' associations, entrepreneurs, knowledge institutes, government ministries, and social partners. The FARM LIFE strategy is to encourage them to self-organise in resilient networks that can last beyond the project timeframe. FARM LIFE is building a transition toolkit that will enable farmers, policymakers and societal partners to effectively implement the agricultural transition towards climate adaptive agroforestry. The project can contribute to the successful upscaling of agroforestry in the Netherlands, Belgium and other European countries, by creating an environment in which the relevant stakeholders can "exchange practical knowledge and tools that can directly facilitate the transition from conventional monocultures to climate-resilient agroforestry.

The second farm, Hoeven Klein Mariendall, is a care farm in the outskirt of Arnhem that is providing a wide range of farming-related activities for its participants (people with intellectual disabilities, psychiatric problems or autistic disorder). One of the activities is growing vegetables, herbs and flowers and selling vegetable basket to customers. The number of customers is decreasing, and the horticulture farm is not making any profit. Because the farm is located in a nature area, intensive farming and greenhouse installation are not allowed, which results in short seasons in winter and also the farm has to supplement products from other producers in the neighboring area. Besides, there is 1.5 hectares of grassland not being used at the moment. The farm management board is now seeking opportunities to increase the number of vegetable baskets and find more customers. They are also interested in growing more special products to develop a brand name and processing fresh produce to add more value as they already have a nice kitchen and restaurant on site. Thus, agroforestry or food forest is an interesting solution to tackle the issues above and to educate people about sustainable farming practices and to involve other citizen in surrounding communities.

1.3 Problem owner

The two problem owners are Kwaalburgse Hoeve producing organic grain and cereal in Alphen and Hoeve Klein Mariëndaal producing organic vegetables in Arnhem.

1.4 Research objective

To identify potential business model, including input, the potential crops and the market for the agroforestry products that the two farm owners plan to cultivate.

1.5 Research question

- What is the current business model of the two farms?
    - What is the value chain of the current products?
    - What are the comparative strengths, weaknesses, opportunities and threats (SWOT) if they plan to continue with the current model?
    - What are the major drivers for costs and revenues of the farms?
- What is the potential business model for agroforestry system in the two farms?
    - What are the reasons for developing agroforestry system?
    - What are potential species to plant in the farm? What is the cultivating model and the value chain for the products?
    - What is SWOT analysis of the new farming system?
    - What is the current consumer demand of new products?
    - How will production cost and revenue change in the new farming system?

1.6 Scope of the study

The study will be organized into six chapters. Chapter one will cover the background of the study, problem statement, research objective and research questions. Chapter two will cover the research methodology including the study area, research framework and strategy. Chapter three will deal with literature review of the research topic and the conceptual framework. Chapter four and five will present the study results of the two farms respectively. Chapter six will consist of the conclusion, discussion and recommendation thereof.

2. Chapter 2: Methodology

2.1 Research framework

This research is a study of two farms in different context who have the same interest in adopting agroforestry practices to diversify their products, generate higher income and develop sustainable production system. The research will be done using both quantitative and qualitative data.

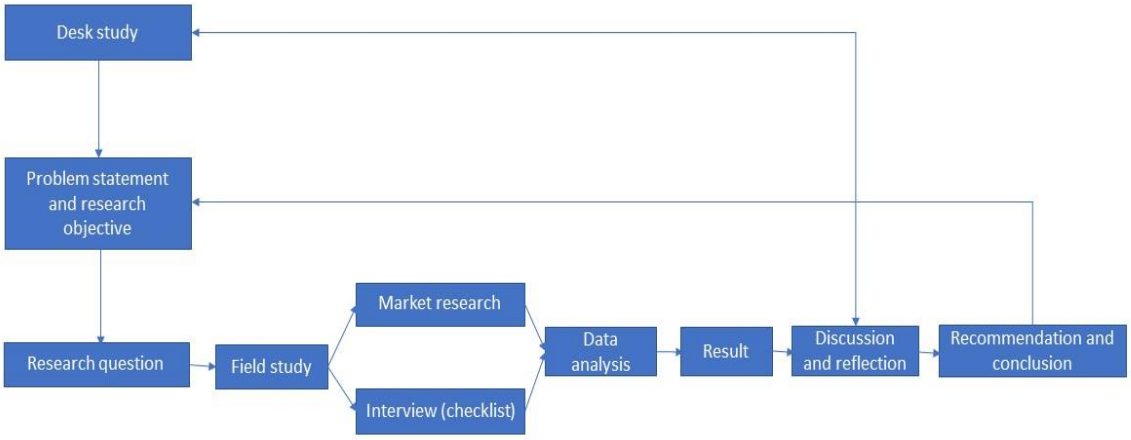


Figure 1 Research framework

2.1.1 Desk study

In the scoping phase, secondary data will be collected from relevant scientific research, journals, articles and documents from peer reviewed sources such as Greeni, Google scholar and institutional websites. These data will provide overall information about the agroforestry in the Netherlands, business model and value chain and will be the theoretical framework of this research. Finding of project FARM LIFE about Kwaalburgse Hoeve and information from Hoeve Klein Mariëndaal website is also used to describe problems encountered by the two farms.

2.1.2 Data collection and analysis

Primary data will be collected mainly by in-depth interview with farm owners and related stakeholders such as farms' suppliers, customers and supporting agencies using checklist as guideline. Photos and records of the interviews will be taken; and transcripts will be made for analysis.

Both the secondary and primary data will be the main input for following analyses: Value chain mapping, CANVAS business model, SWOT and quantitative cost-benefits analysis.

Value chain mapping is a process to visualize the situation in which the farms are operating by defining relationship among chain actors, products and information flows as well as the supporting and enabling environment. Using the value chain map can help determine the bottlenecks and opportunities for the farm owners to adopt agroforestry practices.

CANVAS business model is a comprehensive framework to describe the potential impact of agroforestry system implementation in the two farms of Kwaalburgse Hoeve and Hoeven Klein Mariendall. The current business model of the two farms will be described using the nine building blocks: value proposition, target customer, delivery channel, customer relationship, key resources, key activities, key partners, cost structure and revenue model.

SWOT analysis is a complimentary framework to fully evaluate the potential of agroforestry system in the context of the two farms.

Under the new introduction of trees and processing activities, cost benefit analysis of the agroforestry business will also be developed to make sure the breakeven time frame and returns are aligned with the farm owners' aspiration. The model will cover all the major revenue and cost drivers, including the initial investments in land preparation and the variable costs of farm expenditure such as seed, fertilizer, labor, among others. The model will also need to make assumptions on the productivity cycles of the proposed products and make projections on the market conditions for the outputs. The operating cash flow will be projected for the first five to ten years of operations. The key outputs of the model will be to calculate the investment required, the net present value and the internal rate of return (IRR) if the two farms invest in the agroforestry business as well as the breakeven timeline.

Net Present Value (NPV) is the lump sum value of the project expressed as the sum of discounted annual net returns. A 4% discount rate was applied in the calculation in this paper.

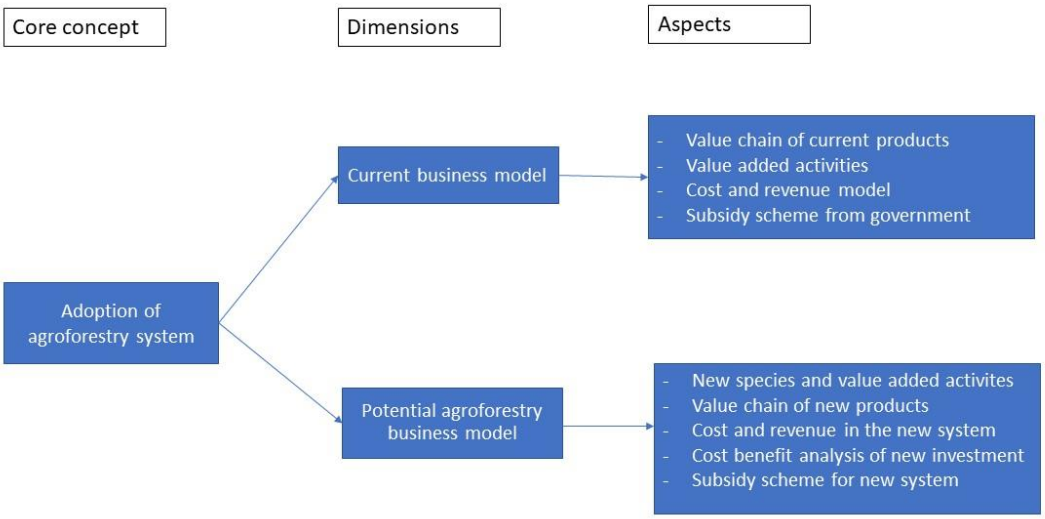
Internal Rate of Return (IRR)

Table 1. Research methodology

Method	Tool	Output	Respondents/ Sources
Literature review	Desk study	- Background information about agroforestry systems - Business model framework - Agroforestry value chain	Greeni, Google Scholar, journals, books and websites
Interviews	-Interview check list -Voice recording -Photos	- Current value chain - Subsidy scheme and other supporting projects for current system - SWOT analysis of current production model - Cost structure and revenue stream of current system - New value chain for agroforestry system - SWOT analysis of new system - Subsidy scheme for new system - Cost structure and revenue stream of new system - Cost benefit analysis of new investment	- Farm owners - Farms' suppliers, distributors - Supporting agencies
Survey	Questionnaire/Interview	- Consumer demand	Consumers

2.2 Conceptual framework

Figure 2 Conceptual framework



3. Chapter 3: Literature review

3.1 Agroforestry definition

A working definition of agroforestry by Parthiban and Seenivasan (2017) is as follows: "a land use management system in which trees or shrubs are grown around or among crops and pastureland." In more abstract level, agroforestry could be defined as "a dynamic, ecologically based, natural resources management system that, "*through the integration of trees in farms and in the landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels"* (Leakey, 1996; adopted by ICRAF, 1997). Currently, a broad classification of agroforestry given by the FAO is the following:

"Agrosilvicultural systems are a combination of crops and trees, such as alley cropping or homegardens.
Silvopastoral systems combine forestry and grazing of domesticated animals on pastures, rangelands or on-farm.
The three elements, namely trees, animals and crops, can be integrated in what are called agrosylvopastoral systems and are illustrated by homegardens involving animals as well as scattered trees on croplands used for grazing after harvests".

As a practice of blending farming or agricultural practices into forest land, agroforestry has been used from the prehistoric times along jungle-clad river banks and the wet foothills of monsoon region.

Especially in tropical regions - from African savannas to Java jungles - people used intercropping to cultivate trees, crops and livestock on the same land. Habitants of the Amazon areas are believed to practice forest gardening and terra preta to increase their food supply for the past 11,000 years (BBC, 2015). In Zambia, Zimbabwe, Ethiopia and Tanzania, agroforestry is widely practiced and plays an essential role in establishing food economy. The Chaga gardens on the slope of Mt. Kilimanjaro are well-known example of agroforestry system. In Europe, agroforestry practices dated back a few thousand years ago. The most traditional systems include the wood pastures (Neolithicum), the Dehesas in Spain (*4,500 years old) and the Hauberg of the Siegerland (established in the Middle Age). Other widespread agroforestry systems are hedgerows, windbreaks and Streuobst (orchard intercropping) (Nerlich *et. al.*, 2012)
The practice of agroforestry could take place in many forms. There are primitive agroforestry systems, which involve clearing the middle layer of the forest but keeping many of the larger original forest trees. This is the usual practice for cultivating such crops as cocoa and coffee which require shade to grow. More sophisticated silvopastoral agroforestry systems require planned planting of a canopy of one or a few species with high desirability among the crops - which could be fast-growing, nitrogen-fixing etc. Forest gardens develop a diverse mixture of trees which provide fruit, nuts and other forest products. There are also silvopastoral systems which incorporate livestock into the ecosystem.

3.2 Impact of agroforestry system

Agroforestry could contribute to important issues that the world is encountering today: increasing food production to secure food security in a sustainable and ecofriendly way as it can generate positive environmental, economic and social impacts (FAO, 2017).

Even though agroforestry is not the only climate adaptive option and in the short and medium term will not be able to replace the monoculture production practice, it brings value to the producers by increasing the diversity of non-commodity products. It helps by easing the conflict between the increased food production and the environmental issues (e.g. soil and land degradation, water runoff and flooding, soil erosion, loss of biodiversity, increased greenhouse gas emissions) by facilitating biological nitrogen fixation and agroecosystem diversification among others. Potentially, there could be losses of yield for crops which directly compete with the trees for resources such as light, water and nutrients. However, losses across the field system will be offset by the incremental values in soil fertility, soil structure, water infiltration and the agroecosystem. The system as a whole, due to introduction of higher market value products (fodder, wood, fruits, nuts, resins, extractives and medicines etc.), could gain positive economic net value. In certain farming practices like cocoa and coffee, the shade of trees is a factor in the production and sustainability of crop. Designing an agroforestry system with productive trees as shade is another way to provide additional source of income. As opposed to the modern intensive farming practices where farmers focus all resources in one crop and hence expose to major risks, agroforestry with its wide range of products provide diversification also along the year lowering the associated risks (FCRN, 2013).

Beyond the economic benefits, agroforestry as a land use system could contribute to the social and environmental sustainability. First, agroforestry makes substantial contribution to biodiversity of the farmed plot of lands, which is good for wildlife conservation and for the strong agroecological functions. Areas where agroforestry is practiced have been found to contain about 75% of the species found in natural forests, while a normal, monocultural plantation has less than 5% (Leaky, 2013). This

is because agroforest systems are more ecologically diverse and depending on the design can resemble natural forests regarding its structure and function. Second, the social impacts that agroforestry brings are two-folded. It promotes business and employment opportunities to the surrounding communities via jobs associated with processing, value-adding, packaging and marketing of agroforestry products. On the other hand, agroforestry brings educational and recreational values as the area could be open to public for field trips, picnics, hikes etc. This could be an additional source of income to the practitioners (FCRN, 2013).

Arnold (n.d) summarized in his research the relevant benefits and constraints of farming systems that incorporate agroforestry practices. These principal positive and negative impacts are presented in Table 3 below.

Table 2 Benefit and constraint of agroforestry system

Benefit and opportunity	Cost and constraint
Maintains or increases site productivity through nutrient recycling and soil protection, at low capital and labour cost	Reduces output of staple food crops while trees compete for use of arable land and/or depress crop yields through shade, root competition or allelopathic interaction
Increases the value of output on a given area of land through spatial or inter-temporal intercropping of tree and other species	Incompatibility of trees with agricultural practices such as free grazing, burning, common fields, etc; which make it difficult to protect trees
Diversifies the range of outputs from a given area, in order to (a) increase self-sufficiency, or/and (b) reduce the risk to income from adverse climatic biological or market impacts on particular crops	Trees can impede cultivation of monocrops and introduction of mechanization, and so (a) increase labour costs in situation where the latter is appropriate and/or (b) inhibit advances in farming practices
Spreads the needs for labour inputs more evenly seasonally so reducing the effect of sharp peaks and troughs in activity characteristic of tropical agriculture	Where the planting seasons is very restricted, e.g., in arid and semi-arid conditions, demands on available labour for crop establishment may prevent tree planting
Provides productive applications for underutilized land, labour or capital	The relatively long production period of trees delays returns beyond what may be tanable for poor farmers, and increase the risks to them associated with insecurity tenure
Creates capital stocks available to meet intermittent costs or unforeseen contingencies	

Source: World Agroforestry Center (n.d)

An analysis by Palma *et. al.* (2007) about environmental and economic impacts of silvoarable agroforestry in Europe showed that in France, silvoarable agroforestry was more profitable than conventional arable farming. By contrast, in Spain and the Netherlands, the conventional arable agriculture had relatively higher profit than the agroforestry alternatives, thus making the performance of agroforestry systems dependent on the proportion of the farm planted, and the tree density and land quality that is used (Palma *et. al.*, 2007). This is contradicting to Oosterbaan and Kuiters (2008)'s finding in which the agroforestry system generated higher productivity for Dutch farmers.

A meta-analysis by Torallba *et. al.* (2016) indicated that agroforestry can further improve biodiversity and ecosystem service provision compared to conventional agriculture and forestry in Europe. If the complex nature of agroforestry is taken into account by policy makers, it could become potential strategy for land use in rural planning.

A study by Jalon *et. al.* (2018) about European stakeholders involved in agroforestry sector showed that the main positive impacts of agroforestry were environmental benefits such as enhanced biodiversity and wildlife habitats, landscape aesthetics, soil conservation, and animal health and welfare. On the other hand, factors hindering the adoption of agroforestry practices were mainly related to management and socio-economic issues, namely increased labour cost, complexity of work, management costs, the administrative burden and in some cases predation by wild animals. In order to promote agroforestry sector, it is crucial that farmers realise the greater benefit of agroforestry compared to other land use practices.

Kay *et. al.* (2019) evaluated economic performance of agroforestry landscapes and agricultural landscapes in term of marketable and non-marketable ecosystem service in Europe. Agroforestry systems were associated to reduced externalities of pollution from nutrient and soil losses, and also generated additional benefits from carbon storage and thus generated an overall higher economic gain.

3.3 Agroforestry in European context

Agroforestry has had a long tradition in Europe and it often took the form of trees on farmland. Some of the most ancient systems include: wood pasture, dehesa and montado, hedgerows and windbreaks, orchards, pollarding and pannage and Hauberg. Agroforestry was an important practice because it not only provided various products but also were important to each country's culture (Nerlich *et. al.*, 2012). With the intensification of agriculture to produce more food at lower price, trees were gradually removed, and these traditional systems were no longer in use. As a result, landscapes in Europe were simplified and biodiversity and ecosystem services were badly affected (Prins, 2017). To tackle the current impacts of global warming and climate change, food security, society and policy demand for nature conservation, agroforestry is gaining public interest as it can solve these environmental issue as well as secure production of food wood products and fodder for cattle (Nerlich *et. al.*, 2012).

During the last two decades, many innovative agroforestry systems have been studied and developed by research centers in Europe**.** The European Agroforestry Foundation defines agroforestry systems as land use systems in which trees are grown in combination with agriculture on the same land and explains more details in the Agroforestry Measure Fiche as: "Agroforestry means land-use systems and practices where woody perennials are deliberately integrated with crops and/or animals on the same parcel or land management unit without the intention to establish a remaining forest stand. The trees may be arranged as single stems, in rows or in groups, while grazing may also take place inside parcels (silvoarable agroforestry, silvopastoralism, grazed or intercropped orchards) or on the limits between parcels (hedges, tree lines)." The main agroforestry practices in Europe are silvopasture, silvoarable, riparian buffer strips in agricultural areas, silvopasture and forest farming in forest areas and homegardens in urban and peri-urban areas (Mosquera-Losada *et. al.*, 2016). These main practices are presented in the following Table 3.

Table 3 Main agroforestry practices in Europe

Land use and agroforestry practice		Common name	Brief description
Agriculture	Silvopasture	Wood pasture and parkland	Typically areas of widely-spaced trees that are also used for forage and animal production.
		Meadow orchards	This practice includes fruit orchards, shrubs which are grazed or sown with pastures, but also olive groves and vineyards
	Silvoarable	Hedgerows and windbreak systems	Here the woody components are planted to provide shelter, shade, or parcel demarcation to a crop and/or livestock production system
		Alley-cropping systems	Widely spaced woody perennials inter-cropped with annual or perennial crops. It comprises alley cropping, scattered trees and orchards and line belts within the plots. These practices are sometimes found only during the first few years of the plantation
	Riparian buffer strips	Riparian buffer strips	Areas of tree and shrubs allowed to establish croplands/pastures and water sources such as streams, lakes, wetlands, and ponds to protect water quality, can be identified as silvoarable or silvopasture.
Forest	Silvopasture	Forest grazing	Forested areas with the understory grazed
	Forest farming	Forest farming	Forested areas used for production or harvest of naturally standing speciality crops for medicinal, ornamental or culinary uses
Urban and peri urban	Homegardens	Homegardens	Combining trees/shrubs with vegetable production usually associated with peri-urban or urban areas

(Source: Mosquera-Losada *et. al.*, 2016)

In Europe, total agroforestry practices including silvopasture, silvoarable and home garden systems are calculated to occupy about 20 million hectares, of which silvopasture account for 85.6% of total agroforestry land. The proportion of each practices is presented in Figure 3 below.

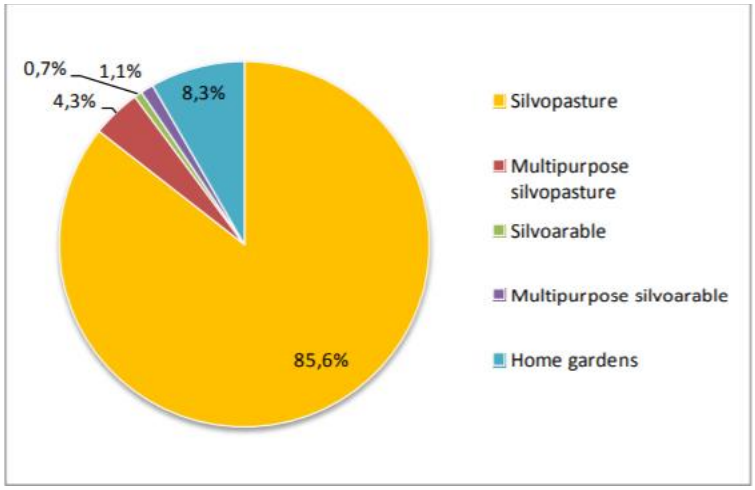


Figure 3 Proportion of different practices in agroforestry land in Europe

(Source: Mosquera-Losada *et. al.*, 2016)

Some EU organizations and agreements that provide policies related to agroforestry development are: Seventh Environment Action Programme to 2020, European Biodiversity Strategy to 2020, Natura2000 - Habitats and Birds Directives, European Strategy for Sustainable Development´ Bioeconomy, European Climate Change Programme (ECCP), European Forest Strategy, Cork 1.0 and 2.0 strategy, and Common Agricultural Policy CAP. The CAP is one of the most important strategies for the development of agriculture sector in Europe. By providing payments to sustainable farming, it increases farmer's livelihood, reduces the impact of market instability and improves farms' resilience to extreme weather events and climate change. With the CAP reform 2014-2020, agroforestry practices are now included in the policy. According to European Agroforestry Foundation, agroforestry practices are listed as Ecological Focus Areas and farmers can receive greening payments for such plots in pillar I (Reg.(EU) 1307/2013). The establishment of agroforestry plots can be supported through national or regional Rural Development Programmes in pillar II (Reg.(EU)1305/2013). Pillar I is designed for direct income support for farmer while pillar II is allocated for rural development. Private land holders, municipalities and their associations can apply for these aids and they are eligible for not only the overhead costs, but also the maintenance costs for 5 years, at a rate of 80% of the amount of eligible investments (EURAF). However, it is up to the Member States to define number of trees per hectare requirement and to adopt measures in their Rural Development Programmes.

Although agroforestry practices have been proven to be beneficial in many aspects, many farmers are still reluctant to adopt these practices in their farmland. This is because of farmers' risk adverse nature and the lack of know-how to manage such system (Nerlich *et. al.*, 2012). A study by Borremans (2019) showed that in Flanders, the main barriers to upscale agroforestry were uncertainty about feasibility and suitability of agroforestry systems, farmers' lack of knowledge, inadequate regulation, rigid support measures and lack of broad support from agriculture sector. The author also stated that the

way forward for agroforestry sector will involve more research and technological development, different earning and financing models, a better legal and policy framework, more knowledge sharing and education, wider support and a shared vision among different stakeholders. These are also similar to findings of Jalon *et. al.* (2018).

3.4 Agroforestry in the Netherlands

Decades of agriculture intensification has led to simplified rural landscapes (Prins, 2017), loss of biodiversity and ecosystem services and exhausted natural resources in the Netherlands (Project FARM LIFE, 2018). These factors in turn caused the farmers to rely more on extensive output to maintain productivity and profitability of their farming system. However, farmers are less resilient to climate change with drastic weather events such as hot weather, intense rainfall, drought and flood. Because of these extreme rainfall and flood, large areas in the south of the Netherlands and in Flanders suffered from damaged crops and failed harvests (Project FARM LIFE, 2018). It is no doubt that agriculture activities have negative impacts on climate change and natural resources, these impacts are still overlooked because warmer weather means Dutch farmers can plant crops that Mediterranean countries can grow.

To ensure the production of goods without depleting natural resources by 2050, the Dutch government has launched programme to promote circular economy. Circular economy aims to sustainably use natural resources, raw materials and recycle products as long as possible to add value to the economy and prevent waste and environmental pollution. In line with circular economy, the transition of food chain to circular food systems is also important on the national agenda. The Netherlands Environmental Assessment Agency (PBL) has stated that there should be effective use management of natural resources (soil, water, biodiversity, minerals), reduced food waste (less consumption of processed food and animal protein and more vegetable protein), less environmental pressure and optimal use of residues. It is also crucial to establish a benchmark to be aware of impacts in the production chain and the added value of products. An overall model of circular food system is presented in Figure 4 below.

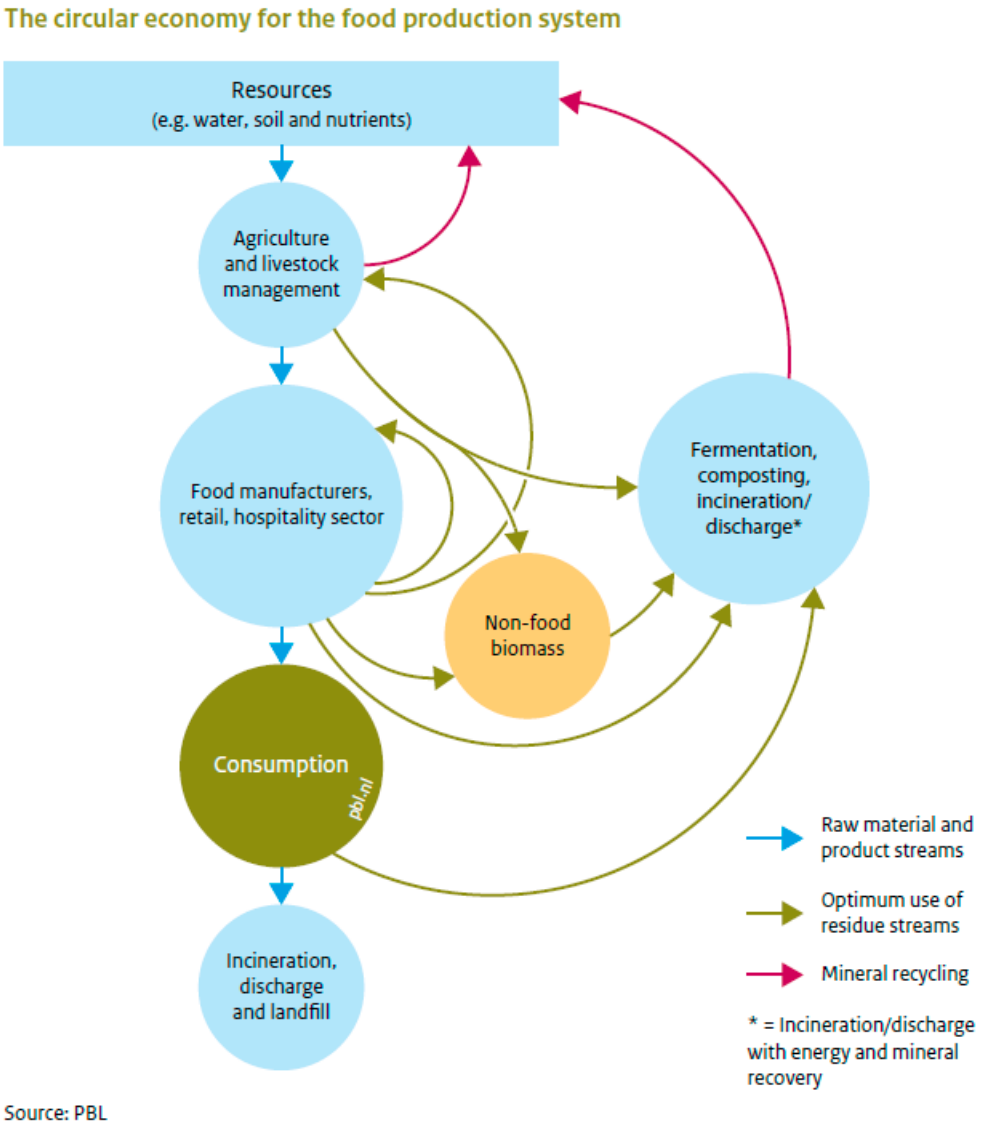


Figure 4 The circular food production system

(Source: Rood *et. al.*, 2017)

An integrated nature-inclusive farming approach is necessary to develop circular food systems and agroforestry is an example of nature inclusive farming. Agroforestry practices offer a sustainable management of resources by using nitrogen fixing trees that can build up soil health and increase crop production. The roots of the trees can slow down soil erosion, and thanks to the trees, birds return to feed off insects thereby reducing the use of chemical pesticides. It also reduces waste by recycling wastes into productive agricultural use. For example, the proportion of chemical fertilisers in agriculture could be minimised or simply not utilised by increasing the volume of nutrients created by biological processes that can be stimulated by good farming practices. Additionally, agroforestry optimises residual streams by

providing biobased organic waste flow materials such as solid biomass (e.g., lignocellulosic waste) and other agroforestry primary residues (e.g. manure, straw, crop residues).

In the Netherlands, most agriculture are large scale and specialised in one type of product (crops, livestock, etc) so adopting agroforestry practices is not appealing to most modern farmers, especially large scale farmers. However, small scale farmers are more optimistic toward agroforestry as they are used to working with trees on their fields (Oostebaan and Kuiters, 2014). More conventional farmers are now aware of the benefits of agroforestry and want to adopt these practices. However, it should be at certain scale that it does not affect their income and livelihood. There are also many people who are inspired by the concept "food forest", one type of agroforestry, and started these initiatives for research, production or promoting social relations. Many municipalities are giving attention to the incipient agroforestry sector. For example, in Nijmegen, the local government, institutes and businesses are putting effort to develop agroforestry practices with the aim to establish 1000 hectares of agroforestry in the future. A few studies were conducted by VHL bachelor and master students to sketch the current situation of agroforestry sector in this region and define drivers to scale up agroforestry practices. Short food chains are also being promoted to raise awareness and get different citizens involved in the food chain. In general, agroforestry in the Netherlands is in transitioning stage with increasing number of pioneers and joint effort of government and industry stakeholders, education and research communities to implement agroforestry for greater benefit of farmers, environment and society.

3.5 Business model canvas

Business model is a new concept that has gained traction during the mid-1990s as an option in management approach, according to Massa, Tucci, and Afuah (2017). Despite being popular in both research and practice, there is no fixed definition of business model (Zott, Amit, and Massa, 2011; Liu, 2015). In general, business model can be defined as a company's plan to make profit. This plan includes products or services the business will sell, targeted market and anticipated expenses. Literature review by Liu (2015) and Spaviero (2019) presented that there is current agreement on how business model depicts broader image of the company rather than just revenue and profit. This paper will use the definition of business model and the business model canvas developed by Osterwalder as the main framework. Osterwalder (2004) defined business model as "a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value […], in order to generate profitable and sustainable revenue streams.". The nine building blocks and main pillar of the business model are presented in Table 5 below.

Table 4 Business model building blocks

Pillar	Business model building block	Description
Product	Value proposition	Overview of company products and services
Customer interface	Target customer	Customer segments that company wants to offer value to
	Delivery channel	How company wants to connect to customer
	Customer Relationship	Linkages between company and customer segments
Infrastructure management	Key activities	Arrangement of activities and resources
	Key resources	Necessary competency to execute business model
	Key partners	Network of cooperative agreements with other companies necessary to efficiently offer and commercialize value
Financial aspects	Cost structure	Sums up the monetary consequences of the means employed in the business model
	Revenue model	How company makes money through a variety of revenue flows

Souce: Osterwalder and Pigneur, 2010.

The framework “business model canvas” can be used to visualize current business model as well as to test new ideas for new business model from planning perspective. Four blocks Customer Segments, Customer Relationships, Channels, and Revenue Streams focus on the customer side; four blocks Key Activities, Key Resources, Key Partners and Cost Structure focus on the supply side of the business. Value Proposition is the main block to connect the supply side and customer side of the business because it is determined by the above-mentioned components. The business model canvas is showed in Figure 5 below.

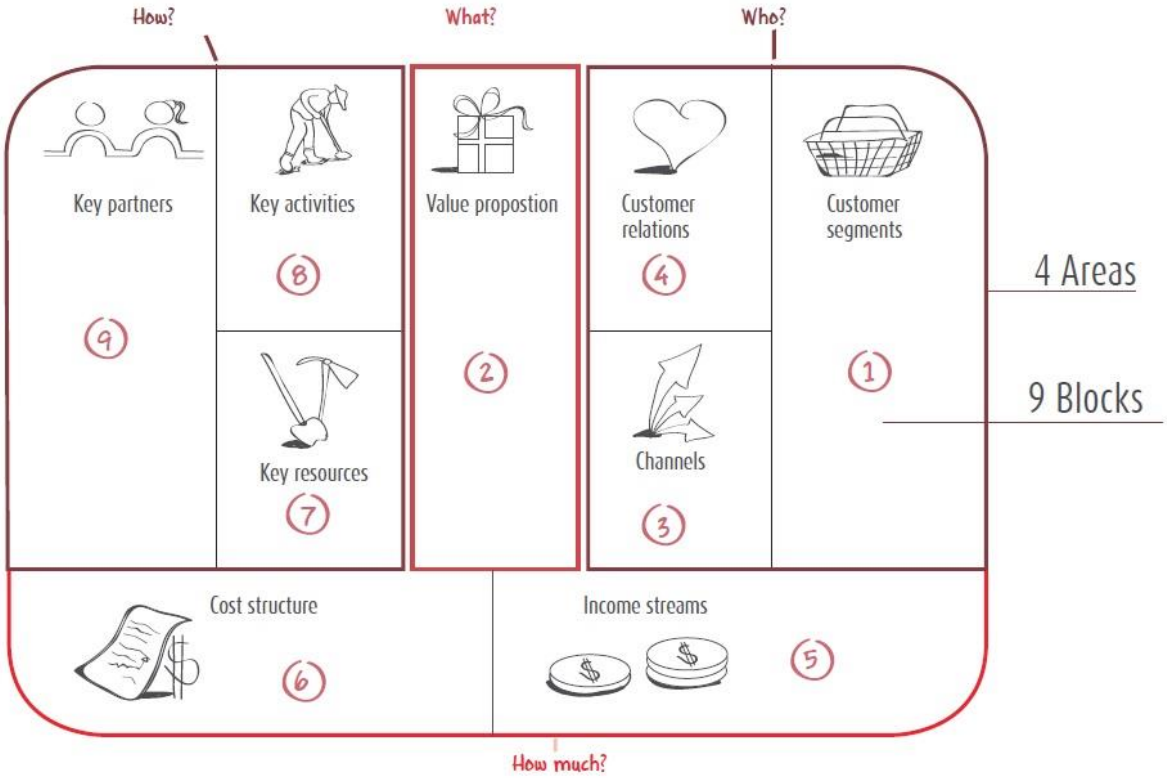


Figure 5 The business model canvas

Source: Lundy *et. al.*, 2014.

Because the business model canvas offers a general and flexible tool to study, visualize and innovate business mode, it can be used in different contexts and different fields (Liu, 2015). Business model canvas has gain massive success in both academia and among practitioners (Sparviero, 2019). The template of business model canvas was downloaded over 5 million times by 2014, and the book Business Model Generation was translated in over 30 different languages and used in more than 250 universities (Stenn 2017).

3.6 Agroforestry business model

Different types of agroforestry systems lead to various implications of business models. Monoculture systems rely only on one cash flow while agroforestry system have diversified sources of income. In the beginning, cash flow comes mainly from agriculture/livestock commodity; then at later stage (after 7-10 years or more depending on selected species) revenue will come from the harvest of timber and/or tree products such as nuts or others. However, the main challenge for adoption of agroforestry practices is the significant initial investment and long payback period (GIZ, 2017). Although an agroforestry system has many social and environmental benefits, these are difficult to measure and appraise. It is “necessary” to include other activities such as recreational or eco-tourism to diversify cash flow before agroforestry

system mature and yield dividends. This is to ensure that agroforestry is an economically feasible option among other cultivation practices.

Research by Burgess *et. al*. (2003) showed that financial performance of an agroforestry system including tree planting and timber harvesting are sensitive to discount rate. Beside net present value, cash flow is another key financial measure of agroforestry system. Due to the high investment cost and long payback period, cash flow of agroforestry system is not as smooth and constant as that of an arable system. However, establishing trees on arable farm will result in higher cash flow than forestry.

Study by Graves et. al. (2007) showed that the arable system had highest profitability, or else it was better to farm owners to either choose arable or forestry system. However, many practical examples showed that agroforestry system were developed on conventional arable or livestock farm to make the farm more sustainable

3.7 Agroforestry value chain

Value chain is a sequence of value adding activities that start with production, processing and ends with marketing and sales to the end user (Kaplinsky *et. al.*, 2001). While 'supply chain' focuses on the process of production and on delivery to the end-user, 'value chain' emphasize on the value created throughout the whole process between the two ends of the chain (EIP-AGRI Workshop, 2016). According to Lundy *et. al.* (2014), value chain analysis can help define relationships and interconnection among chain actors; provide insight about the flow of products, services, information and payments; improve communication among actors; and identify bottleneck and opportunity to upgrade the value chain.

The EIP-AGRI workshop about New value chains from multifunctional forests (2016) with 76 participants from 22 European countries had discussed and presented about characteristics of new agroforestry initiatives. These value chains combine traditional land uses and products with new technologies and the eco-friendly feature of the products is one of the most prominent upselling points. Some challenges for these value chain to become successful includes the intensive knowledge and strong commitment requirement for land owner, stable product quality and quantity and adequate marketing approaches. To upscale and implement these initiatives in different context, it is crucial to disseminate knowledge (e.g. transfer, advisory services, peer learning), increase awareness and demand for agroforestry products by the consumer and promote stable and standard regulatory framework (e.g. at EU level).

In order to maintain the economic viability of agroforestry system in the long run, both internal and external factors should be taken into consideration. Proper engagement in the value chain and intensive marketing research to meet consumer demand, find the niche market and exploit the trend and value added of agroforestry products are the most crucial factors in the long run (Hannachi *et. al.*, 2017).

Master students at Van Hall Larenstein University of Applied Science (2018 and 2019) had done research about agroforestry value chains, the main actors and stakeholders and drivers to scale up agroforestry businesses and projects in the area of Arnhem-Nijmegen. Results from these researches include a potential value chain for agroforestry systems as presented in Figure 6 below.

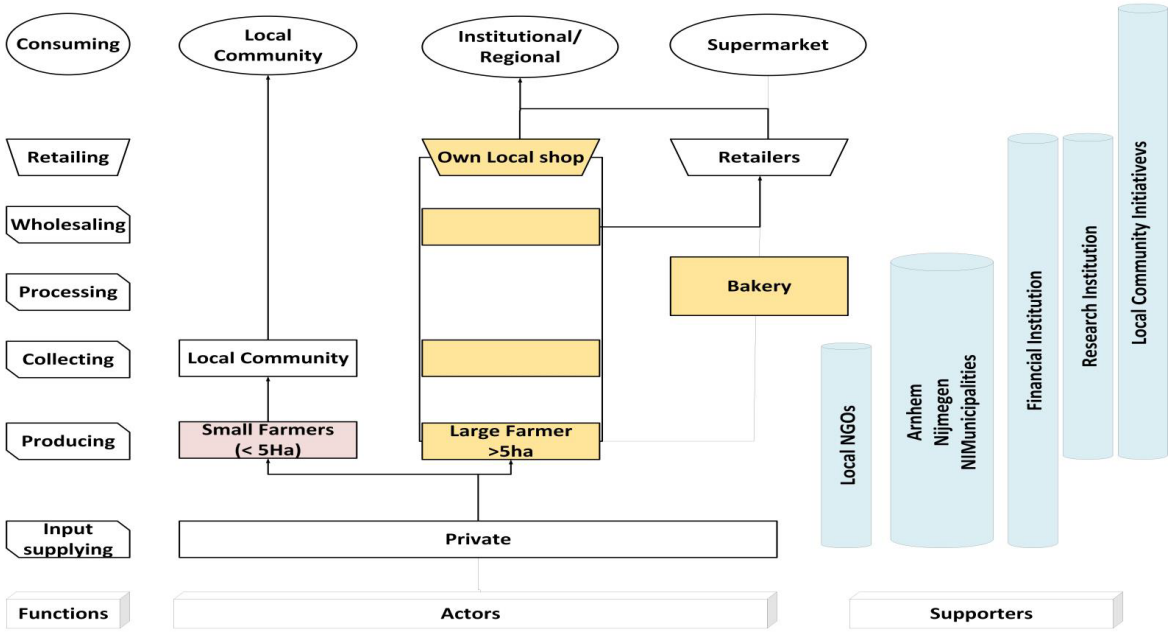


Figure 6. Potential value chain for agroforestry products

(Source: VHL APCM, 2018)

Findings from these researches indicated that there are many stakeholders involved in the agroforestry value chain; however, their roles are quite overlapping, and information and coordination is inadequate among these stakeholders. Besides, there is no specific policy for agroforestry initiatives at both national and municipality level. These are the main reasons for the delay in development of agroforestry system. People perception towards agroforestry is determined by the mind-set of the local community about the benefits of the agroforestry systems. There is still doubt about the implementation and profitability of agroforestry practices among local people, community and farmers are doubtful about its implementation and profitability. Interestingly, consumers are more aware of agroforestry products and they are content with diverse products as well as positive development of the landscape brought by agroforestry.

3.8 Consumer demand for organic product

According to the USDA report (2018), the Netherlands is the seventh largest organic market in the EU with an estimated value of €1.9 billion. On average, Dutch consumer spends nearly €100 on organic products annually. In 2016, the organic market value soared to €1.4 billion. Organic market share is expected to double from 3.3% in 2016 to nearly 7% in 2025. During the last five years, sale of organic market increased by 10% per annum while that of total food market increased only by 3%. Some product segments that have high growth rate and ample potential in the future include dried products, bread and pastry, eggs, meat, soup, baby food and snack food.

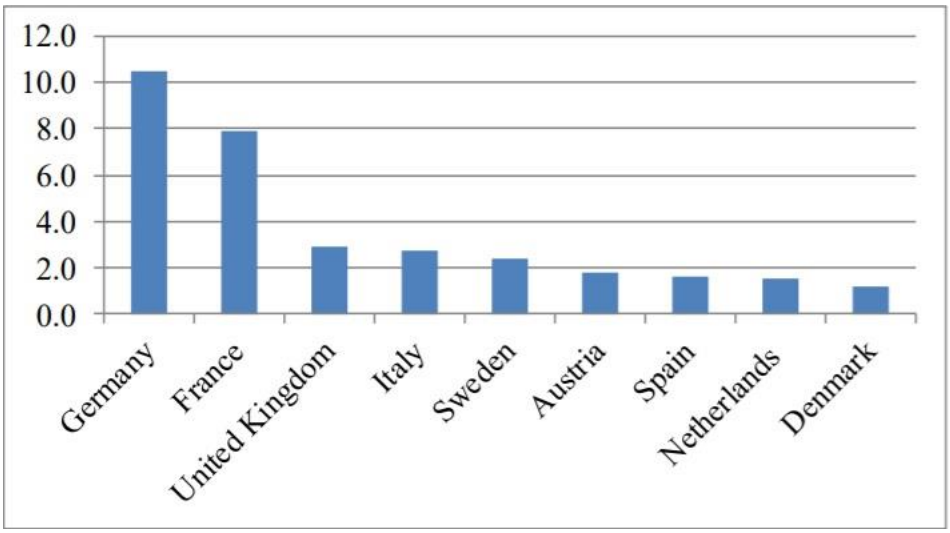


Figure 7 Largest organic markets in the EU in 2016, million €

(Source: USDA, 2018)

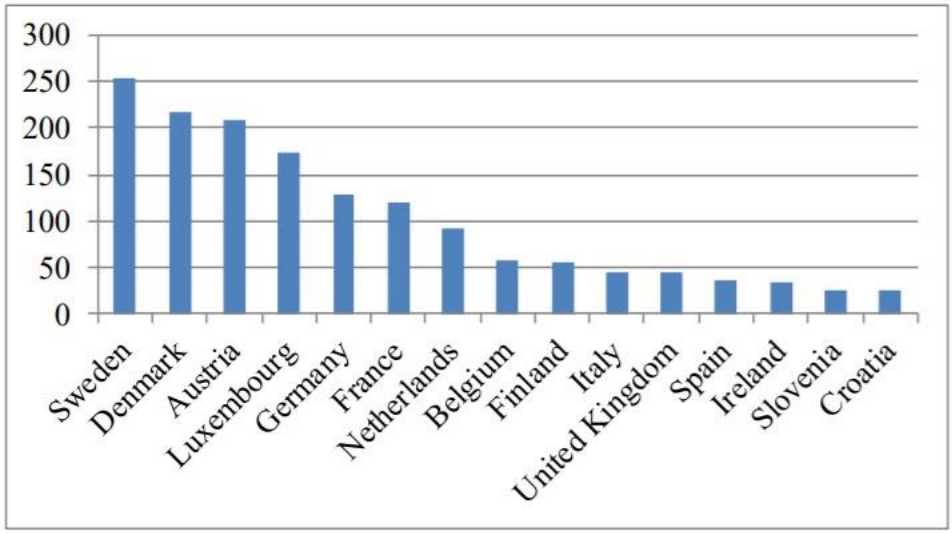


Figure 8 Highest per capita organic consumption in the EU in 2016, €

(Source: USDA, 2018)

Dutch consumers of organic products are divided into two groups. The first group is loyal consumers who have been purchasing organic unprocessed products (fresh produce, nuts, cheese, etc) at local farmer market and special stores for a long time. They prefer local products that is produced with consideration to environmental sustainability and animal welfare and price does not strongly affect their buying behaviour. This group makes up for roughly 30% of total organic sales. The second groups is bigger and more diverse with affluent consumers and millennials. These consumers are more knowledgeable and have constant access to information (Bemmel *et. al.*, 2017), so they pay attention to not only taste, quality but also environmental issues, animal welfare and corporate responsibility. This second group of consumer is considered important for the development of organic market in the future.

Organic products are distributed in the Netherlands via three main channels, including regular food retailers, organic specialty stores and food service industry. Sale records of the three channels in 2016 are €735 million, €336 million and €230 million respectively (USDA, 2018). Other distribution channels include in-farm sales and farmers market and online sales. Although half of all organic products are distributed via supermarkets, organic specialty stores are also very important distribution channel because many loyal customers buy from these stores. Also, these stores are trying to provide more special and value added products with interesting stories to attract customers and differentiate themselves from other retailers and normal supermarkets.

Dutch people consider organic products to be healthier and organic production are more sustainable and transparent. They are paying more attention on the story behind the products, how and by whom the products were produced. As people are looking for healthier food and snack options and changing their diet to more plant-based products (Bemmel *et. al.*, 2017), market for fresh produces (vegetable, beans, lentils fresh fruit, berries, etc) is also expanding. The snack and bakery industry also have growing demand for nuts and specialty grains.

4. Chapter 4: Result and analysis of Klein Mariëndaal

4.1 General description

Hoeve Klein Mariëndaal is a care farm located on the outskirt of Arnhem. The farm is run by a foundation with the aim to increase life quality of isolated participants (for example intellectually or physically disabled people, long-term unemployed people, people with dementia, etc) by offering a suitable work place to develop competency and self- reliance and enter the labour market if possible. Besides, the farm also provides high quality horticulture products to citizens and give agriculture and horticulture a new place in society through social, educational and recreational activities. Main activities for care participants to work on include tea house, horticulture farm and small herd of animals. Funding is provided through care in nature the contract with the municipalities of Arnhem, Renkum and Rheden, via PGB and via the WLZ (subcontracting).

The main focus of this research is the horticulture farm. Horticulture production includes a garden (0.09ha) with fruit trees, berries, flower, herbs, row of grape vines as demonstration for nearby vineyard, and vegetable (cucumber, zucchini, fennel, chives, parsley), small greenhouse (18m2) and an area of 0.22ha with many different types of vegetable depending on season (berries, maize, onion, paksoi, herbs, carrot, parsnip, beetroot, celery, lettuce, bean, potato, turnip, etc.)

4.2 Current value chain mapping

Value chain of the horticulture farm is visualized in Figure 9 below. The farm sources out input such as seed and organic fertilizers from local input suppliers. Part of the fertilizer is compost made at the farm, however, it only accounts for a small amount. Everything is grown organically, without pesticides and with organic seeds and fertilizer. Production has been tested and certified by the SKAL. At Klein Mariëndaal, fresh produces include 40 types of seasonal vegetables (zucchini, pumpkin, sweet corn, beans, leeks, fennel, beets, onions, shallots, radish, garlic, cabbage lettuce, various lettuce varieties, etc), herbs (parsley, chives, basil, rosemary, thyme, dill) and berries. A few fruit trees such as apples and pears are planted but these are not mature yet. Vegetable is cultivated by the auxiliary farmers working on the care farm and people with intellectual disabilities, psychiatric problems or autistic disorder. Majority of fresh

produce goes to vegetable basket. When customers subscribe via email, they will receive weekly fresh vegetable basket. Each basket contains at least 5 types of vegetables from the season. In addition, herbs or berries are also supplemented in the basket. Prices of basket are 8.5 euros, 10.5 euros and 13.5 euros per week for 1 person, 2 people and 3 people respectively. There are 7 collection points where customers can come and pick up the baskets on Wednesday and Friday. The remaining of produce is sold to organic shops (Odin in Oosterbeek and Arnhem and St. Natuurcentrum Arnhem) and products like berries are kept in freezer to make juice and chutney to sell in winter time. In winter, due to cold weather and limited amount of vegetables, Klein Mariëndaal has to source vegetables from other organic farms in local area to prepare the basket. The farm started selling vegetable baskets 8 years ago with around 60 customers, however, the number of customers has decreased over time and at the time of this research, there are about 20-25 customers for vegetable basket.

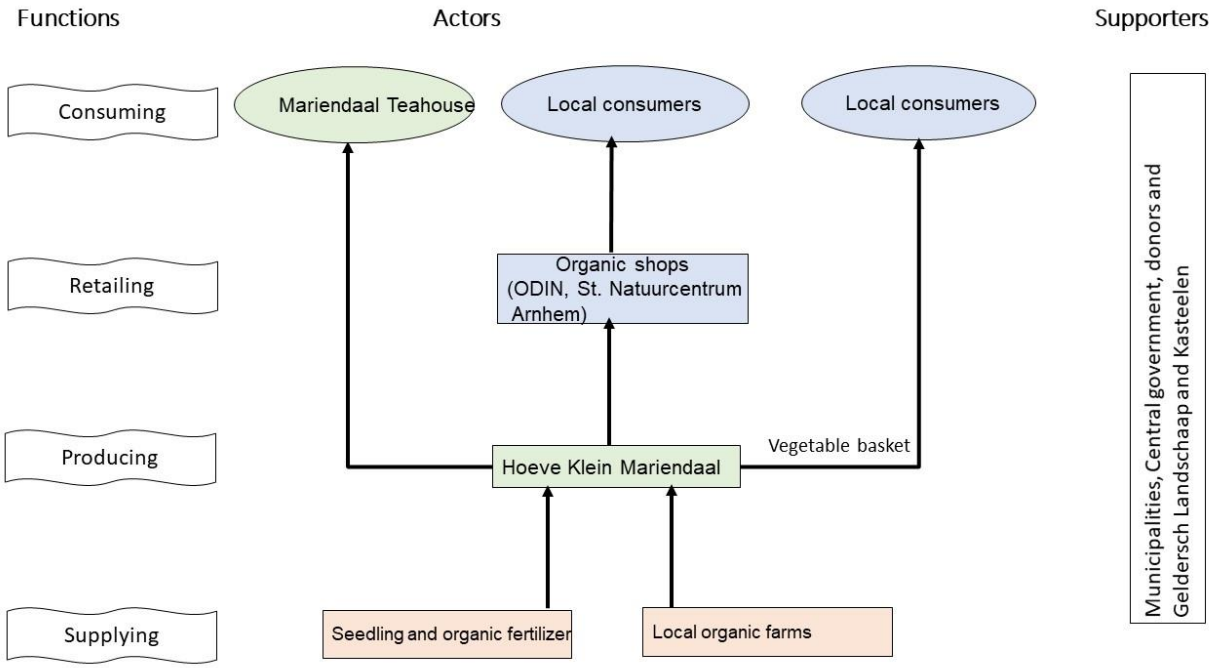


Figure 9 Klein Mariëndaal current chain map

4.3 Business canvas model

<table>
<tr>
<td rowspan="2">KEY PARTNERS

- Input suppliers
- Local organic producers
- Government (Municipalities, GLK)
- Organic retailers</td>
<td>KEY ACTIVITIES

- Horticulture farming
- Prepare and deliver vegetable basket</td>
<td rowspan="2">VALUE PROPOSITION
- Organic products prepared by disabled/ mentally ill people</td>
<td>CUSTOMER RELATIONSHIP
-</td>
<td rowspan="2">CUSTOMER SEGMENTS
- Care clients
- Buyers from neighboring area and the city</td>
</tr>
<tr>
<td>KEY RESOURCES
- Land
- Seedling and fertilisers
- Labour</td>
<td>CHANNELS
- Farm gate sale
- Vegetable basket subscription via email and farm website</td>
</tr>
<tr>
<td colspan="2">COST STRUCTURE
- Fix costs
o Machinery
o Water irrigation
o Land
- Variable costs
o Labor
o Seedling
o Fertilizer</td>
<td colspan="3">REVENUE STREAMS
- Revenue from vegetable baskets
- Revenue from selling to organic shops</td>
</tr>
</table>

4.4 SWOT analysis

Table 5 summarizes the strengths, weaknesses, opportunities and threats (SWOT) of the Klein Mariëndaal horticulture farm. The focus of the analysis is the farm's current business model with regard to its competitive weaknesses and strengths in local markets. Key issues of the farm are as follows:

-Given the fact that Klein Mariëndaal is a care farm and its main revenue stream comes from care activities, tea house and catering activities, there is no pressure to make the horticulture part become more profitable at the moment. All cultivation and harvesting activities are done by care participants and volunteer so labour cost is quite small. With expertise for organic production, various sources of income, availability of land and available facilities (kitchen and teahouse), it is possible to expand production and process fresh produce into refinement for higher value added. Revenues from other sources can sustain cash flow while horticulture production is yet to generate profit.

- Main problem of the current business model is the reliance or participants and volunteers for all activities of the horticulture farm from cultivation to harvesting. Sometimes participants do not show up because of their health or harsh weather, it can delay the production or harvesting. Because there have been no specific production plan and marketing plan to get access to new market and new customers, number of vegetable basket has decreased over time. The lack of facility to cool and store extra produces is also a

disadvantage because it means higher production loss. The small scale production leads to small quantity, irregular supply and uneven quality of produces, which can be a hindrance when there are more consumers and retailers to sell to. As the cold winter weather is not suitable for many vegetables, Klein Mariëndaal has to rely on other organic producers who has price comparative advantage as they have larger production area, greenhouse to grow in winter and higher productivity. Due to the volume of harvested products, Klein Mariëndaal cannot complete with larger scale organic farms, however, there is possibility to find niche market through its network interaction, including connection with municipalities, donors, schools, companies and community in local area.

Strengths • Expertise available for horticulture production • SKAL certified organic production • Available of kitchen and restaurant • Available land • Location close to residential area and schools • Diversified income source	Weaknesses • Reliance on care participants for production and harvesting • Lack of labor • Lack of production plan • Lack of marketing skill • Lack of facility for cooling and storing produces • Small and irregular supply of products, especially in winter
Opportunities • Increasing demand for organic and locally produced products • Premium price for organic products	Threats • Erratic weather condition • Cold winter is not suitable for many crop • Competition from other organic producers • Intensive farming and greenhouse is not allowed

Table 5 Klein Mariëndaal SWOT analysis of current business model

4.5 Cost-revenue structure

Profitability of Klein Mariëndaal in 2018 was positive. The farm made a net income of € 20,500 in 2018. There are three major revenue-generating activities for the farm: care provision to people with special needs (77% of recurring revenue), food and beverage at the onsite teahouse (22% of recurring revenue) and sales of fruit baskets to local residents and farm products to local grocery stores (1% of recurring revenue). The farm also has two additional sites providing care services: Heidestein and Heidehuis. However, the scale of these two operations are minimal compared to the main farm.

Major costs incurred for the farm can be divided into operational and administrative costs. For the care services, the largest cost buckets are salaries for care staff. Similarly for the tea house, procurement and staff are the two largest costs. The overhead business operations and management and administration costs in 2018 totaled up to nearly €100,000. Other than this, the farm also needs to address the finance cost of debt, which amounted to €18,000 per year.

The farm plans to maintain the operations of care services and tea house and expand the current gardening operations. The current work area serves two purposes: providing work activities for the care service participants and contributing the vegetable products to sell as vegetable baskets. In 2018, the farm

sold a total of 962 fruit baskets, averaging around 19 baskets per week. Each basket is priced at EUR 9.5 or EUR 10.5, depending on the amount of vegetable inside. The main customers of these fruit baskets are local citizens, who have visited the farm for care services or leisure activities. The farm products are also sold to ODIN and St. Natuurcentrum in Arnhem. The total scale of sales to retailers is small: only EUR 388 to ODIN and EUR 1,225 to St. Natuurcentrum.

One major cost and obstacle to the current vegetable basket operations is that Klein Mariëndaal grows very limited winter crops, and therefore has to purchase vegetable from other farms to continue its vegetable basket sales during winter season. The cost of input for gardening production, including seeds, manure, packaging etc., is € 1,200 in 2018. In the future, if the farm expands its production output and is able to acquire additional storage capacity, it can significantly reduce its winter purchase expense.

4.6 Customer review

A questionnaire was prepared in consultation with Klein Mariëndaal farm manager to quickly review customers who buy vegetable baskets. Detail of the questionnaire can be found in Annex. The questionnaire was sent with weekly information via email to customers. Although there are about 20 customers at the moment, only 12 customers responded to the questionnaire. Of 12 respondents, there are 9 females and 3 males. Most of respondents belong to age group from 35 to 44 and older than 55.

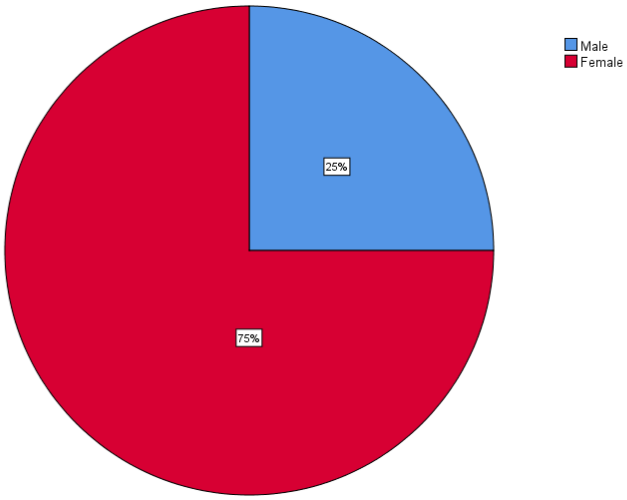


Figure 10 Respondents categorized by gender

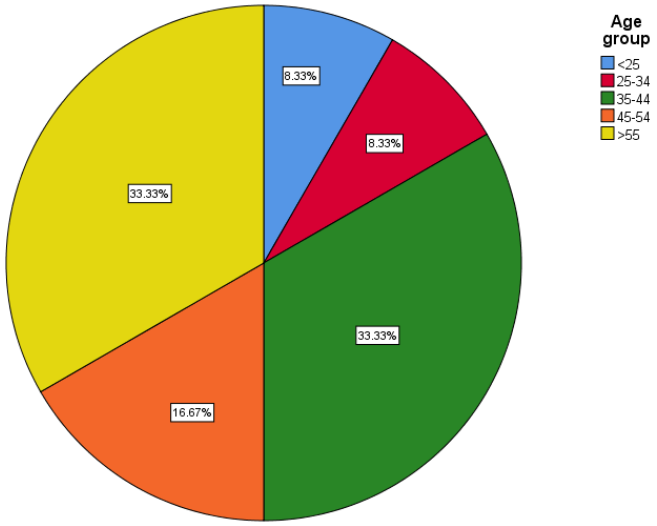


Figure 11 Respondents categorized by age group

Most customers have bought vegetable baskets for a long time, 7 people for more than 3 years and 3 people between 1 and 3 years. Some customers even bought vegetable since the day Klein Mariëndaal first started. These are loyal customers, and this is also reflected by the farm manager and coordinator. Klein Mariëndaal did not focus much on the sale of vegetable baskets as this is not the core business and there were not many new customers during the last few years. Customers know about the vegetable basket because they live nearby (4 people), via the farm's website (3 people) or because they participate in the farm's activities previously (5 people).

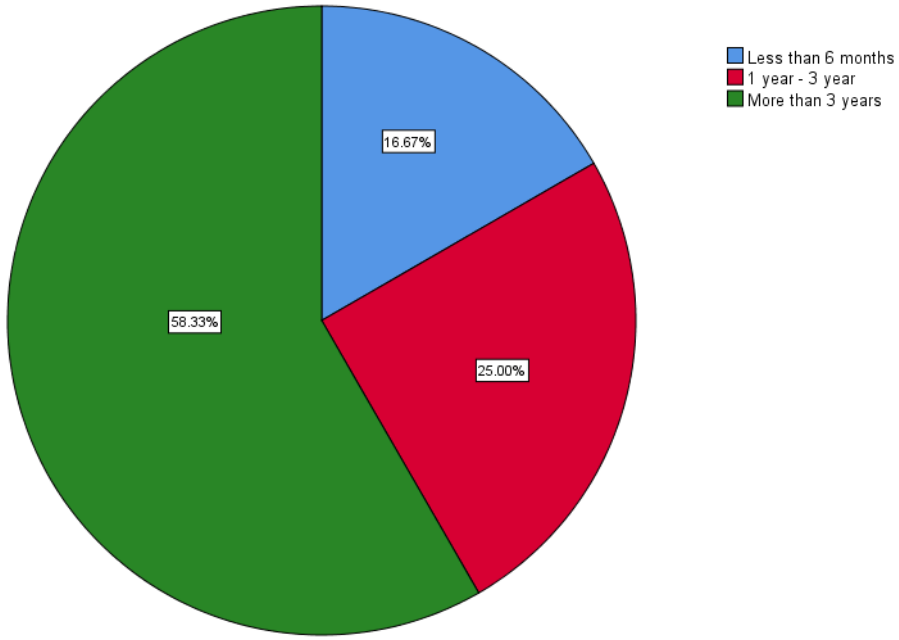


Figure 12 Respondents' period of buying product

In general, customers have positive attitude toward Klein Mariëndaal vegetable basket. 7 people are satisfied, and 4 people are very satisfied with the product. They are also likely to continue to buy the

products and recommend to their friends. Most people prefer to have more varieties of vegetables and more processed products. Freshness of vegetables is also an important factor. One respondent said “I get the vegetables for the entire week on Friday. I have to process most vegetables immediately, otherwise they are no longer tasty or fresh enough. It can be an idea to pick up fresh vegetables twice a week for those who want and are able to”. Another respondent’s recommendation is “The vegetables are always outside, even in the summer. We cannot always pick up the package on Friday afternoon when the new package arrives. To keep the vegetables as fresh as possible, cooling would be nice”. Besides, respondents also think it would be nice if there is a newsletter every week about the content of the package. In order to tackle these issues, it is necessary that Klein Mariëndaal plan what to produce and keep track of the production and harvesting. A cooling storage is also important to reduce production loss, save harvesting time and keep fresh produce for customers to buy directly in farm. When number of customers increase, Klein Mariëndaal can provide vegetable basket twice a week at pick up points. In order to reach out to new customers, especially young millennials, using website and providing smaller package with more varieties is a possible option.

4.7 Agroforestry hypothetical design

In consultation with the farm manager to understand his visions and needs, a hypothetical design of an agroforestry system is created for the currently unused patch of land on the farm. Some of the key objectives of the farm in practicing agroforestry are:

- Triple to quadruple the current production output of the farm to correspondingly expand the vegetable basket sales (more basket to sell to employees of a nearby company) and business with local retailers.
- Reduced dependence on external purchasing during the winter for vegetable basket sales
- Pioneering and innovative farming model that emphasizes eco-friendliness, natural systems that have low labor requirements for establishment, fertilization and crop protection
- Get more urban citizen to be involved in nature and farming by providing more activities like harvesting fruit and vegetable for children from nearby schools
- Have some synchronization with the value of the care farm

Some of the key constraints and inputs from the farm that the agroforestry model has to address:

- Currently lack of permanent labor
- Lack of expertise in agroforestry farming
- Lack of storage facility
- Small area of land
- Trees cannot be against the landscape

Recommendations to address some of the constraints would be in discussion/ recommendation section.

The following is the design of the agroforestry system based on learnings from literature review and discussion with the farm.

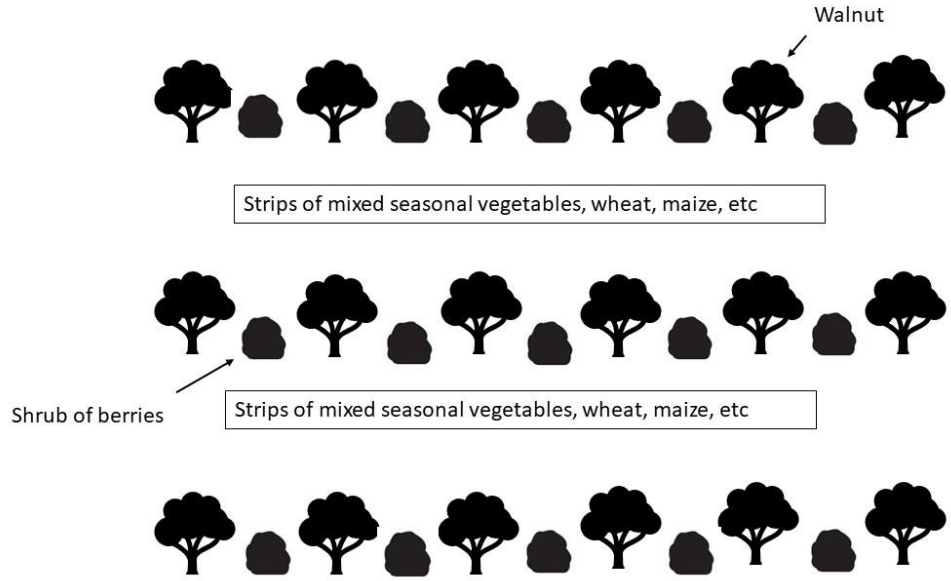


Figure 13 Hypothetical design of Klein Mariëndaal agroforestry system

The goal of design is to maximize the area of land that is available, while incorporating multiple crops for the vegetable basket business. Walnuts are introduced to the field as natural fencing and wind breaker. As the canopy width of a solitary walnut is 10-15 meters (Oosterbaan 2015), the trees are planted 12.5 meter apart surrounding the growing area. The productive age of the walnut trees is around 50 years, and this is also estimated as the length of the rotation.

Within the land, there are three main types of crop that are cultivated to provide the farm with products: mixed seasonal vegetables, wheat and berries scrub. The berries scrub strips act as natural boundaries between patches of vegetables and wheats.

4.8 Cost benefit analysis of agroforestry system

Estimations and calculations of the cost benefit analysis of the new agroforestry system are derived from literature review and secondary data. Details of farm model calculation can be found in Annex

Table 6 below shows the assumption of all species that are going to be introduced in the new farming system. The new system includes walnut as large tree, raspberry and red currants as shrubs and triticale and mixed vegetables as annual crops. Fruit an d vegetables will be sold as fresh produce. Price estimation are based on farm price, retailer price and secondary data.

Cultivation costs of agroforestry system are divided into fixed cost and labor cost. In this model, fixed cost refers to wage of another full-time gardener to oversee all horticultural activities. Variable costs include establishment cost, maintenance cost, harvesting cost and marketing cost. Detail of these costs is in Annex.

Table 6 Summary of Klein Mariëndaal agroforestry system

Agroforestry area	
Number of walnut trees	50
Number of raspberry plants	750
Number of red currant bushes	400
Area of trinticale	0.6 ha
Area of vegetables	1.2 ha
Cashflow	
Total project life	60 years
Year of positive cashflow	Year 11
NPV @ 4%	€28,155.09
IRR	8%

With the implementation of agroforestry system, net present value at discount rate 4% is €28,155.09 and internal rate of return is 8%. This indicates that agroforestry system is profitable.

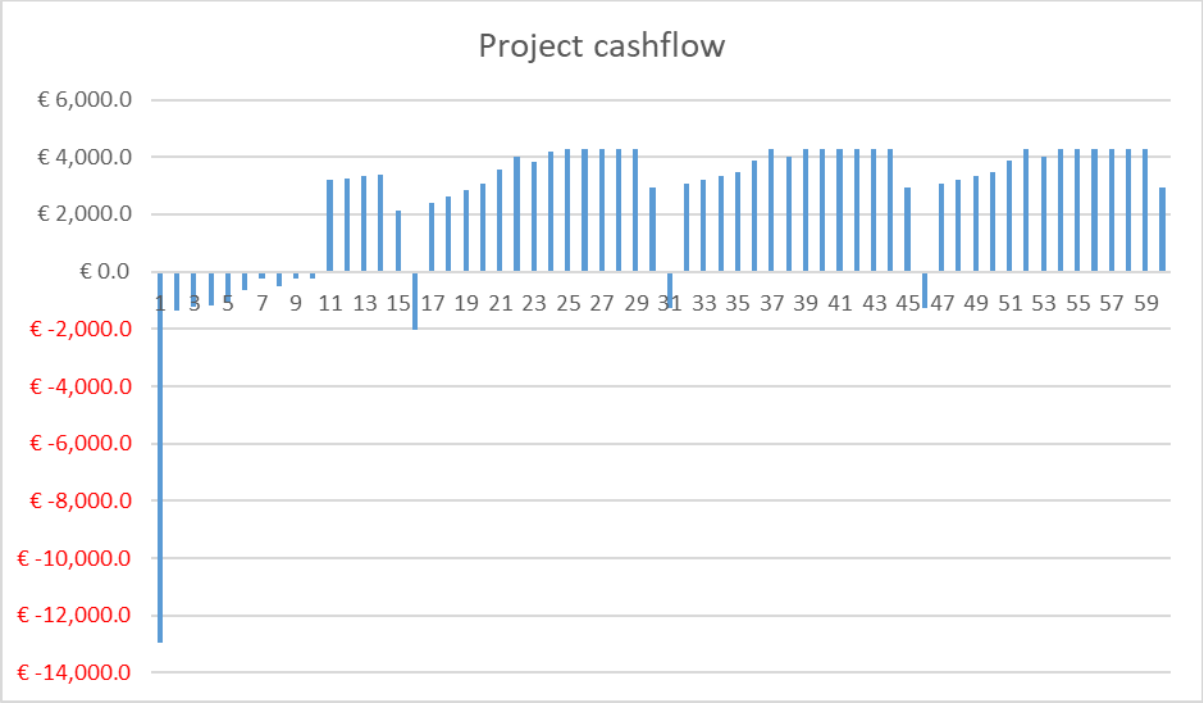


Figure 14 Projected cashflow of Klein Mariëndaal agroforestry system

Figure 14 shows projected cashflow of the new agroforestry system during the period of 60 years, which is the length rotation of the model. After 11 years, the new system will generate positive cash flow because of the yield from walnut trees. Annual crops such as vegetable and triticale are important source

of income to balance the negative cashflow and keep it at low level. Year 16th, 31st and 46th experience negative cash flow because of the replacement of shrubs and fruit tree.

According to European Parliament, under the new CAP, Member States may adopt a simplified scheme benefiting small farmers if an annual payment of up to EUR 1 250 is made, irrespective of farm size. Participants are subject to less stringent cross-compliance requirements and do not have to meet greening requirements. This can be a potential source of subsidy for Klein Mariëndaal. If a subsidy of 1000 euros per year is included in the cost table, net present value of the system at 4% interest rate will increase to 29,116.63 euros while IRR remains the same at 8%.

4.9 New value chain mapping

In consultation with Klein Mariëndaal farm manager, it is more likely that the core business of the farm will stay the same, but horticulture production will be expanded into more commercial scale. In the new system, there will be higher volume of produce and more varieties such as corn, wheat, etc. Klein Mariëndaal will keep selling vegetable baskets to more customers in surrounding area, either directly at the farm shop or delivery to pickup points; using fresh produce for the tea house and selling to organic retailers. Special products like wheat variety (triticale or spelt) can be sold to bakers and milers granted the supply and quality can be maintained consistently. For examples, there are cooperation between millers in the area of Nijmegen, Arnhem and Wageningen and their organic bakers that are being developed now. The new value chain is depicted in Figure 15 below.

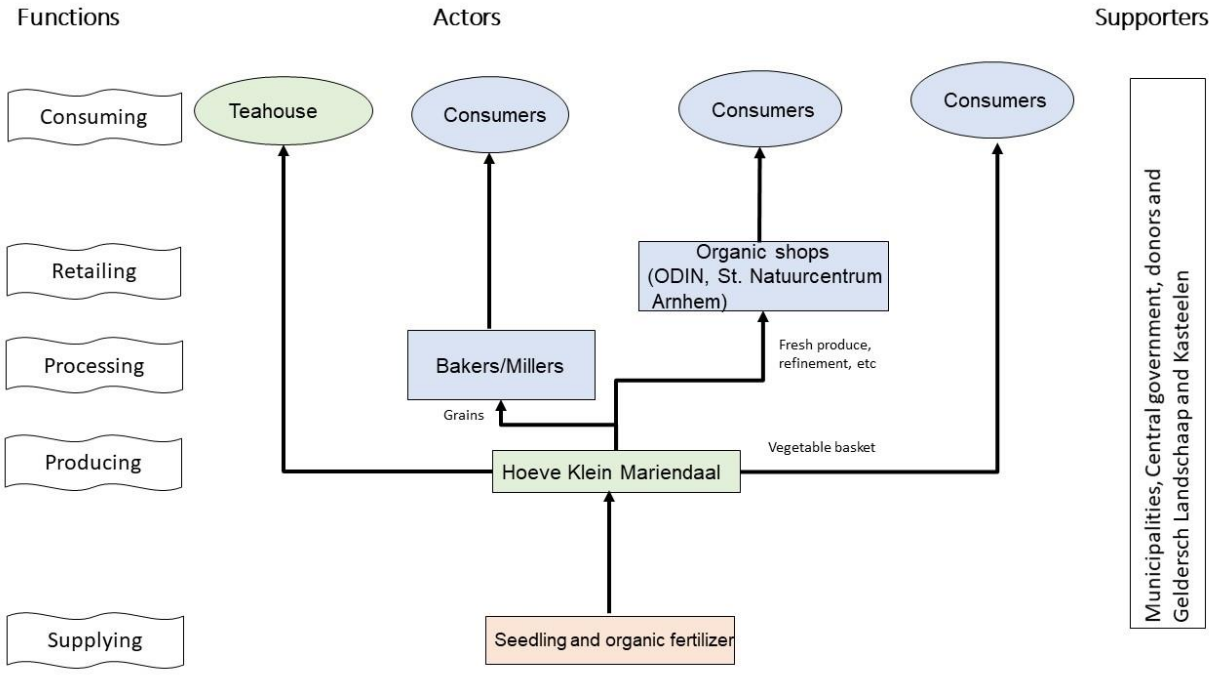


Figure 15 Klein Mariëndaal new value chain

4.10 SWOT analysis of new system

Under the new agroforestry system, Klein Mariëndaal can produce more varieties of products with higher volume to sell to increased number of vegetable basket and reduce reliance on external purchasing for winter sale. By setting up cooling storage at the farm, people can come and buy directly at farm gate thus reducing transportation cost to pick up points. Customers can also harvest vegetable and collect nuts by themselves; they pay less, and the farm needs less labor and storage. These activities can be set up for children in nearby schools to educate them about farming, horticulture and nature. Organic nuts and wheat can be sold to specialty bakeries or organic stores at premium price. Because Klein Mariëndaal is the only farm from Arnhem selling products at Odin Arnhem, this can be an advantage to create products with unique story behind to attract local people. According to manager at Odin Arnhem, local consumers are now becoming more interested in eco-friendly farming practices like agroforestry or food forests and they are willing to try new products so there is a potential niche market for products from these systems.

However, there are certain weaknesses that Klein Mariëndaal needs to address when developing agroforestry practices. Overhead cost for trees, equipment and facility will be expensive at the beginnings and payback time will take a few years because walnut trees matures after 8 years and small-scale production of walnut without machinery will not yield big revenue. The lack of permanent and skill labors who have sufficient knowledge about agroforestry is an important issue because the core business of the farm is care activities and it is crucial to hire more labor to expand current horticulture activities.

Table 7 Klein Mariëndaal SWOT analysis of new agroforestry system

Strengths • Increased horticulture production • More varieties of products • Provision of ecological services • Unique local products • More activities for urban citizens/children from local area	Weaknesses • High investment cost, especially for equipment and facility • Lack of agroforestry knowledge • Long payback time • Maintenance of original landscape • Lack of permanent and skilled labors
Opportunities • Higher value added products • Farm gate sales of products • Demand for organic products/ food forest-agroforestry product • Local products preferred by local community	Threats • Low margin for selling at organic specialty shop • Separation of care activities and horticulture farm • Lack of legislation and policies

5. Chapter 5 Result and analysis Kwaalburgse

5.1 Description of Kwaalburgse

Kwaalburgse Hoeve owned by Horst Beheer B.V. is one of three project sites under project FARM LIFE. This project's objective is to contribute to climate change adaptation including climate change mitigation, climate governance and agricultural knowledge dissemination. Main activities of the project are:

- Demonstrate innovative adaptation technologies in three sites in the Dutch province of Noord-Brabant, contributing to improved climate resilience, socio-economic development and benefits for the environment and biodiversity; and
- Promote and replicate technical and methodological results, in particular with regards to the demonstration sites as well as learning tools and methodologies connecting farmers with each other and with their societal partners in resilient rural networks.

The project will contribute towards the EU strategy on adaptation to climate change, the 2030 climate and energy framework, the Common Agricultural Policy, the EU Biodiversity Strategy and the European Water Framework Directive.

The Kwaalburgse Hoeve is located near the village of Alphen in the municipality of Alphen-Chaaam (province of Noord-Brabant). The farm consists of 8 hectares of agricultural land covering two locations (almost 6 hectares lon the Kwaalburg and 2.3 hectares adjacent to Bels Lijntje). De Kwaalburgse Hoeve was formerly leased land dated back to the 14th century in historic document. The farm became private land in the 19th century and current owner has lived there for 20 years. Production of the farm is certified as organic by SKAL. The farm has produced crops like quinoa, cereals and sunflower and is seeking to convert to agroforestry with combinations of trees and shrubs (e.g. walnut, chestnut, hazelnut) and an underlayer of annual crops such as spelt and chicory.

5.2 Current value chain mapping

During the time of this research, it was impossible for the researcher to talk to Kwaalburgse farm owner so information about the farm's current value chain is limited. Figure 16 below show the value chain based on information provided by project FARM LIFE. The farm owner mainly grows cereal and sells to millers. He also sells clover/grass as fodder for local organic livestock farms. On a small part of the farm, he is experimenting with different species like walnut and sunflower. However, there is no distribution channel for these products yet. The farm owner receives subsidy from CAP pillar 1 for agriculture products and he is also applying for Natuurnetwerk Brabant (NNB) fund. As the farm is chosen as pilot for project Farm LIFE, the project will provide technical support as well as financial support for the development of the new agroforestry system. The scoping mission of the project resulted in the following provisional (non-exhaustive) list of relevant stakeholders.

Table 8 Stakeholders and their roles

Name organization	Relation to the project
Buurtschap De Kwaalburg	This is a traditional neighborhood community of which the farm is part as well. They have a B&B and camping, and their activities are in line with the project's landscape approach to farming.
Collectief Bels Lijntje	One project plot is located next to this old railroad track called 'Bels Lijntje', which is no longer in use but preserves interesting biodiversity as well as cultural history. This organization is interested in developing initiatives in relation to this railroad track and its conservation purpose.
Citta Slow organization (Alphen-Chaam is a Citta Slow municipality)	They promote 'slow-food' and have a large network of restaurants and potential customers and sales channels.
Water board Brabantse Delta.	As water management authority they regulate water levels.
ZLTO (farmer organization)	They are an influential agricultural organization
Hogeschool Den Bosch	The principal educational institute in Brabant, with expertise on a variety of project topics.
Brabantse Milieu Federatie	This is an important NGO in Noord-Brabant promoting sustainable land use
Wageningen University (Janjo de Haan)	Known for research on agroforestry income modeling.
Groen Ontwikkel Fonds Brabant (Province of Noord-Brabant).	They financed part of this LIFE proposal writing and publicly support EU programs such as LIFE.
Municipality Alphen-Chaam	This is where the project plot is located
Nederlandse Notenvereniging (located in Zoelen)	This organization promotes cultivation and processing of nuts, and owns an oil press cooperative in village of Zoelen.

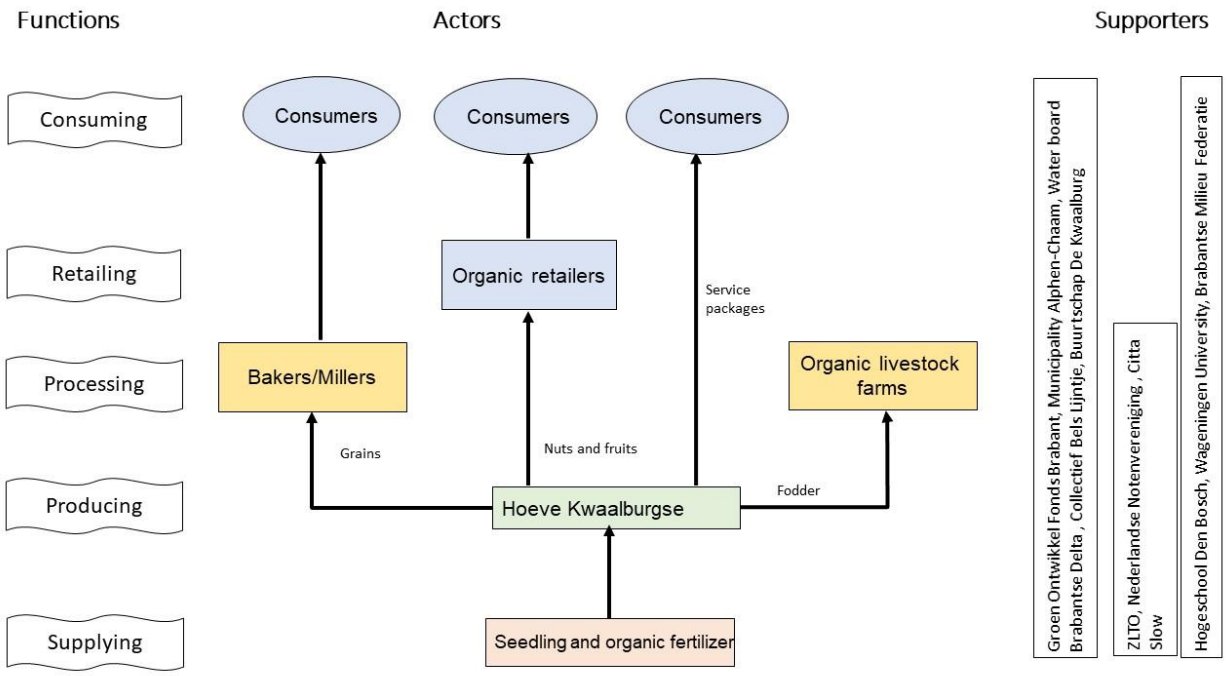


Figure 16 Kwaalburgse value chain

5.3 Business canvas model

Below is the business canvas model of Kwaalburgse. The model was prepared using information from Project FARM LIFE.

<table>
<tr>
<td rowspan="2">KEY PARTNERS

- Input suppliers
- Millers
- Nut processing cooperative
- Bakeries</td>
<td>KEY ACTIVITIES

- Horticulture farming
- Bee keeping</td>
<td rowspan="2">VALUE PROPOSITION
- Organic spelt
- Fodder
- Nuts
- Flower</td>
<td>CUSTOMER RELATIONSHIP
-</td>
<td rowspan="2">CUSTOMER SEGMENTS
- Millers
- Specialized bakeries
- Organic retailers</td>
</tr>
<tr>
<td>KEY RESOURCES
- Land
- Seedling and fertilisers
- Labour</td>
<td>CHANNELS
- Direct sale to miller/bakery
- Farm gate sale</td>
</tr>
<tr>
<td colspan="2">COST STRUCTURE
- Fix costs
o Machinery
o Water irrigation
o Land
- Variable costs
o Labor
o Seedling
o Fertilizer</td>
<td colspan="3">REVENUE STREAMS
- Revenue from selling grains to bakery/ millers and fodder to biological livestock farm</td>
</tr>
</table>

5.4 Agroforestry hypothetical design

According to agroforestry scan report and stakeholder analysis report of project FARM LIFE, Horst (Kwasslburgse farm owner) was keen on adopting agroforestry system because of the following reasons. Firstly, Horst had experiences with cacao farming in Brazil, in an ecosystem vulnerable to climate change and he is concerned that climate change will also severely affect agricultural activities in the Netherlands in the future. Because of the extreme drought in 2017 in Noord-Brabant, rain water did not reach the ground water and the regional water board begun to restrict crop irrigation. If the drought continues and becomes more frequently in the future, watering crops might not be guarantee and Horst's farm with its higher laying sandy soil might become unsuitable for agricultural production. Secondly, Horst opposes common soil-depleting practices in the surrounding area focusing on high-input potato farming. Thirdly, Horst have concluded that his current business only leads to a marginal return and he wants to focus on business operations where small scale production with more varieties and local sales play a major role. He believes that another approach for sustainable and climate smart agriculture is crucial, and the approach proposed by project FARM LIFE is a solution for this issue. The main goals is to develop feasible agroforestry business models and another important goal is learning and dissemination of lessons learned.

The Kwaalburg Hoeve mainly wants to focus on a combination of tree crops (walnuts and hazelnuts), cereals and honey production. Due to intensive agricultural activities, trees have disappeared and the original landscape in the area has become an open space. The farm owner wants to create a layout that removes the specific line between agriculture area and nature area in the region. Under project FARM LIFE, the farm area will be developed using agroforestry practices to ensure a gradual transition from agriculture to nature, where there is room for nature values and biodiversity, with the appropriate flora and fauna. With the support from project FARM LIFE, the farm owner is now developing agroforestry system in his farm. The area that will be used for the project consists of three separate sites, of which two laying adjacent to each other (site 1 and 2). On site 1, a mixture of grass and clover is currently grown and on site 2, spelt is grown. Site 3 is also used for grass/clover. Site 1 has a surface of 1,7 hectares, site 2 has a surface of 3 hectares and site 3 has a surface of 2,2 hectares.

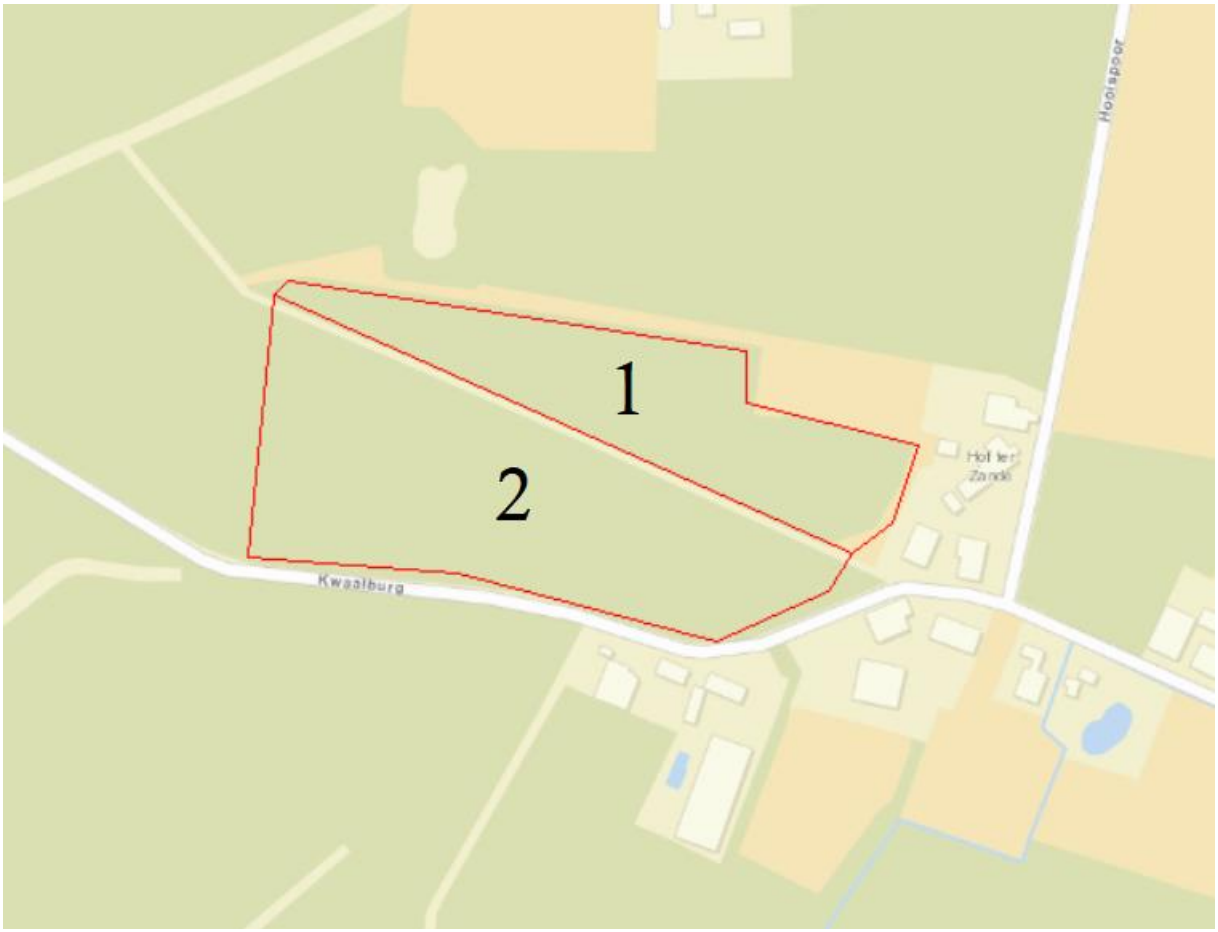


Figure 17 Project site 1 and 2

(Source: Project Farm LIFE)

Figure 18 Project site 3

(Source: Project FARM LIFE)

Agroforestry development plan for Kwaalburgse has been prepared by project FARM LIFE with main focus on functions of the farm. The functions were determined by goals and target % in pillar (5% for social benefit, 35% for environmental benefit and 60% for economic benefit). Target market for future products will be niche markets for customers like more luxury restaurant/hotel establishments, small specialist shops and maybe small retail chains with high quality (bio) products with a good story. The selected functions for hypothetical design and calculation of this research are as follow:

- Nut tree will take a substantial part of the system because the profit per kg is quite high and demand for nut/ trail mix is increasing. Larger trees will stand in small square patches/islands. In each patch there is 1 tree and several other things (see other functions). Between the patches the annuals can grow and are harvested.
- Shrub of berries will be planted in between nut trees and these will overgrown the strip in the long run.

- Between the trees and shrub rows or patches of wheat/ spelt can be grown as long as the trees are not big enough and casting too much shadow. Special bio seeds can be produced for sales to other landowners.

5.5 Cost benefit analysis of agroforestry system

Table 9 below summarizes assumption and cost benefit analysis of the new agroforestry system without subsidy from project Farm LIFE. The model only covers the main components: walnut trees and annual crops (triticale and spelt) on site 1 and 2; and grass/clover on site 3. Detail calculation can be found in Annex.

Table 9 Summary of Kwaalburgse agroforestry system

Agroforestry area	
Number of walnut trees	100 trees in 1 ha
Area of triticale	2 ha
Area of spelt	2 ha
Area of grass/clover	2 ha
Cashflow	
Total project life	60 years
Year of positive cashflow	19th
NPV @ 4%	€(16,548.20)
IRR	3%

The new agroforestry system will take 14 years to generate positive cash flow due to high overhead cost and larger scale of production. Net present value at 4% discount rate of the project is -16,548.20 euros and internal rate of return is 3%.

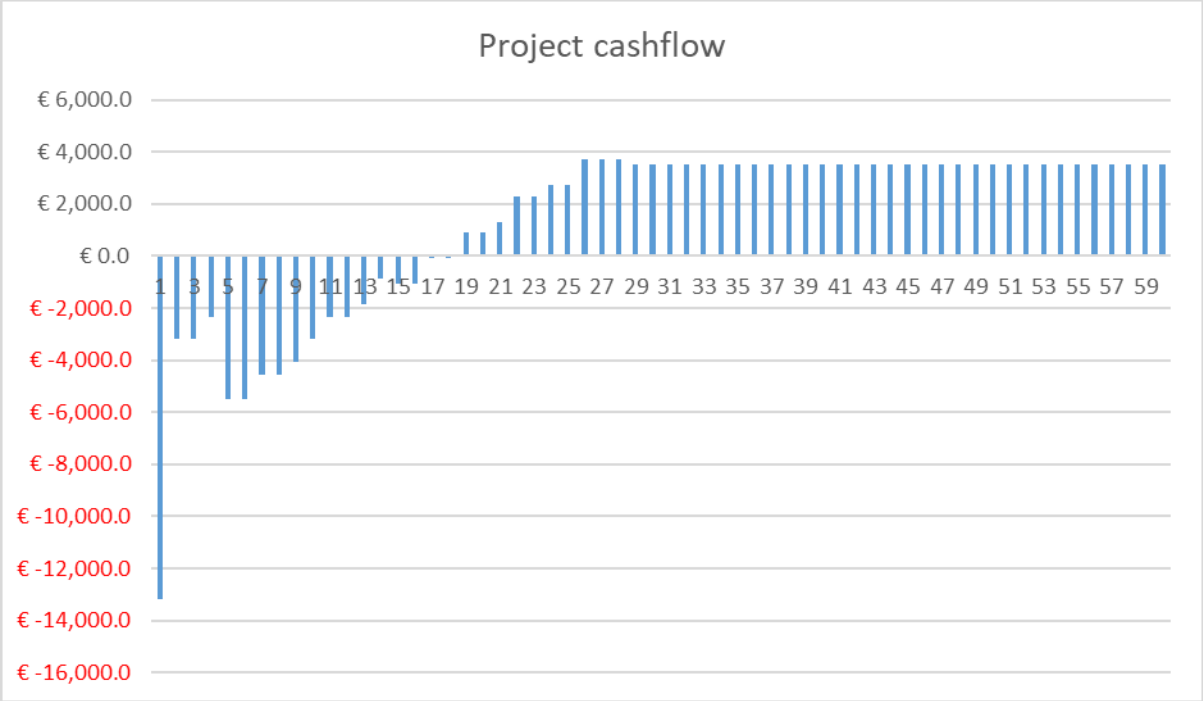


Figure 19 Projected cashflow of Kwaalburgse agroforestry system (without project subsidy)

Because Kwaalburgse is chosen as pilot of project FARM LIFE, there will be financial support to set up the agroforestry system from the project. Table 10 below shows the relevant activities and budgets provided by the project for Kwaalburgse farm owner.

Table 10 Project FARM Life subsidy

	Activity	2020	2021	2022	2023
C2	Personnel cost	360			
C3	Acquisition & Soil and Material Preparations	4361			
C5	Establishing Agroforestry Demonstration sites	4650	4650	4650	
C8	Agroforestry Product Development and Branding	900	900		
C9	Agroforestry Sustainability Certification	1440	2160		
	Total	11711	7710		

When project subsidy is included, net present value at 4% discount rate of the agroforestry system is 5974.54 euros euros and internal rate of return increases to 5%. Figure 20 below shows projected cashflow with project subsidy.

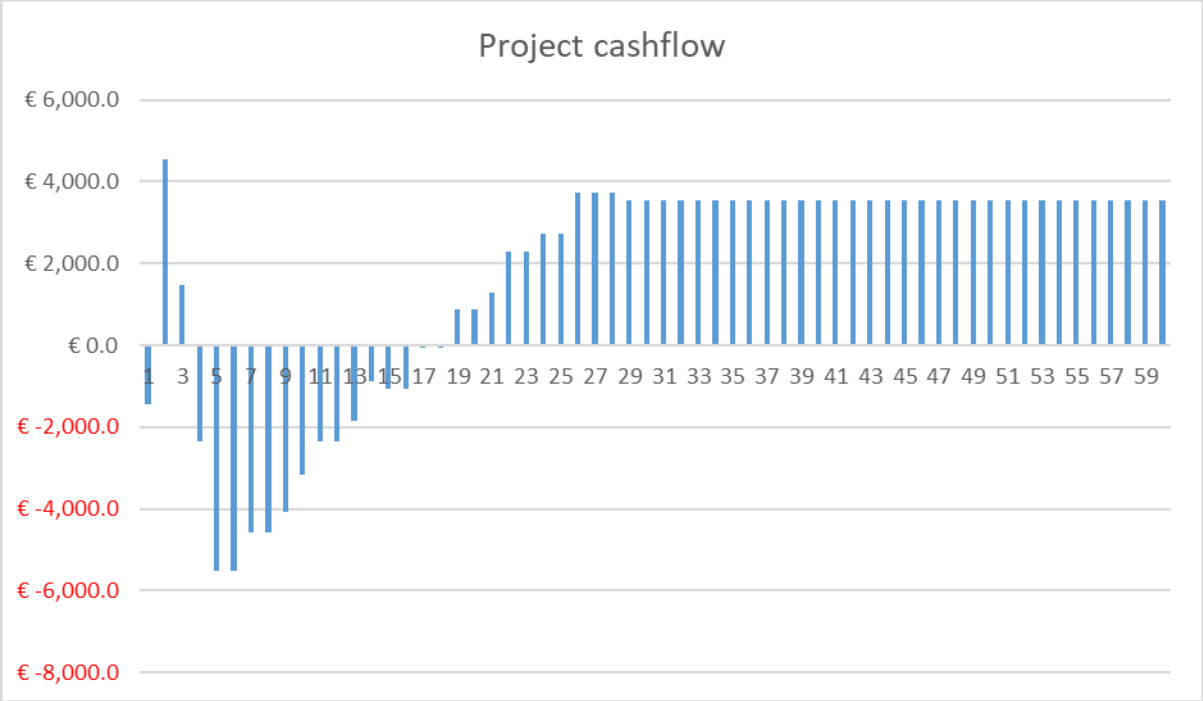


Figure 20 Projected cashflow of Kwaalburgse agroforestry system (with project subsidy)

5.6 SWOT analysis of agroforestry system

For opportunity, the establishment of agroforestry system will be supported by project FARM LIFE, both technically and financially. The project uses the "living labs" innovation model with dynamic cooperation among governments, entrepreneurs, knowledge institutes and citizens to promote policies, new markets/business, cultivation/harvesting techniques and closing the agroforestry value chain towards the national ambition of circular economy. This approach will ensure a successful and sustainable agroforestry business model for the farm. Besides, substantial and increasing demand for organic products in the Netherlands means that organic farming can generate higher gross margin, thus making the farm more profitable and cash flow positive. As agroforestry system can provide more ecological services, farm owner might be eligible for various sources of subsidies, which can help to maintain and develop agroforestry system in the farm.

For weaknesses, Kwaalburgse might face the lack of knowledge in agroforestry planning, design and maintenance and also low level of profitability and finance when developing the new agroforestry system. Even though agroforestry has become more popular in the Netherlands, there is still a lack of data on agroforestry with practical example on species, how they perform on different soil types, how to start on bare soil, and how to plan and manage agroforestry plots. Moreover, agroforestry is difficult to integrate in the current agro-business model because the profit of agroforestry system can only be realized in the long term. Without adequate income, farm owner has no financial means to invest and maintain agroforestry system. A Stakeholder meeting held by Project FARM LIFE had also confirmed some obstacles to develop agroforestry system in Noord-Brabant including unclear legislation and policies, inadequate good quality and economic planting material and lack of strong supply chain.

Table 11 Kwaalburgse SWOT analysis

Strengths • SKAL certified organic production • Available of land	Weaknesses • Lack of agroforestry knowledge • Lack of profitability and finance • Lack of planning
Opportunities • Subsidies from various sources • Support from project Farm LIFE • Increasing demand for organic products	Threats • Absence of agroforestry supply chains • Lack of good quality and economic planting material • Incompatible legislation and policies

6. Chapter 6: Discussion and recommendation

6.1 Sustainability of agroforestry system

In general, linkages among each farm and its stakeholders are weak and insufficient for the successful development of agroforestry system. In fact, they are operating from bottom up and there is no market research or production plan in hand. No niche market has been defined thus making it difficult for the two farms to find distribution channels for their products. There is hardly any information flow from customers to the farms and it also shows in their business canvas model: there is no clear customer relationships. Hence, in this case a top down approach is much needed.

From the cash flow model, the agroforestry system in both cases will take a long time to be economically sustainable regardless of the subsidy. This is resulted from the high investment cost, lack of expertise in designing, planning and maintaining agroforestry system. Since both farms do not have a clear system to record and keep track of their production, it will be difficult to prepare for capital purchasing, borrowing or accessing to credit line. The system could be more profitable from other recreational activities in the landscapes and processing of fresh produce for higher value added.

From a social perspective, development of agroforestry system in the two farms can be beneficial to the community in general. Agroforestry system can be a place for urban citizen or small children to volunteer and join cultivation and harvesting activities so they can learn more about nature and the food production system. This will also increase people's awareness about farming, horticulture as well as eco-friendly production system that can help ease all the negative effect of climate change. Moreover, landscape provided by agroforestry system can become a place for recreational activities such as walking, bicycling and sight seeing to improve life quality of local community. In case of Klein Mariëndaal, agroforestry system can greatly affect the well being of citizen in deprived neighborhood (people with mental issues or isolated people) because it generates opportunities to work in a green and nature area.

6.2 The agroforestry value chain

Based on the finding from both cases, a PESTEC analysis in Table 12 below was prepared to evaluate the opportunity and challenges of the adoption of agroforestry practices.

Table 12 PESTEC analysis

	Challenges	Opportunity
Political	• Unclear legislation and policies for agroforestry practices • Overlapping roles of stakeholders/enablers	• Policy makers are now paying more attention to climate smart practices • More stakeholders are involved in the development of agroforestry value chain • Living labs as a potential solution to connect stakeholders
Economic	• High investment cost and long payback period • High land prices and low food price	• Increasing demand for local organic products • Agroforestry/ organic products are sold at premium price
Social	• Invasion of non-native species will affect the original landscape	• Development of agroforestry system can involve more citizens (urban people, children) and show them the importance of horticulture/farming. • Local people have positive attitude toward agroforestry and are willing to volunteer in the farm
Technology	• Technical entry barriers caused by lack of data on how to start agroforestry system • Lack of machinery for harvesting of agroforestry system • Inadequate good quality and economic planting material • Lack of strong supply chain • Lack of sustainable brand name for agroforestry products	• On-going experiments to advance the knowledge and practice in agroforestry and agro-ecology in general
Environment		• Agroforestry is a sustainable system that can cope with climate change and extreme weather conditions • Ecological functions of agricultural land can be provided with the inclusion of more trees

Cultural	• Monoculture is more prominent in the Netherlands and it is difficult to change the mindset of conventional farmers • Skeptical about profitability of agroforestry system	• Millennial consumers are more aware of sustainable and eco-friendly products

6.3 Limitation of the study

Firstly, the model of this paper is only hypothetical calculation and it serves as a starting point for farm owners to consider if they want to develop agroforestry system. The models do not include opportunities and potential subsidy from ecosystem services provided by the introduction of trees on agricultural land. In fact, project FARM LIFE provides funding for the maintenance of ecosystem in Kwaalburgse but this was not included in the calculation. The same applies for other agricultural nature conservation grants. Other possible benefits that can be incorporated in the models is the effect of urban farming and agroecological farming on care activities of Klein Mariëndaal.

Secondly, social and environmental benefits are not quantified and included in the cashflow models. Feasible economic models should take carbon credits into account, as well as ''blue credits'' from improved water retention, in cooperation with the water boards. Once these benefits are included, the agroforestry system will become more profitable.

Thirdly, due to some difficulty during data collection stage and the lack of records by both farms, the author could not prepare a similar cost benefit analysis of current production model for comparison agroforestry system. If there is a comparison of conventional farming investment and agroforestry investment, the farm owners can base on that to justify their choices.

Last but not least, estimation of labour cost, yield and administrative cost remains a challenge. The on-going maintenance costs and other non-financial cost is unknown thus making the calculation of investment cost complicated. Also, the effect of taxation and loans are not incorporated in the cashflow model.

6.4 Recommendation

Since the rotation period of an agroforestry system is 60 years, the planning for integrating agroforestry practices to the farm system is as important as the actual establishment of the practice itself. Detail plan with specific timeline will help the monitor and evaluation process as well as increase the chance of success of the new agroforestry system. Planning will enable farm owners to achieve specific on-farm goals and identify market opportunity and challenges. A detail plan should include:

- Crop plants: All species that the owners decide to grow and market

- Management objectives: It can be a prepared for annual or 5-year period

- A list of tasks with clear timelines to achieve said objectives

- Materials: Estimates of seed, seedlings, fertilizer and other items necessary for corresponding tasks

- Labor and equipment: A record of labor and equipment needs (if any) for each of the specific tasks.

It is also crucial for both farms to develop a system to keep good records of their businesses. By doing so, they can calculate the complete product costs, including all costs related to cultivation, packaging, distribution and promotion of the products. Even the cost of loss and unsold products should be listed.

Another aspect to be considered is how to do marketing of agroforestry products. Small scale production can benefit from direct marketing such as farmers' market, on farm sales (farm store or u-pick), mail order sales, food service (meal packages, vegetable packet) or door to door sale. Larger scale production with less diversified products might benefit from indirect marketing by selling to retailers (for example Eko Plaza, Odin, etc) or institutional buyers (processing group/ organization, high end restaurants/ bakeries, etc).

For Klein Mariëndaal, to solve the issue of limited crops during winter time and sandy soils, a list of crops that can be taken into consideration is presented below:

Table 13 Potential species

	Name	Minimum-maximum temperature	Soil requirements	Potential revenue per ha (euro/ha)	Year of harvesting	Remark
1	Chokeberry	4-25	Sandy soil Ph 5.5-7	40000	2nd year	Can tolerate atmospheric pollution Erosion control
2	Wild asparagus	11-25	Sandy soil Ph 6-8	30720	3rd year	Can grow in very acid, very alkaline and saline soils.
3	Hyssop	5-26	Sandy soil 5.5-7.5	14500	3rd year	

(Source: Project FARM LIFE)

7. Chapter 7: Conclusion

This study was conducted to explore the potential business model for agroforestry system of two farms in Arnhem and Noord Brabant, the first on is a small care farm and the latter is a normal agricultural farm with larger scale. The study evaluates the value chain that both farms are operating in and provides insight on strengths and weaknesses of each farm during the transition from conventional horticulture to more sustainable agroforestry system. The study also includes cost benefit analysis of hypothetical agroforestry design to help the farm owners to make decision and plan the implementation of the agroforestry system. Result of the study showed that in two farms, the adoption of agroforestry system requires high overhead cost and results in long payback period. For Klein Mariëndaal in Arnhem, the NPV is €28,155.09 and it takes for the system 11 years to be cashflow positive. For Kwaalburgse in Noord Brabant, the NPV is €(16,548.20) and it takes 19 years for the system to be cashflow positive. In both case, potential subsidy is also included in the calculation, however, it does not change the cashflow and breakeven point of the system. It is recommended that the two farms develop a detail plan with specific timeline and goals, decide on marketing plan as well as develop a system to record production cost as the first step to successfully adopt agroforestry practice.

References

Arnold, J.E.M., nd. *Chapter 11: Economic considerations in agroforestry*. [online] Available at: http://www.worldagroforestry.org/Units/Library/Books/Book%2007/agroforestry%20a%20decade%20of%20development/html/4_economic.htm?n=20

APCM VHL Master Students (2018). *Agroforestry in Arnhem and Nijmegen.* Velp.

APCM VHL Master Students (2019). *Agroforestry in Arnhem-Nijmegen Region: Identifying Drivers to Scale Up Agroforestry System.* Velp

A Circular Economy in the Netherlands by 2050. [online] Available at: https://www.government.nl/documents/policy-notes/2016/09/14/a-circular-economy-in-the-netherlands-by-2050

Beers, P.J., Bemmel, K.v. & Maas, S.v.d. 2017, *The potential of permaculture principles in the agrifood transition: Analysing the values and opportunities of Dutch food forest' business models,* , Den Bosch.

Borremans, L. 2019. *The development of agroforesty systems in Flanders. A farming systems research approach to social, institutional and economic inquiry.* PhD thesis. [online] Available at: http://www.eurafagroforestry.eu/resources/thesis/phd_Lieve_Borremans

Burgress et al, 2017. *EIP-AGRI Focus Group Agroforestry MINIPAPER: Financial Impact of Agroforestry.* [online] Available at: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/fg22_mp6_financials_2017_en.pdf

European Commission, 2015. *EU agriculture spending focused on results*. [online] Available at: https://ec.europa.eu/agriculture/sites/agriculture/files/cap-funding/pdf/cap-spending-09-2015_en.pdf

European Commission, 2017. *Agriculture and water*. [online] Available at: https://ec.europa.eu/agriculture/envir/water_en

Eurostat, 2017. *Agriculture - greenhouse gas emission statistics*. [online] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Archive:Agriculture_-_greenhouse_gas_emission_statistics

Eurostat, 2017. *Land use statistics*. [online] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Land_use_statistics

Eurostat, 2017. *Agri-environmental indicator - soil erosion*. [online] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_soil_erosion

European Commission, 2016. *EIP-AGRI Workshop New value chains from multifunctional forests*. [online] Available at: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_workshop_forest_value_chains_final_report_2017_en.pdf

European Commission, 2017. *CAP explained. Direct payment for farmer 2015-2020.* [online] Available at: https://ec.europa.eu/agriculture/sites/agriculture/files/direct-support/direct-payments/docs/direct-payments-schemes_en.pdf

European Parliament, nd. *First pillar of the common agricultural policy (CAP): II – Direct payments to farmers.* . [online] Available at http://www.europarl.europa.eu/factsheets/en/sheet/109/first-pillar-of-the-common-agricultural-policy-cap-ii-direct-payments-to-farmers

Eksvärd, 2016. *EIP-AGRI Focus Group Agroforestry.* [online] Available at: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/fg22_agroforestry_startingpaper_2017_en.pdf

FAO, 2017. *Agroforestry.* [Online] Available at: http://www.fao.org/forestry/agroforestry/en/

FCRN, 2013. *Perspectives on agroforestry as a model for sustainable intensification of agriculture.* [online] Available at: https://www.fcrn.org.uk/interviews/perspectives-agroforestry-model-sustainable-intensification-agriculture

García de Jalón, S., Burgess, P.J., Graves, A. *et. al.*. *Agroforest Syst* (2018) 92: 829. https://doi.org/10.1007/s10457-017-0116-3

GIZ, 2017. *Agroforestry business models. Investment opportunities in Costa Rica.* [online] Available at: https://www.uniquelanduse.de/images/publications/vereinheitlicht/Agroforestry_business_models_Costa_Rica_EN_web.pdf

Groot, E. and Veen, E., 2017. *Food Forests: An upcoming phenomenon in the Netherlands*. [online] Available at: https://www.ruaf.org/sites/default/files/RUAF-UAM%2033_WEB_34-36.pdf.

Hannachi et al, 2017. *EIP-AGRI Focus Group Agroforestry MINIPAPER 1: Organising added value of agroforestry.* [online] Available at: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/fg22_mp1_organising_added_value_2017_en.pdf

Kaplinsky, R. and Morris, M. 2001. A handbook of Value Chain Research.

Kay *et. al.*., 2019. *Agroforestry is paying off – Economic evaluation of ecosystem services in European landscapes with and without agroforestry systems*. [online] Available at: https://doi.org/10.1016/j.ecoser.2019.100896

Limareva, A., Bentvelzen, L.W.J., Valent, A.P.M., Baken, A., Foodforestry Netherlands & Hogeschool Van Hall Larenstein 2014, *Ecological principles in natural temperate forest ecosystems relevant for productive food forests: lessons learned from food forest Ketelbroek, the Netherlands,* , Leeuwarden.

Liu, S. 2015. *Business Characteristics and Business Model Classification in Urban Agriculture.* [online] Available at: http://edepot.wur.nl/343326

Lundy *et. al.*, 2014. *LINK methodology: A participatory guide to business models that link smallholders to markets.* Cali, CO : Centro Internacional de Agricultura Tropical (CIAT)

Massa, L., C. L. Tucci, and A. Afuah. 2017. *"A Critical Assessment of Business Model Research."* Academy of Management Annals 11 (1): 73–104. [online] Available at: https://doi.org/10.5465/annals.2014.0072

Mosquera-Losada, M., *et. al.*, 2016. AGFORWARD. *Extent and Success of Current Policy Measures to Promote Agroforestry across Europe*. [online] Available at: http://www.eurafagroforestry.eu/action/policy/Eligibility_of_agroforestry_parcels_for_CAP_basic_payments

Mosquera-Losada, M., *et. al.*, 2017. AGFORWARD. *How can policy support the uptake of agroforestry in Europe*? [online] Available at: http://www.eurafagroforestry.eu/action/policy/Eligibility_of_agroforestry_parcels_for_CAP_basic_payments

Mosquera-Losada, M.R., McAdam J., Romero-Franco, R., Santiago-Freijanes, J.J., Riguero-Rodríquez A. (2009). *Definitions and components of agroforestry practices in Europe*. In: RigueiroRodríguez, A., McAdam, J., Mosquera-Losada, M. (eds) *Agroforestry in Europe: current status and prospects*. Springer Science + Business Media B.V., Dordrecht, p. 3-19.

Nerlich, K., Graeff-Ho¨nninger, S., Claupein, W., 2012, *Agroforestry in Europe: a review of the disappearance of traditional systems and development of modern agroforestry practices, with emphasis on experiences in Germany.* [online] Available at: https://link.springer.com/article/10.1007/s10457-012-9560-2

Osterwalder, A and Pigneur, Y. 2010. *Business Model Generation. A Handbook for Visionaries, Game Changers, and Challengers.* [online] Available at: https://www.skipr.nl/wosmedia/10309/business_model_generation_summary.pdf

Oosterbaan, A. & Kuiters, A.T. 2014. *Agroforestry in the Netherlands | EURAF*. [online] Available at: http://www.eurafagroforestry.eu/countries/netherlands/Agroforestry_in_netherlands

Palma, J., ¨ Graves, A.R., Burgess, P.J., Van der Werf, W., Herzog, F. 2007. *Integrating environmental and economic performance to assess modern silvoarable agroforestry in Europe*. [online] Available at: https://doi.org/10.1016/j.ecolecon.2007.01.011

Prins, E. 2017. *Exploring the potential of agroforestry integration in arable and dairy farms in The Netherlands – an ex-ante assessment at field and farm level*. [online] Available at: edepot.wur.nl/416387

Sparviero, S. 2019. *The Case for a Socially Oriented Business Model Canvas: The Social Enterprise Model Canvas.* Journal of Social Entrepreneurship. Volume 10, 2019 - Issue 2.[online] Available at: https://www.tandfonline.com/doi/full/10.1080/19420676.2018.1541011

Stenn, T. L. 2017. *Social Entrepreneurship As Sustainable Development*. Cham: Springer International Publishing. [online] Available at: https://doi.org/10.1007/978-3-319-48060-2

Torralba, M., Fagerholm, N., Burgess, P.J., Moreno, G., and Plieninger, T., 2016. *Do European agroforestry systems enhance biodiversity and ecosystem services? A meta-analysis*. [online] Available at: https://doi.org/10.1016/j.agee.2016.06.002