

THE POTENTIAL OF PERMACULTURE PRINCIPLES IN THE AGRIFOOD TRANSITION



Analysing the values and opportunities of Dutch 'food forest' business models

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Prologue

Permanent Agriculture

As western European agriculture students in the year 2017, the first three authors of this report live in a world that reaps the full benefits of the successes of industrial agriculture. We do not grow our own food; in fact we grew up having nothing to do with food production. We have never experienced hunger and have no idea what food insecurity feels like. We cannot even imagine supermarkets ever running out of anything. Our situation is uniquely luxurious. Thanks for that, and good job everyone!

Through this unprecedented situation of abundance and stability, we have the luxurious position to be able to look at the existing systems surrounding us, not from a perspective of need, but from one of purpose. And as students of agriculture, we wonder what the purpose of it actually is. Does agriculture only serve to satisfy our need to eat, or does it encompass more functions?

The Industrial Revolution, amongst other things, has provided most of the world with sufficient, safe food. Even more than enough, in many developed places. Too little of it in other places, but most agree: we are producing enough food to feed every human being on earth. It is the practice of politics and international trade that function unfavourably for some.

What then, is the obvious direction for our generation to turn to? The distribution of wealth seems to be open to improvement, and the magic word of our time is sustainability, a term that cannot be looked at in a singular manner; it does not only mean a secure food supply and stable incomes, but refers to a system as a whole. A sustainable agricultural system, embedded in sustainable cultural systems - that is the direction we want to turn to.

Studying agriculture in the 21st century means to learn to understand the ingenious systems behind our abundance of food, but it also means to learn of the negative outcomes, as they are part of the deal. This perspective of accepting the downsides made sense when looking from a position of needing to produce more food, which was the case a generation ago. It makes less sense from a position of abundance of food, and one of stability, which is the perspective us "Millennials" enjoy.

Future agriculturists are likely to realise that they are able to give more than food. Multiple elements, relationships and functions make up farms and embed them in their surroundings, interlinking of which could enable sustainability while delivering abundant value. The food system needs to continue changing along with a changing society and take the next step: learn to generate not only the abundance we so value, but to generate it sustainably while delivering purpose to those involved.

We report on a research project about permanent agriculture, carried out over the course of 20 weeks, supported by the HAS Research Group "New Business Models for Agrifood transition" and the Staay Food Group. It was initiated in order to enrich the knowledge base about permaculture and related business models, as well as their potential for agrifood transition.

The process was guided by three lecturers of the HAS University of Applied Sciences: Jos Wesselink, Carla Schonenberg and Erwin Bouwmans, to whom we want to express our gratitude for their mindful guidance and cheerful support.

Executive summary

The current western agrifood system is highly successful in providing for human needs. However, the dominant agricultural approach of up-scaling and specialisation is put under pressure by a number of developments in the global landscape. Global developments such as population growth, pollution, soil degradation and climate change, in which agriculture plays a crucial role, make the need for a transition towards a paradigm with a broader range of values evident.

Niche initiatives often develop as a reaction to needs not fulfilled by the regime. Therefore, certain niches may have the potential of driving a necessary transition. This research aims to determine if permaculture, being a niche, has this potential.

The main question for this research was formulated as follows:

How can a production system based on permaculture principles contribute to the agrifood transition?

To answer this question, relevant current trends and global developments were used as a basis for developing a future scenario. Empirical qualitative data on permaculture businesses in the Netherlands was gathered as well, of which the results were used for a determination of permaculture's performance in this future scenario. This was done by comparing a standardised permaculture system with a conventional potato system. As a result of this comparison, the Unique Selling Points of permaculture were identified, which determine the future potential of permaculture. Below, these topics are summarised:

Global developments and trends

Several global developments, consumer trends and related sector trends were identified as drivers for agrifood transition. These include:

- Global trends:
 - A changing demography
 - Climate change
 - Degradation of land and biodiversity
 - Institutional attention for sustainability
- Consumer trends:
 - Attention for sustainability
 - Convenience for individuals
 - More informed and conscious lifestyles; self-actualization through food
- Related sector trends:
 - Continuation of large-scale, intensive agriculture
 - Automation and robotisation
 - Move towards more sustainable practices
 - New business models (e.g. local for local; short supply chains)
 - Increased importance of communication of sustainability
 - New relations and interdisciplinary approaches

The abovementioned consumer trends show an increased awareness and accordingly an increased realization of responsibility. Simultaneously, some trends appear to be oppositions (e.g. using food as means of personal identification and preferring convenience food).

Agrifood in 2037

The further development of the abovementioned trends in the coming 20 years is expected to lead the agrifood sector to a scenario in which being independent of or resilient to the weather, as well as independence from external inputs, plays a major factor. Also, the image of a will be of high importance, as awareness of impacts of production and consumption choices grows. Two general paths in dealing with these demands can be distinguished: food systems either tend towards finding high-tech solutions to ensure sustainability or opt for agro-ecological approaches.

In the perspective of this research, the high-tech approach can be regarded as a continuation of the 'old paradigm', an account of how the regime may develop and adapt in the future, whereas the agro-ecological approach represents a growth of niches like permaculture.

Permaculture

Permaculture is an agricultural approach that is based on three ethics:

- Earth care
- People care
- Fair share

Additionally, permaculture enterprises base their structure on twelve principles, which, in agriculture, results in production systems which mimic ecosystems. This leads to diverse and highly integrated systems which are mostly perennial. Creating social and ecological values is inherent to such permaculture systems due to the ethics and principles. Accordingly, activities on permaculture farms are not only related to food production, but also to nature restoration and management, social involvement, knowledge creation and sharing as well as local economy and community building.

Gathered qualitative data concerning the business models of permaculture in the Netherlands (mostly operating as *food forests*), shows that all the initiatives share great valorisation for ecological aspects and reflect inherent valorisation of the permaculture ethics. The flexibility of permaculture business models is illustrated by the fact that up to twelve archetypes can result from applying the permaculture principles, two of which were observed within farms analysed in this research. One of the archetypes places strong emphasis on production, the other on creation of social values.

- **The social model:** emphasises social values, e.g. by providing recreation or education
- **The productive model:** main focus lies on producing and selling food

These two business models represent both sides of an observable gradient of focus amongst the business models, which attach different levels of importance on different values, suitable to the local circumstances. The ability of the system to provide the values that are in growing demand makes it suited to respond to future developments, rendering the system uniquely transformative.

Future performance of permaculture

Based on parameters related to the environment and social as well as technological developments, a comparison of permaculture with conventional production of potato shows that, within the context of a future scenario, the following Unique Selling Points of permaculture are likely to be of relevance:

- **Ecological**
 - Use and provision of ecosystem services benefitting soil, water, air and biodiversity

- Independence of limited resources
- **Social**
 - Attractive recreational space and beneficial health effects of green environments
 - Direct personal involvement possible, resulting in transparency (trust)
 - Landscape stewardship and food production can be achieved simultaneously
 - High health benefits of residue-free produce
- **Production system**
 - System resilience to bioclimatic extremes creating resilience of farm livelihoods
 - Flexible and adaptable to local circumstances and short, local supply chains
 - Applicable in locations unfit for conventional agriculture

Permaculture in a corporate context

The transitional properties of permaculture are not limited to the existing business models which are mainly based on traditional permaculture. Instead, permaculture, or aspects of it, could be adopted within a corporate context, both giving extra perspective to permaculture applications, and to new possibilities for conventional production systems.

Traditional permaculture has the potential to be used as a way of producing in a corporate context if certain requirements are met. Firstly, the predictability of yield and production schedule has to be researched further, lowering the uncertainty for these factors. Secondly, supermarkets will have to make moves towards being lenient towards the less predictable production system, as long as the products make them willing to compensate. This is unlikely to be the case presently, however it is likely that in the future the qualities of products that permaculture can offer will be of increased importance.

It is highly recommendable for farmers to transition to a production system incorporating permaculture or agro-ecological principles in order to guarantee their own income in the long run, and to contribute to sustainable agrifood systems with associated products and lifestyles that are healthy and ethically sound. Bioclimatic changes and shifting consumer demands create a need for change, and cross-pollination can enable permaculture principles to offer solutions in a corporate context.

General conclusions

Due to its diversity and inherent social and ecological values, permaculture is expected to be able to respond well to future bioclimatic conditions and consumer demands, which conventional systems are less likely to excel in. The underlying ethics and principles foster resilience and flexibility and can be applied in any system, permaculture or not.

Permaculture principles are therefore expected to contribute to the agrifood transition by creating values that respond flexibly to future developments, and by providing options to the conventional system to adopt a broader sense of value. Social values especially will be the deciding factor of a permaculture systems' performance, and is the key strength with at its core permaculture principles.

The permaculture principles are not adhered to dogmatically, but represent a way of thinking inherent in permaculture farmers driven by intrinsic motivation. It is this different mind-set that allows permaculture principles to be expressed in a multitude of beneficial values.

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Introduction

Everything is changing. The world continuously evolves, and with it do our human cultures. In the 21st century, this change is occurring and accelerating at an unprecedented pace. We live differently, consume, behave, decide and think differently than the generations before us have. And our constantly evolving lives and minds have constantly changing effects on the rest of the world.

Never before has humanity experienced an abundance of food, material possessions and possibilities as at the present time. And never before has humanity left so heavy a footprint on Earth's ecological resources. We are overusing almost every limited resource at our disposal, depleting stocks of fossil fuels, minerals and groundwater, to fuel an unsustainable, linear economy.

Agriculture is the sector that perhaps has the closest connection to nature – and today it is one of the sectors that has the most degrading effect on the very nature that it originates from. The degradation of elements like forest cover, clean water, living soils and biodiversity leads to a loss of ecosystem functions that include valuable services for us, like the sequestration of carbon from the atmosphere, water cycling and refilling of aquifers,¹ soil fertilization, resilience and genetic diversity. In turn, this degradation may come to threaten the future of agriculture.

Researchers, CEOs, teachers, students, governments and consumers are becoming aware of the impact our societal and economic choices have, and many begin to realise the responsibility we share. FAO Director-General José Graziano da Silva described it to as follows: “We cannot rely on an input intensive model to increase production and [...] the solutions of the past have shown their limits.” He calls for a “paradigm shift” and stresses the most urgent challenges of today: “to lower the use of agricultural inputs, especially water and chemicals, in order to put agriculture, forestry and fisheries on a more sustainable and productive long-term path” (FAO, 2014).

In essence, the agricultural system is at a crossroads. A transition is required, a paradigm shift, as da Silva put it, in order to protect the remaining functionality of existing ecosystems and safeguard the future sustainability of food, fuel and fibre production. But the transition may take various shapes, may come via various pathways. It is tempting to “rely on the intensive model to increase production” (Silva, 2014). Indeed, intensive solutions to increase yields will continue be sought. But alternative approaches of more nature-inclusive agriculture suggest a different perspective on food production, which does not aim at maximising production only, but which aim at maximising value creation in multiple areas, including the social and ecological ones.

Minimising input requirements and viewing ecological sustainability as the foundation of the activities, such alternative approaches are promising and their potential for the social and ecological domains is vast. But can necessary production volumes and stakeholder values be obtained through low-input, nature-inclusive agriculture? For this research, permaculture was selected as an example of such a low-input approach to agriculture, and in the course of this report, the potential of the permaculture principles in today's agricultural transition will be analysed.

Permaculture is an approach for designing and maintaining productive agricultural systems which have the diversity, stability and resilience of natural ecosystems. This is achieved by growing a

¹ Aquifer: geological underground formations capable of yielding a significant amount of water to a drinking water well or spring. Loss of the ecosystem function of refilling of aquifers refers to ground water depletion.

diversity of edible crops, usually including perennials and trees, and maintaining a number of other farm functions (such as educational/recreational functions or animal husbandry). The purposeful design of such an environment takes into account the beneficial attributes of each element, thus creating a mutually-supportive, self-sufficient system (PermacultuurNederland, 2017).

Permaculture is promoted as an ethical and holistic approach to the human culture as a whole and to agriculture in particular, embracing and strengthening the farm-ecosystem while generating healthy agricultural outputs as well as social and ecological benefits.

Currently, the approach is mainly applied on comparatively small scales in the Netherlands. Outside of Europe, some permaculture farms are operating on larger scales and with more professional business perspectives. In the region² of the Netherlands, however, no large-scale professional examples can be found at the time of writing.³ The theoretical potential of the approach may be vast, but to separate idealistic thinking from reality, the main research question for this assignment aims to analyse its actual potential, by asking:

**How can a production system based on permaculture principles
contribute to agrifood transition?**

² Within this report, the meaning of the words region(al) and local is defined as follows:

Regional: referring to a country

Local: referring to the direct environment (e.g. of a farm), being an estimated radius of 25km.

³ There are however plans for serious initiatives, which span dozens of hectares. They are often partly initiated by governments, who want to explore the possibility of commercial food forest systems, or recognize the values present in these systems.

Reader's guide

Chapter 1 introduces the multi-level perspective (MLP) in the context of (agricultural) transitions. Transitions theory serves as a framework for the reasoning of this paper. We use the MLP to identify current trends in the dynamics of the agrifood system. Furthermore, it introduces the transformative business model concept that we use to analyse permaculture business models. In addition, an outline of the issues of the conventional agricultural approach is given, illustrating the requirement for a transition.

Chapter 2 elaborates on the topic of permaculture.

Chapter 3 introduces our research methods – future exploration business model analysis and business model comparison.

Chapter 4 describes a tentative future pathway towards agrifood transition in the year 2037. Chapter 4 introduces the permaculture approach, giving background information on its origin and history, its purpose and status today.

The subsequent Chapter 5 reports on the empirical about the business model of permaculture farms in the Netherlands.

Chapter 6 gives a tentative performance comparison between conventional potato production and permaculture, given the future pathway described in Chapter 3. We use this comparison to identify unique selling points of permaculture.

Chapter 7 discusses the possibilities of using permaculture principles in a corporate context.

The final Chapter broadly discusses the potential impacts that might result from a changing societal landscape, after which some recommendations are made for further research. The subsequent Epilogue gives an impression of the authors' stance on the topic and offers a big picture perspective on the implications of social developments the findings of the research.

1. Transitions

The first section of this chapter introduces transition science, pointing out the multi-level perspective through which dynamic transition processes can be understood. It answers the question of why transitions exist and why it is valuable to look at their theory in the first place, followed by an account of what characterises transitions by looking at the example of organic agriculture.

The second section of this chapter focuses on today's on-going agrifood transition, beginning by pointing out some global tendencies and drivers of contemporary developments to illustrate the overall direction of today's transition. To be more concrete with regards to these developments, relevant modern trends as perceived by the clients of this research were included in this section.

1.1. Transitions

Many of the world's most urgent problems can only be solved through fundamental change in the systems that sustain them (Rotmans, Kemp, & Van Asselt, 2001). Transitions can best be described as large, but slow, societal changes, where the functions of a certain system will be fulfilled in a different manner than before, or new functions are required for the same system (Rotmans, Kemp, & Van Asselt, 2001). In transitions, modern society not only evolves in social terms but also co-evolves with technological and ecological developments. Transitions are said to be 'socio-technical' in nature, and new socio-technical configurations are the outcome of such transitions (Berkhout, Smith, & Stirling, 2003).

For the agricultural sector, transition means that practices change and that new ways of meeting the need for food, fuel and fibre develop. Transition scholars have made valuable contributions to the knowledge of the challenges and opportunities for achieving sustainable development. At this point, and in view of the vast challenges pointed out in the introduction, this knowledge is of great importance: The need for a transition towards a aims to move towards sustainable practices and explore the extent and possibilities of sustainability is now widely recognised, and the urgency to identify the best course for such transition as soon as possible is becoming apparent.

1.1.1. Multi-level perspective

The multi-level perspective (MLP) is a commonly used framework to study the potential and urgency for transitions (Figure 1). The MLP distinguishes three levels that can be identified in a societal system such as the agrifood system: The landscape (macro-level), the regime (meso-level) and the niches (micro-level).

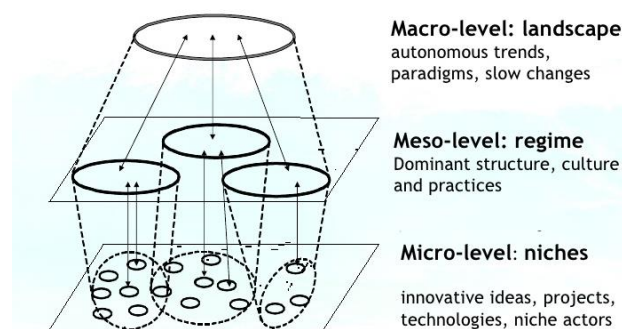


Figure 1 – Transition levels Invalid source specified.

1.1.2. Regime, landscape, niche

The *regime* is that which is most prevalent and accepted today. It describes which structures, practices and culture in a system are most dominant, and what has most control in the current system. The regime operates within a broader socio-technical *landscape*, which determines how effectively the regime can function. The landscape includes both societal trends and ecological developments (Geels F., 2002). Landscape developments can cause pressure on the regime; they can undermine its sustainability. These developments may serve as a basis for the development of *niches*. Niches are variations or innovations that are too different from the current regime to develop within the regime, and are often radically different from it (Geels F., 2002).

1.1.3. The role of niches

Niche initiatives often develop as a reaction to needs not fulfilled by the regime, or threats to the regime and idealism can be observed among many actors in niches. Niches often include small enterprises that focus on specialty products or products that are relatively expensive. This, in combination with other factors, makes it difficult for niches to compete at cost price level with the regime. Some niche initiatives enjoy the support of potential future stakeholders, others do not. From this point, a number of situations can develop. Some lead to the disappearance of the niche. Others lead to growing attention for the niche, which may result in a niche becoming part of the regime, or a complete transformation of the regime (Ten Pierick & van Mil, 2009).

Organic agriculture – A niche example

The development and progression of organic agriculture is an example for an agricultural transition induced by a niche. The movement already existed as a niche in the first half of the 20th century, spearheaded by ideologists and for example the Swiss anthroposophist Rudolf Steiner with his philosophical perspective on biological-dynamic farming. At the end of World War II, organic agriculture did not receive much further attention, as it did not fit into the emerging paradigm of substantial economic growth through the application of new technologies.

It was the alternative youth counter-culture of the 70s that was attracted to the approach on a wider scale. As a result of the increased interest in organics, scientists and politicians became interested in the niche, founded organic research institutes, formulated best practices based on the experiences of early pioneers, and made knowledge widely accessible. Still small, the organic niche slowly gained more widespread attention throughout the 80s, when the first organic farmers association was founded in Switzerland, still seen as a group of outsiders at that time (Geels, Elzen, & Green, 2004).

Only when the first large conventional stakeholders became interested in the approach did the actual success story of organic crystallise. Towards the 90s, the supermarket chain Migros for instance developed an integrated programme for agricultural production related to the organic standards of reduced input of chemicals and integration of ecological aspects (Geels, Elzen, & Green, 2004).

Certain drastic changes on the landscape took place during this period, paving the way for the breakthrough of the niche. The Chernobyl disaster of '86 for instance was a major incident that began to shake the trust in the safety of modern technology (Lochard, 1996). In central Europe, another industrial accident led to the release of poisonous substances into the Rhine river.

Public reaction to these incidents accumulated to become a landscape development: Actors who had previously upheld the regime-paradigm began to change their mind, and it was soon clear that at least part of the western European population no longer wanted to support a kind of agriculture that caused ecological issues. Scientists of the time went so far as to say that “the long-term social contract between the population and the farmers began to fall apart” (Geels F. , Socio-technical transitions to sustainability, 2013), attesting for a macro-change in societal values.

With this, the stage was set for the niche to “grow up”. Larger producers and retailers picked up on the new organic market and increasing demand, and policies were established throughout the EU that formalised organic production and introduced compensations for ecological contributions, like the Brundtland Commission in 1987 (Brundtland, 1987; Klemmensen, 2007). The organic movement had found its place – and the rest is history.

This analysis of the circumstances that led to the breakthrough of the organic niche is an important example of the nature of transitions: They are not the result of isolated incidences, but take place through the accumulation of various factors and developments on multiple levels. Pressure on the regime accumulates through several changes and events on the landscape level, leading to an incremental shift in perception and ultimately to a new socio-technological regime (Geels, Elzen, & Green, 2004; Geels, Socio-technical transitions to sustainability, 2013).

1.1.4. Transformative Business Models

The emergence of a business model can be seen as a major step in the maturation of niche. For this reason, there is an increasing interest in new business models among transition scholars. However, a transition-oriented business model concept appears to be lacking so far.

Traditional, generic frameworks for describing business models, such as Osterwalder’s ‘business model canvas’ (Osterwalder, 2004), fail to give insights in the particular capabilities that niches have for transformative change, as they only recognise economical values, have a limited perspective on relevant stakeholders and pay too little attention to the changing societal and physical environment of a business, which, from a transition perspective, are in perpetual motion (Beers, 2016).

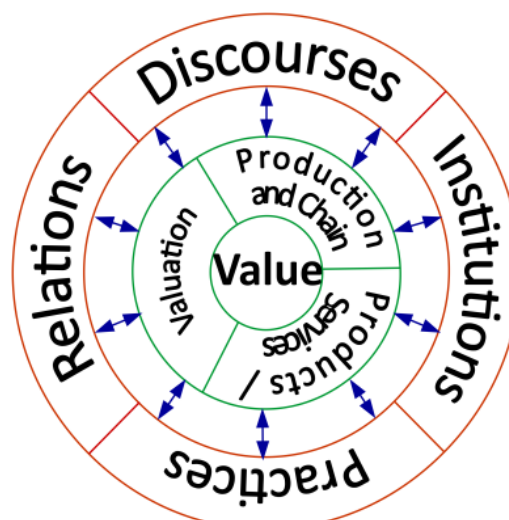


Figure 2 – Transformative Business Model (Beers, 2016)

As is shown in Figure 2, the TBM framework places values in a central position for analysing business models. Values are seen here in a broader sense than economic value, encompassing also environmental and social ones. Not only positive values are important, but negative value may need to be addressed as well (e.g. externalised costs) (Beers, 2016). Additionally, transitions can be seen as a change in what is valuable, or what can be monetised. This completes the perspective of the TBM and it triggers long-term thinking regarding for instance what could be monetised in the future.

In this report, we use a transformative business model framework (see Figure 2; Beers, 2016) to analyse the transition potential of the permaculture niche. The transformative business model concept places values in a central position. Values are seen here in a broader sense than economic values, encompassing also social and environmental values. The values are embedded in and carried out through the key activities of the businesses, being products & services, production and chain organisation and valuation model. Additionally, for a business to be able to perform in a transitioning environment, it must respond to changes in its societal and physical environment. This is assessed based on changes in the domains shown in the outer circle of Figure 2: discourses, practices, relations and institutions.

1.2. The current agrifood transition

The situation of the 21st century is unique in view of the pressing issues and vast consequences those issues could have if they remain unattended. Up to this point, agriculture's main contributions have been maximum food production based on dwindling resources, but it also compromised resource sustainability and ecological diversity. Today's transition calls for agriculture to become an agent of sustainable land stewardship instead. The development of a sustainable society based on sustainable production systems lies at the heart of the agrifood transition.

1.2.1. Pressure on the regime

The current food regime can be characterised as agro-industrial, focused on large scales and bulk production. With up-scaling comes specialisation on a limited number of crops, large yields of which are enabled by mechanisation and intensification, delivering safe and affordable food. But the approach has also led to a stark compartmentalisation of the agrifood system. Separation exists between specialisations in different fields, and clear distinctions are made between nature and agriculture, rural and urban, conventional and alternative and between producers and consumers (Marsden & Morley, 2014).

Food safety and sustainability are aimed to be guaranteed by adherence to guidelines, policies and certification. Large amounts of uniform products moved through large-scale international trading systems are the signature of the conventional approach. Food waste is an issue: one third of all food produced for human consumption is never consumed by people (Cederberg & Sonesson, 2011).

The abundant yields and intensive production do not come without consequences. Agrochemicals and emissions reach ground water bodies, reside on products and accelerate climate change. Pollution by agriculture itself is enhanced by pollution of related industries, and in the long run, many of those factors impact human and ecosystem health. Related costs remain unpaid for by the system which initially caused the conditions leading to them (Beers, 2016).

In this complex system, it is difficult to pinpoint where responsibility for important aspects such as food safety and environmental impacts lie: Responsibilities are spread out through supply chains,

making it hard for policy makers to create and enforce effective policies.⁴ Due to the aforementioned compartmentalisation, policies often focus on a single aspect of the system, obscuring the relationships between the elements of the system, like environmental and human health. Additionally, the meaning of sustainability is obscured by increasingly being used as a marketing term (Marsden & Morley, 2014).

The continuation of the contemporary agrifood regime may be more and more difficult, given current landscape developments. It may increasingly be confronted by resource depletion, soil degradation, changed climate and insecure farmers. Societal voices increasingly demand for sustainability, putting pressure on governments to address this with policies, and on the agrifood system to become sustainable.

1.2.2. Transformation in the regime

In terms of the agricultural transition of the 21st century, an increasing demand for solutions offers opportunities for niches to grow. Permaculture is at a stage where it is moving away from its grass-roots origins, and is viewed as a way of thinking that offers practical solutions for real-world problems. In MLP terms, it can be seen as a developing niche.

The inception of permaculture took place in the 70s when Bill Mollison published the first book with the title *Permaculture One* (Mollison, 1978); by now, the message has spread around the world, and as external pressures for change increase, more and more people follow the message of permaculture. With its growing support and the continued showcasing the successes of permaculture principles, permaculture approaches are increasingly fit to accrue market value as a next step of its niche development.

1.3. Today's trends

We have argued why today's transition is on the way and what its driving forces are. The following paragraphs give an account of how this transition may take form. A number of landscape trends have developed that aim at creating resilience and sustainable alternatives, while other, and partially opposing trends, can be observed, as well. Within the trends, three categories are distinguished: global, consumer and sector trends.

1.3.1. Global trends

- *Changing demography*

By 2030, three billion people in Asia and Africa will have risen to the middle class, increasing the demand for higher quality and different products (McKinsey & Company, 2013). These **rising living standards** in developing countries are associated with **urbanisation and population growth**.

⁴ This is reflected in the organization of the Dutch ministries. There are separate ministries dealing with the environment and public health, making it difficult to create policies that are aligned with one another. The ministries for agriculture and economic affairs have been merged, risking conflicting policies between health, environment and economic motivation. The Dutch climate policies are weak compared to its EU counterparts as a result (Beers, 2016). This conflict can also be observed in the competition for space in the Netherlands. Due to both its high density in population and in agricultural activity, there is a competition for land to be used either for agricultural or for societal needs (Fischer, Beers, Jacobsen, & van Trijp, 2011).

The number of **international migrants** worldwide is rapidly growing. In 2015, 3,3 per cent of the global population were migrants, which is a 41% increase compared to 2000. People migrate towards Europe or Asia, and most migrants are born in Asia. Social and political unrest also cause an increase in refugees, contributing 8% to the total amount of migrants of 244 million (UN, 2015).

- *Climate change*

Agriculture increasingly faces periods of drought and flooding, **unpredictable weather patterns**, heat extremes and loss of arable land (Agri-footprint, 2015). In the Netherlands, the effect can be witnessed as heat extremes, milder winters, more frequent **droughts and floods** (PBL&KNMI, 2015), as well as colder springs with later spring frosts (HLN, 2017).

- *Degradation of soil and biodiversity*

Worldwide, **soil health is declining** due to suboptimal management of arable land.⁵ In 2012, 20% of land on earth was considered degraded, and an additional 12 million hectares are eroded each year (IPES-Food, 2016). Loss of diversity in agricultural systems paired with loss of natural habitat leads to an accelerated **loss of biodiversity** around the world (PAR & FAO, 2010).

- *Institutional responsibility*

As a response to these developments, the topic of sustainability is gaining more and more attention. Globally, concerns are rising climate change, biodiversity loss and population growth. The current energy transition towards renewable sources is an example of this development (US Energy Information Administration, 2017). And the FAO, for instance, acknowledges the need for sustainable development and states that ‘the sustainable management and utilisation of natural resources, including land, water, air, climate and genetic resources’ as one of their main goals (FAO, 2017).

1.3.2. Consumer trends

- *Attention for sustainability*

Discourses on climate change, sustainability and health care are reflected in western consumers’ preferences. An increased awareness of issues like health or the environment is leading to a greater **appreciation of sustainable products**. Simultaneously, the generation of Millennials is coming of age, shifting the profile of consumer characteristics. A large segment of young people is more conscious, innovative and concerned about the state of affairs, while being more assertive and eager to realise positive impact with their lives, especially related to food (Barton, 2012).

A growing interest in **local food** can be observed: consumers are more interested in and critical about the origin of their food. They are also becoming more knowledgeable on what was necessary for their food to be produced and how their consumption pattern is influencing the world around them (Beers, 2016). **Residue-free and “free from” products** are gaining larger market shares: organic sales in Dutch supermarkets grew by 17,3% in the first half of 2016 (Meredith & Willer, 2016). A new international study by Unilever reveals that a third of consumers (33%) are now choosing to buy from brands they believe are **doing social or environmental good** (Unilever, 2017).

⁵ Factors include: land use changes like deforestation; exposure of bare soil to the elements; compaction of soils by heavy machinery and subsequent tilling and deep-tilling; use of agrochemicals and irrigation.

Not only food is on the consumers' sustainability radar, but topics like green energy are gaining importance as well: a study showed that consumers want more renewable energy (Vestas, 2011).

- *Convenience for individuals*

A development towards **convenience food** related to an increasing **individualisation** in consumer behaviour can be observed. Rather than having meals with their families at set times, people tend to eat on-the-go and at times that are convenient for them. The convenience trend includes **ready-to-eat meals**, increasing **online food purchases** and **home deliveries** (FoodService Instituut, 2015).

- *Lifestyles, food and health*

Worldwide, the occurrence of **lifestyle related diseases** is increasing, mostly amongst mid- and low-income populations. It is becoming common knowledge that some parts of the fast-paced modern lifestyle (e.g. stress, unhealthy diets, lack of exercise) can lead to diseases such as heart disease, obesity, and cancer (WHO, 2010).

While the above-mentioned convenience trend is indeed reflected in many consumer choices, more and more consumers are also becoming aware of the impact their diets and lifestyle choices have on their health. They have become **more knowledgeable** about nutritional values of food items. Consequently, they are making more **conscious food choices**. The rise of vegetarianism in western Europe is an example: fruit and vegetables are 'hot' and many consumers are consciously increasing their intake of whole, organic, seasonal foods for health and sustainability reasons. Buying food from a local source is increasingly preferred as well (Satran, 2012).

In addition to the increased awareness concerning diets and health, food is also becoming more important as a **recreational activity** (cooking; trying new things; eating out) and a means of **personal identification** (Sloan, 2015). This is an extension of the trend 'from product to solution', where consumers do not want food, but they want taste, nutrition, and a meaningful eating experience.

1.3.3. Related sectoral trends

- *Large-scale, intensive agriculture*

The agro-industrial food regime is the dominant system in the West, and developing nations are generally adopting the model. The trend of **up-scaling** paired with **intensification** remains inherent to the sector in order to fulfil the resource demands of a growing and increasingly urban world population. Intensification can be achieved through e.g. reduction of inputs like labour, developing crops that have higher productivity, and developing pesticides that better manage pests and their resistance.

- *Automation and robotisation*

Through technological innovations, **automating processes** is one of the most effective ways to **reduce labour requirements**, and is becoming increasingly efficient. Such innovations apply to all parts of the chain, minimising labour costs and improving working efficiency (De Wilde, 2016).

An example is the rise of **indoor farming**: Full control is achieved by growing crops on substrate in indoor environments with regulated climate and lighting. Most of the processes involved are

automated: From sowing, irrigation and fertilization until harvesting. This not only reduces labour requirements, but also **minimises pesticide and water use** while ensuring predictable production.

Another development of automation is the proliferation of **smart farming or precision agriculture**. Through the collection and processing of large amounts of data, farmers can manage their activities more precisely, directing inputs where they are needed most, obtaining real-time feedback and as a result, using limited resources more efficiently (Huisman & de By, 2009).

- *Sustainability*

All sector trends described include **sustainable intensification**. Indoor and smart farming, too, are methods to sustainably intensify production, as various resource requirements are reduced. Also **renewable energy** is on the rise and improves sustainability (US Energy Information Administration, 2017). The **local-for-local** trend, based on the wish for low food miles and reduced costs and emissions, is gaining importance amongst supermarkets and consumers (Satran, 2012).

- *New business models*

The **local food and convenience trends** have caused many **new business models** to appear, many of which revolve around the '**local-for-local**' ideology. Alternative sales channels, such as direct farmer-to-consumer sales, web-shops, pick-up points and food boxes are gaining popularity (Duff & Phelps, 2016), and new businesses are trying to create **shorter supply chains** in order to provide **transparency** at better prices for the producer.

An example of this is 'community supported agriculture' (CSA), a model in which a group of citizens (i.e. the community) has direct contact to farmers, contribute to financing the farming activities and take part in decision making concerning crops to be grown and practices used. Such models gain popularity and offer local and transparent food production (Hense & van Benthem, 2015).

- *Communicating sustainability (CSR+)*

Companies develop and show their sustainability initiatives via **CSR efforts** (corporate social responsibility), a well-known approach to social sustainability. Nowadays, environmental sustainability matters as well. In addition to social responsibility, efforts like planting trees, reducing waste or protecting species are increasingly common in the course of the **expansion of CSR**.⁶ Modern businesses **communicate their sustainability** to the public, improving their image⁷ and economic performance, but also sustainability awareness (Nidumolu, Prahalad, & Rangaswami, 2009).

⁶ Processors for instance are becoming more creative with their waste streams, and seek to add value and reduce waste through "**zero-waste**" initiatives such as KromKommer, Verspillingsfabriek and RotterZwam. In retail, new initiatives combine the consumers' demand for easily accessible food with their demand for healthy, sustainable products, such as the organic super market chain Odin.

⁷ **Unilever**, for example, is keen on proving its sustainability ambitions. The multinational aims to improve the health of over a billion people through more nutritious products and by improving hygienic conditions in developing countries (Unilever, 2016). Also the supermarket chain **Jumbo** shows its ambitions in for instance reducing their food waste, selling healthier products, and sourcing sustainably with regards to biodiversity and the environment (Jumbo, 2016).

- *Interdisciplinary approaches*

The search for sustainable solutions is impossible to complete in isolation, and unusual new relations develop when different actors realise this and get together to develop solutions. An increasing number of stakeholders realise that the challenges they face cannot be solved single-handedly. Greenhouse growers, for example, are developing solutions in conversation with Greenpeace and the Dutch forest and nature management institution (**Staatsbosbeheer**) **is cooperating with farmers**. New business models and supply chains are emerging through such new relations.

1.4. Conclusion

This Chapter has given an impression of the dynamics of the agricultural sector and how trends have the potential to trigger change, and even full-scale transitions, of the whole system. The need for a transition of our current system has been stressed and it was pointed out which trends and developments can already be witnessed that strive to create alternatives to the regime.

Interestingly, the trends described above show some commonalities. On most levels an increased awareness and accordingly an increased realisation of responsibility is becoming apparent. The notion seems to be gaining momentum that the ways we consume, produce and behave are not isolated phenomena, but interrelated, with world-wide impacts.

Simultaneously, some trends appear to be opposites (e.g. using especially healthy or sustainable food as personal identification versus preferring convenience food) and it will be interesting to see how these trends will shape the future.

2. Introduction to permaculture

Many of the trends described in the first Chapter speak of a rising awareness of the need to develop sustainable systems. Permaculture is a niche in today's agrifood system that responds to several of the observed trends. This Chapter serves as an introduction to the permaculture approach. In the following, its origin, definition and status in the Netherlands are described, also pointing out similar agricultural approaches that are in line with the permaculture principles.

2.1. Origin and definition

Permaculture was first described by Bill Mollison and David Holmgren in the mid-1970's as "an integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man" (Holmgren, 2002). Holmgren and Mollison studied the possible interrelations between natural ecosystems, agriculture, energy and human living, and developed an integrated approach for an agriculture and lifestyle system 'beyond sustainability' (Smith, 2012).

Over the years, permaculture was taught and adapted by a great number of people over the world. Hence, permaculture's focus has expanded to a broader perspective. A more current definition is "consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre and energy" (Holmgren, 2002). While the permaculture method was meant, and often adopted, to design and build a self-sustaining manner of life, the principles of permaculture now appear to be generalisable and are applied in many different parts of human settlements, such as urban planning and community development (Smith, 2012). In this paper, focus lies on the application of permaculture principles to agricultural activities.

2.2. Ethics and principles

The design principles of permaculture are guided by three main ethics, which resemble the People-Planet-Profit mantra nowadays, and are commonly referred to as:

Earth care - People care - Fair share (Figure 3, centre; Holmgren, 2002; Telford, 2017).

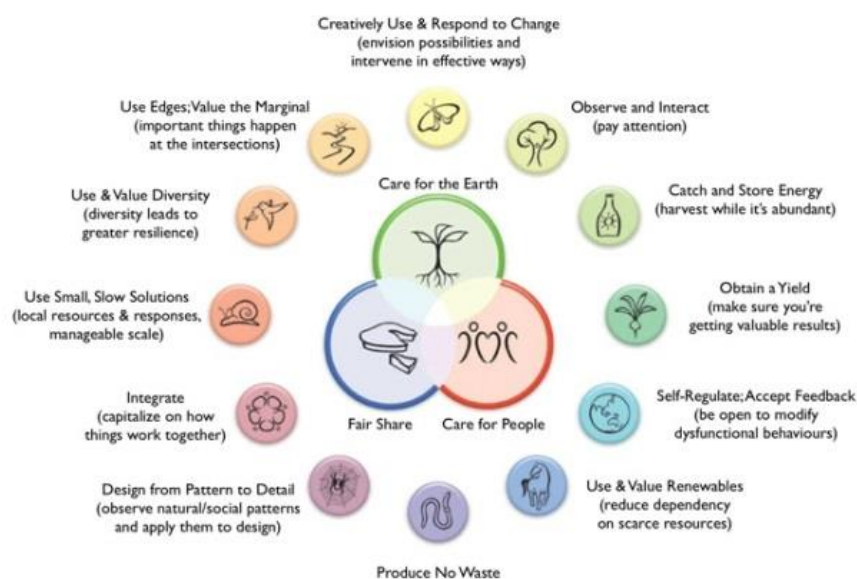


Figure 3 – Permaculture ethics (centre) and design principles (Watts Permaculture, 2014)

Based on these fundamental ethics, twelve design principles have been identified and are also shown in Figure 3, surrounding the central ethics. The design principles arise from systems thinking and, when followed, create holistically functioning systems (Permaculture Research Institute, 2014). Below, several of the principles that are referred to throughout this paper are described briefly.

- **Use and value renewable resources and services:** refers to making use of natural abundance in order to reduce consumption and dependence on non-renewable resources.
- **Produce no waste:** refers to making use of all resources available. Waste is perceived as non-existent.
- **Integrate rather than segregate:** refers to making use of interrelations between different plant, animals and other farm elements.
- **Use small, slow solutions:** refers to the slow and small-scale build-up of permaculture systems, with the underlying reason that small and slowly developing systems are easier to maintain and make better use of local resources.
- **Use and value diversity:** refers to creating diversity in order to decrease vulnerability to a number of threats, such as pests and bad weather circumstances.
- **Creatively use and respond to change:** refers to the aim to have a positive influence by observing and reacting to changes.
- **Obtain a yield:** refers to the need of obtaining immediate results in order to sustain the undertaking from the beginning

Proposed values of the approach

As a farming method, permaculture is said to create broad environmental values through incorporating various mutually supportive crops into one permanent farming system. Synergies between the different plants and farm elements lead to the reduction of most conventional input requirements (i.e. fertilizers, herbicides, pest control agents). For example, legumes are planted to provide nitrogen for other crops, and hedges are planted to provide a habitat for biological pest control agents.

A low input farming system can therefore be achieved that does not pollute land, products or surrounding water sources, but strengthens them. It creates a permanent cover of productive photosynthetic activity that protects the soil, and a permanent root system that improves beneficial soil life, fertility and water retention capacity. The permanent vegetation above and below ground also stores carbon in its biomass. Diversity is created, leading to resilience of the system in times of adversity, and an abundance of residue free organic crops can be harvested throughout the season, while genetic diversity is safeguarded.

2.3. Related approaches

Although the original literature on permaculture and most permaculture education provide specific purposeful solutions and practices, permaculture can be interpreted in many different ways, and therefore, different farming systems are possible. Other approaches to sustainable agriculture show similarities to permaculture as well. When researching permaculture, related approaches can therefore not be ignored. Approaches that are closely related to permaculture, and that could be interpreted as an expression of permaculture principles, include Food Forests or Forest Gardens, Nature-inclusive Agriculture and Agro-ecology or Agroforestry systems.

Food forests

In permaculture, the term food forest or ‘edible forest garden’ refers to a perennial production system that integrates tree crops, which needs little human management and provides harvest from various species. In the Netherlands, they are commonly called food forests (“voedselbossen”).

Layering is an important aspect of food forests, which are often have seven or more productive layers, as depicted below (Figure 4). In so doing, create a three dimensional system as opposed to conventional, two dimensional fields, which could be viewed as a natural form of vertical farming.

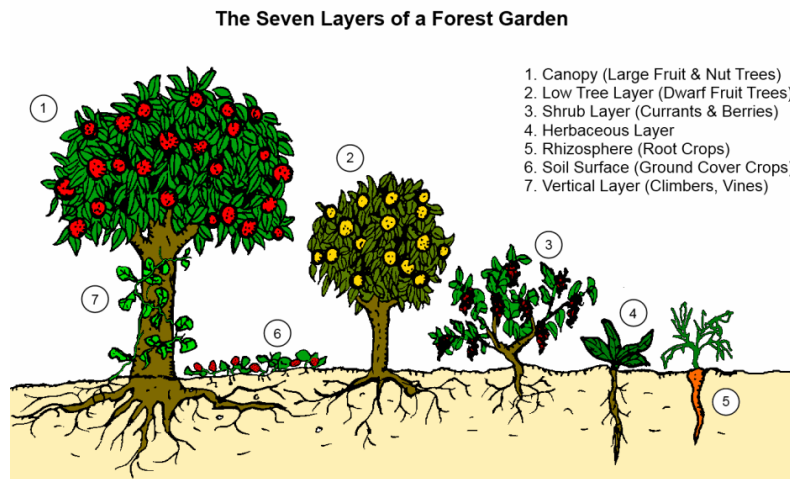


Figure 4 – Food forest layers (Permacultuur Nederland, 2014)

Vertical space is utilised through planting crops that mature in different heights, while taking into consideration the characteristics of individual crops. For example, apricot is a sun loving tree and is usually planted south of the taller nut trees, whereas shade loving crops such as potato are planted on the north side of shadow casting crops.

The research has shown that food forests in the Netherlands are becoming more common and are increasingly aiming at production (as opposed to many small, idealistic permaculture gardens); they played a major role in this research.

Nature-inclusive agriculture

In the Netherlands, the term ‘nature-inclusive’ is used to describe farming systems that in any way include management of nature and ecosystem services in their approach to food production. Nature-inclusive practices similar to permaculture practices are, for example, creating links between nature and agriculture (biological pest management), and management of on-farm nature areas.

Agroforestry/Agro-ecology

Agroforestry is “the intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits” (USDA, 2017). In the Netherlands, agroforestry is mostly adopted by livestock farmers who want to combine grazing with the production of fruits or wood (Agro-Forestry Nederland, unknown date). This approach capitalises on the mutually beneficial effects of growing fodder and perennial food production, causing a net gain in production.

2.4. Status today

Nowadays, several large-scale permaculture farming initiatives are present in Australia and on the American continent, and permaculture is adopted in sub-tropical areas for nature restoration purposes. In Europe, only very few farms are adapting large-scale permaculture as a business model. New initiatives are often undertaken by young people who want to have a societal or ecological impact, and who are committed to contributing to the agrifood transition.

In Germany, one supermarket chain has begun to make permaculture produce available to the broader public, while educating consumers about the reasons and benefits. Permaculture-branded products in the supermarket 'Real' are supplied by a professional producer in Spain, who grows a variety of organic fruits and vegetables on 50 hectares in Spain (agricultura-ecologica, 2011).

2.5. Conclusion

The permaculture approach internalises social and ecological values in food production, but also needs to be linked to innovative business models in order to shift its profile away from small scale backyard farming, and to prove its larger-scale commercial, as well as transitional potential.

Currently, this shift is slowly happening with permaculture and related approaches, however still on a comparatively small scale. More and more individuals, often young city dwellers, develop an interest in the topic and follow design courses. Many farmers begin including (some of) the permaculture principles into their enterprises, conscious or unconscious of the fact that they could call it permaculture, but expecting that the measures will improve their farm's sustainability.

Hence, a growing interest in and recognition of permaculture and related approaches can be witnessed. Simultaneously, permaculture still has wide-spread connotations with neo-hippy culture and backyard gardening. A lack of data for a business perspective forms the largest weakness of permaculture and prevents it from already playing a more impactful role in the agrifood transition.

3. Methodology

The main question guiding the research was formulated as follows:

How can a production system based on permaculture principles contribute to agrifood transition?

The study consisted of three main activities: future scenario development, business model analysis and performance comparison. The main purpose of the future scenario was to have a base of comparison for the performance of different types of agriculture. In other words, it serves as a means to compare business models now and in the future, it was not an end in and of itself in this research.

3.1. Scenario development

Existing knowledge on transition science and management, as well as input from client interviews and desk research, influential trends and developments in the global- as well as western European agrifood system were identified (see Chapter 1.3). Based on the relevant trends and the insights of transition science, a possible transition pathway to the future of the agrifood sector and consumption patterns in 2037 was developed synthesised.

Note that the resulting scenario was only developed to exhibit some level of plausibility in the light of the identified landscape developments. It did not result from a larger future exploration with multiple stakeholders. The scenario has no predictive value and only little intersubjective validity. However, it does provide a useful base of comparison for the future performance of permaculture and other types of agriculture.

3.2. Business model analysis

The status as well as the transitional potential of permaculture was studied by looking at its existing business models in the Netherlands and their performance. Empirical data was gathered through conducting eight interviews, with seven farmers and one expert in the field of institutionalisation of agrifood transitions. A permaculture expert contributed to one of the farmer interviews. All of the interviews were conducted in a semi-structured manner, took place mostly on-farm and included a farm tour. The interviews with the expert on institutionalization was conducted using the same guideline as for farmer interviews, however, for this interview the focus was placed on societal and institutional developments rather than on permaculture business models. The list of interviewees, as well as the interview guideline, can be found in Appendix I.

The interviews were audio-recorded, and for the purpose of thorough analysis they were transcribed verbatim and subsequently coded according to the following eight categories:

- Value propositions
- Products & services
- Production & chain
- Valuation
- Discourses
- Practices
- Relations
- Institutions

These categories are based on the concept of the ‘transformative business model’ as described by (Beers, 2016). Accordingly, the eight coding categories were predetermined (closed coding). Excerpts from the interview transcripts were gathered according to the eight closed categories. Next, all of the collected and coded excerpts were divided into sub-categories, which were determined based on the

content of the excerpts (open coding). Finally, these sub-categories were grouped in order to derive the main topics that the interviewees discussed for each of the eight main categories.

The result of the coding process, an overview of all relevant statements of the interviewees with relation to the topics of permaculture and transition, delivered qualitative data on the status, success factors and potential of the permaculture approach, as perceived by the interviewees. This has led to a conclusion about common types of permaculture business models in the Netherlands.

3.3. Performance comparison

To be able to determine what kind of potential the permaculture principles have in supporting the current agrifood transition, they need to be weighed against an alternative, and they need to prove their potential in a rapidly changing and highly unpredictable world. As an example of an alternative, the conventional approach to potato cultivation was chosen. A standardised example of the permaculture approach was used based a master thesis at Wageningen University on the integration of permaculture in conventional business models (Prins, 2017). These two standardised examples of a conventional versus a permaculture approach were evaluated in the light of the transition pathway and compared according critical success factors determined by the future scenario.

For this comparison, data on conventional agriculture has been gathered through desk and literature research of sources like (KWIN, 2015). Data on permaculture farming as obtained from the interview analysis has been supplemented by desk and literature research.

The outcome of the comparison led to the identification of Unique Selling Points (USPs) of permaculture, and thereby provided an indication for the contribution of permaculture principles to the agrifood transition.

To evaluate the opportunities as well as the hurdles for applying permaculture principles in a corporate environment, the standardised example of permaculture production that was used for the comparison was adjusted to better match the requirements of the agro-industrial context.

A broad discussion deals with the speculative aspects of the research, placing the findings into the bigger picture, followed by recommendations to the research group as well as suggestions to those readers interested in sustainable future food systems.

4. A future pathway from the agrifood perspective

Based on the trends described in Chapter 1.3, what follows is a future pathway for the western European context with a focus on the Netherlands. It is a story showing in which direction today's transition could be developing, and how it may take shape. This scenario will be used in a later chapter to evaluate how well the permaculture production system might perform in the future, when compared to conventional agriculture (Chapter 6).

What the future will look like is unknown; hence this scenario is inevitably faulty. But it is reasonable to assume a general direction of the transition to begin with. Transition scholars in the Netherlands have drawn up a map showing possible pathways for the agrifood transition (Figure 5).

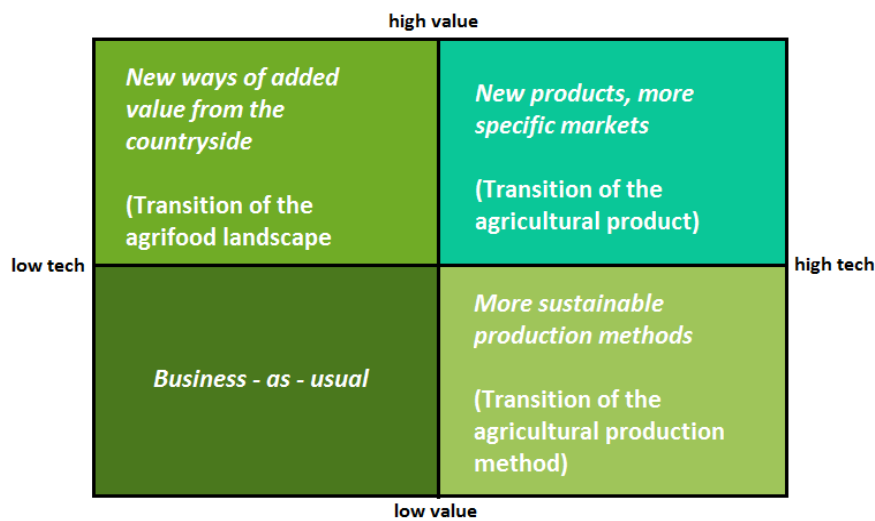


Figure 5 – Possible transition pathways (Beers, 2016)

Based on the assumption that current trends in the Netherlands will continue to develop, this future scenario focuses on developments towards two of the depicted, and distinctly different, directions. On the one hand, high-tech solutions aim at efficient production on big scales but with low added value ('Transition of the agricultural production method' in Figure 5), leading to more sustainable and cleaner food production, mainly commodities, potentially for urban environments and international trade. On the other hand, various forms of multipurpose agriculture developments point to the other direction ('Transition of the agrifood landscape' in Figure 5). Those may take on the responsibility to fulfil societal and ecological functions, like recreation, ecosystem services, and personal fulfilment.

For the scenario described below, a time span of 20 years from now has been chosen because enough time will be covered for meaningful changes to have taken place, while it is close enough to the present for the basics of societal life to not have changed unrecognisably. Furthermore, the 20 year time span puts the scenario in a time (2037) that is between the deadlines of two global agreements related to sustainable development: The UN Sustainable Development Goals, aimed at 2020, and the Paris Agreements, aimed at 2050. Therefore, change towards sustainability is expected to accelerate in the years between now and 2037, making it a period of unique transition potential.

Disclaimer

Even though this future scenario is based on agreed upon trends as described in Chapter 1, it is by no means a precise prediction of the future, and should not be considered as such. The future is too uncertain, and the current issues too controversial, to be predictable at all. That said, in order to establish critical factors for future success, and as a basis of comparison to assess the potential future performance of permaculture production systems, the proposed scenario fulfils its purpose.

4.1. Global landscape in 20 years

It is the year 2037 and the world has a range of new challenges to face. The environmental issues that have been recognised years ago were impossible to reverse within the past decades, though substantial improvements have been made. With a world population of around 9 billion, many of whom enjoy a higher standard of living, the task to fulfil the needs of all world citizens is challenging.

Through the rise of the middle class in emerging economies like India and China, there is a flood of new middle class lifestyles to be provided with resources (better food, more energy, additional services and mobility). The increased demand for additional resources is reinforced by the ‘rural exodus’ and urbanization: farming communities left the countryside as agricultural productivity, to some extent, is compromised by the changed climate. Harvest losses occur more frequently due to weather extremes and degraded soils. Growth of agro-industrial yields has plateaued in many sectors (FAO, 2017; Madre & Devuyt, 2017; Brown, 2012).⁸ Trans-boundary pests and diseases are covering previously unaffected areas and disturb traditional production patterns.

The pressure faced by the agrifood regime is critical. The global commodity market is unstable; price spikes and fluctuations are more common and food prices, especially for fresh produce, are high, leading to food insecurity and more frequent occurrences of social unrest. On the other hand, cooperation between developed countries in supporting displaced populations is harmonising.

4.2. The Netherlands in 20 years

It is the year 2037, and it is expected that the Netherlands will have managed to keep their lands dry and continue to be a major food exporter. Dutch cities are becoming masterpieces of spatial planning, and they have to be, as the small country’s population has grown by around a million additional inhabitants, now approaching 18 million people, most of whom live in the metropolitan areas. The process of urban restructuring is on-going as the whole country is facing increased competition for the little land it covers (NEAA, 2012).

4.2.1. Urbanisation and urban restructuring

The crowded cities require restructuring of urban areas and “green belts” surrounding cities: Green space is created in and around the cities for its social (recreational) and ecological value and many hectares of previous agricultural and recreational land have been converted into forests, according to the ‘Action Plan Forest and Wood’ that was signed during the Paris Climate Summit in 2016 (Platform hout, natuur & Millieu; VBNE, 2016). However, the establishment of a continuous ecological zone is compromised by continued urban sprawl. In addition, water bodies with a capacity to catch and store

⁸ According to the FAO, “the needed acceleration in productivity growth is hampered by the degradation of natural resources, the loss of biodiversity, and the spread of transboundary pests and diseases of plants and animals, some of which are becoming resistant to antimicrobials”

excess water are needed as flood protection, but the approach to introduce both measures, green spaces and flood protection, into existing cities is difficult and costly (NEAA, 2012).

4.2.2. Lifestyles

In the cities, the bulk of people's food is provided by enterprises following the 'high tech, low value' pathway (Figure 5). Consumers obtain their food through convenient channels (e.g. online purchasing, home deliveries, pick-up points and food preference tracking), spending less time on purchasing and preparing it. Ready-to-eat meals and convenient single-servings are the dominant food choice on weekdays.

As a response to increased individualisation and the stressors of crowded urban life, activities like cooking and spending time in nature have become important aspects of leisure time. With land being increasingly scarce, natural areas close to metropolitan have become so popular that it is necessary to limit the number of visitors in order to maintain the area's quality.

4.2.3. Public opinion

In the Netherlands, international developments have an influence on the shape of agriculture as well as on public opinion. With increased consumer awareness, global issues are topic of public discourse, and a demand to demonstrate responsibility is reflected in changing markets.

As Millennials have come of age, they now constitute the core of the workforce as well as a strong purchasing power, so their choices weigh heavily. They are replacing the old paradigm, as conservative views are retiring, making space for awareness and a desire for purpose (The Guardian, 2016). Global issues have greatly influenced their attitudes: were they "more conscious, innovative and concerned about the state of affairs, while being more eager to realise positive impact with their lives" in their youth (Unilever, 2017), as adults their feeling of and demand for responsibility is changing the outlook of the economy.

These new consumers are more knowledgeable and have constant access to information. They want to buy transparent, responsible products. International studies revealed that in the past, more than 20% of consumers chose brands they believed were doing social or environmental good (Unilever, 2017), which has increased to more than half of consumers rewarding corporate responsibility.

4.2.4. Consumption patterns

Accordingly, different types of products are consumed. Organic products have gained larger market shares: organic sales in Dutch supermarkets grew with 17,3% in 2016 (Meredith & Willer, 2016) and now, 20 years later, almost half of all fresh produce consumed in the Netherlands is organic, and also conventional produce fulfils higher standards of reduced maximum residue levels.

In processed food items use of additives is greatly reduced. The "free from" trend has become so pronounced that not only artificial colouring and preservatives are shunned, but also refined sugars, oils and starches. As research is beginning to show the benefits of whole foods and social meals for physical and emotional health, people eat highly processed or animal-based products only a few times per week, with fruits and vegetables forming the bulk of their diet.

Recognition of the health properties of many plant based foods has influenced this development, too. While a large number of people seize the healthy properties of plant-based foods directly by consuming fresh food, processed and convenience food is fortified to provide optimised nutrition.

4.3. Institutional reactions

Dutch institutions have formalised many of the demands of the past years, and have developed systems that make transparency a basic aspect of supply chains. Responding to continued discourses, incentives are created to shorten chains sustainably and in accordance with consumer demands.

Financial rewards for land stewardship encourage farmers to perform nature-preserving activities, which used to be cost only, and now becomes an opportunity for farmers to be reimbursed for previously unpaid services (NEAA, 2012).⁹

Institutional perception has also changed with regards to the relation between agriculture, diets and human health. Already in 2016, organisations like the FAO recognised the need for sustainable dietary guidelines based on sustainable production systems. Back then, countries like Germany and Qatar began integrating sustainability concerns into their dietary guidelines, realizing such diets are often healthier (FAO, 2016). Sustainable dietary guidelines are now becoming the norm in the EU.

Institutional developments of the past 20 years have thereby created a less compartmentalised perspective on international food systems. Interrelatedness of the system as a whole is recognised, and the sustainability notion prevails. This changed perception, supported by long-term agreements (e.g. the Paris Agreement), influences decision making, as long-term benefits are weighed heavier in political decision making than proposed short-term gains. Transparency of all links of the chains enables the allocation and monitoring of impacts directly related to the individual actors in the chain, allowing for allocation of responsibility and effective implementation of improvements (NEAA, 2012).

4.4. Dutch agrifood in 2037

The strong public notion to reward sustainable developments reflects the greatest challenge agricultural producers face in developed countries: to keep its societal license to operate.

In the Netherlands, the agrifood regime has been holding on to exploring tech-solutions and much progress is realised, for instance in reducing waste and pollution. Overall sustainability concerns, however, are ever more pressing. Scientists acknowledged years ago that technological fixes are not enough, and that fundamental, systemic change is required (Raven, van den Bosch, & Weterings, 2010). Now, industry actors and policy makers agree as well, and openly question the regime.

In view of the real global challenges affecting Dutch trade, most and to sustainably increase domestic food production and cater for the needs of consumers demanding responsibility, two general approaches can be distinguished. The high-tech approach to sustainable intensification and the eco-system approach based on agro-ecological principles.¹⁰

⁹ These developments are in line with EU wide developments, which have been shaped throughout the past decades. Already in 2010, the Netherlands Environmental Assessment Agency (PBL) was anticipating Common Agriculture Policy (CAP) reforms that would enable countries to move away from the then common system of agricultural subsidies towards a system that rewards farmers for 'landscape stewardship' (improving the quality of landscape and nature and providing ecosystem services). Additional investments in resulting landscape stewardship schemes for Dutch National Landscapes now offer financial rewards to ecologically sustainable farmers.

¹⁰ The future of animal production, which counted for 53% of the total number of Dutch agricultural business in 2015, has not been assessed in the course of this future scenario. The mentioned directions of development solely refer to production of crops.

4.4.1. The high-tech approach: Sustainable intensification

Continuing the local-for-local trend, a highly specialised food industry is clustering in the industrial areas of metropolitan centres. Indoor production in controlled environments with a high degree of automation is key to providing clean food with few 'food miles'. Supplemented by international commodities, an urban food system provides easily storable and transportable food to cities. These processed, non-perishable 'urban food' products also fuel the export statistics of the Netherlands.

The factories are now highly automated and robots and artificial intelligence (AI) have replaced a great portion of production workers. They are powered with renewable energy sources and highly cost-effective. A data-focussed integrated IT approach leads to a high degree of transparency.

Traditional conventional farms (i.e. soil-based and outdoors) in the rural areas find themselves in the need to fundamentally change to improve soil and water management to prevent harvest losses and soaring input costs, and to achieve resilience. Regulations for inputs are stricter, for example regarding pest control and nitrogen application, and producers are expected to minimise negative outcomes of their activities.

Precision farming offers more sustainable on-field solutions through sensors, GPS, automation and AI. Tractors learn to autonomously navigate fields, analysing on the spot which parts of the field lack nutrients and apply them at ideal amounts, preventing any leaching of surplus. With automated systems, farmers do not have to leave their homes much and can monitor the tractors' activities online. Very few tasks are done manually, and one farmer can cultivate a large amount of hectares.

4.4.2. The agro-ecological approach: multi-functional farming

Traditional Dutch farms have been facing challenging decades, and to persevere they learned from each other and from examples of sustainable initiatives. A greater number of farmers switched to organic production, which improved their business, as margins for organic are still higher than for conventional products, and organic farms do not rely as heavily on expensive inputs. Because of the stricter regulations concerning emissions and pesticide use, the difference between organic and conventional agriculture has become minimal. To distinguish themselves, organic farmers implement additional sustainability measures to add value to the production system and thus to the produce.

Consequently, farmers are transitioning to the 'next level' of organic, implementing strategies that provide additional benefits in social or environmental terms, and communicate this directly to consumers. Not only the more demanding consumers benefit from 'organic plus...' strategies; Farmers themselves experience increased resilience as a result of their adaptations.¹¹

New functions for farms and nature

In the year 2037, soil-based farms are expected to deliver more than just food. Farming has become more knowledge-intensive and farmers are realizing their opportunity of becoming sustainable land stewards, thereby transforming their very own surroundings and livelihoods, and changing their

¹¹ Farmers that were interviewed during this research have seen at numerous occasions that for example rows of trees or perennial polycultures can replace expensive water management. For example, one farmer, who designed some of his land in cooperation with the Dutch Water Board in order to provide space for water retention, mentioned that there were months during which the surrounding agricultural fields were standing in water but that on his farm, water was absorbed and stored in the soil and biomass. At drier times of the same season, his neighbours had to irrigate the land while his system contained sufficient water to withstand the prolonged dry conditions.

impact. Accordingly, farms are beginning to be viewed as the vectors to fulfil additional purposes like the contribution to attractive landscapes and integrating the provision of ecosystem services.

A growing notion promotes the idea that the functions of natural systems should be performed by agro-ecological systems, implying the combination of nature and agriculture. Nature areas and reserves thereby offer new, albeit limited opportunities to incorporate food production with conservation.¹² Accordingly, related payment schemes have changed. Farmers may obtain produce from natural areas, as long as ecosystem services remain uncompromised. Such adaptations make nature economically viable through allowing sustainable production of food, fuel and fibres. Such new functions of farms and nature have led to new relationships between local stakeholders. Cooperation and exchange between Dutch farmers has increased through modern communication technology, and they autonomously learn from each other, spreading best practices fast.¹³

4.5. Conclusion: Critical success factors

In view of the challenges faced, it is no surprise that sustainability awareness of consumers¹⁴ as well as producers lie in the heart of most of the changes described in this chapter.

In the agricultural sector, two general paths were distinguished. In the perspective of this research, the high-tech approach can be regarded as a continuation of the 'old paradigm', whereas the agro-ecological approach represents a niche ideology, suggesting a renewed paradigm. Both approaches aim to create a resilient food system and reflect their own values, sustainability strategies, and specific adaptations to a changing landscape. But as has been shown, it is not only sustainability, but especially social perception that determines the success of transitional developments.

The future scenario, reflecting the demands of a changed landscape, leads to the identification of several indicators for the success of a production system in the future:

- Independence of limited resources
- Positive impact on soil, water, air, biodiversity (landscape stewardship)
- Transparency (or trustworthiness) in relation to sustainability
- Provision of nutrition and contribution to human health
- Suitability of the produce for marketing and processing
- Potential for automation of the system and related sector
- Systemic resilience to changing bioclimatic circumstances

¹² In order to reach the climate goals as agreed upon in the Paris agreement, Staatsbosbeheer plans to transform 100.000 hectares of agricultural land into forest. There have been advocates suggesting to use that land in smarter ways, not compromising food production for nature conservation, but combine the two: Apply agriculture that has the same environmental benefits as forests have: Use food forests. Dear reader, imagine the implications such an initiative would have. Connect with the authors if you feel called to discuss such imagination.

¹³ For example, as farmers included flowering edges around their fields and included rows of trees, more biomass was available on farms. Local communities joined together in various places and set up e.g. shared biogas facilities, which now provide local fuel based on local renewable resources. In this way, new relationships and circular local economies are appearing. With this, the perceived separation between producer and consumer can be reduced to some extent, as the consumer of food items becomes the producer of biomass inputs.

¹⁴ Social Drivers for institutional reactions: Section 1.2.3 began with stating that institutions have formalized consumer demands, which showed the importance of consumer perception also for institutional decisions. Institutional strategy formulation is increasingly based on social trends. In a report on the Future of the Netherlands (Outlook of the physical living environment, PBL, 2010), the Dutch Environmental Assessment Agency perceived social trends as the defining force for land use changes.

5. Transformative permaculture business models

To discover the success factors and potential of permaculture principles in the agrifood transition, interviews were conducted with permaculture farmers and experts in the Netherlands, the outcomes of which are presented in this Chapter.¹⁵ The interviews aimed at gathering information about the existing business models and their transformative character. As a guideline, the ‘transformative business model’ concept developed by the HAS research group ‘New Business Models’ was used, which led to the division of interview results into following eight Transformative Business Model categories (also see

Figure 6):

- Value propositions
- Products and services
- Production and Chain
- Valuation
- Discourses
- Practices
- Relations
- Institutions

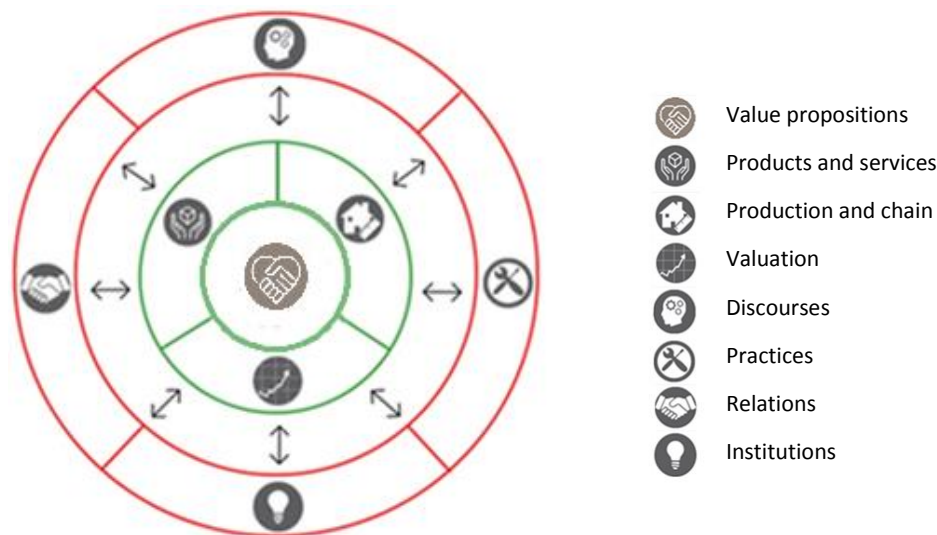


Figure 6 – Transformative Business Model (Beers, 2016)

Sections 5.1 and 5.2 contain the main findings of the interview analysis and give an account of the status of permaculture initiatives and observed business models in the Netherlands.

5.1. Farm and business model characteristics

The values and key activities of the business models that were investigated are described below. The excerpts that are quoted are taken from farm interviews and were translated when necessary. Four categories describe the business characteristics: value propositions, products and services, production and chain, and valuation.

¹⁵ **Note: Existing Business Models:** As has been mentioned before, there is a lack of ‘textbook permaculture’ initiatives in the Netherlands, and most are very young and at an early, experimental stage. They do operate with innovative business models, but most initiatives that were visited had in common that they did not have economic profitability as their main motivation. As a consequence, information concerning economic viability is scarce. The various approaches of permaculture are similar; therefore terms are used interchangeably in the following. The interviews showed the similarity of the approaches, as all farms shared certain elements within their business models. A description of the farms and experts visited can be found in appendix I.

5.1.1. Value Propositions

A similarity between the visited farms is that all of them create multiple values that are not only economical, but also environmental and social. This is inherent to permaculture, as its ethics cover earth care, people care and fair share, which is at the core of a farmers' philosophy and business approach. Below, different found values are listed and explained.



Product qualities

“You can offer all sorts of things that are special, fresh, taste amazing and are produced locally”

Product qualities refer to product-related values delivered to or perceived by consumers. All of the produce is residue-free and delivered fresh, sometimes on consumer demand. Consumers perceive the products as fresh, healthy and better tasting. Transparency regarding production methods is high as farms are usually accessible to the public. Consumers can see and often participate in production. Furthermore, many farmers produce new, unusual products, which make for a unique consumer experience.



Environmental values

“In June and May it was very wet in our area, and all the conventional fields were waterlogged. But in the food forest, water was absorbed and stored in the soil.”

The way in which permaculture farmers grow their food is motivated by working with natural cycles. Mimicking natural ecosystems, farm elements fulfil multiple functions and are mutually supportive. They work from the perspective that what benefits one aspect of the system also benefits the others, and local communities. The above quote is an illustrative example: Permanent cover of a food forest has improved soil structure and water retention capacity, an ecosystem service the farmer invested in, and which pays back in times of drought or floods by managing the water in the soil naturally.

A general benefit that can be observed on all farms is high carbon sequestration due to for the presence of high amounts of biomass on-site. Environmental values that were mentioned are improvements in soil health; increase in biodiversity; improved air and water quality; positive influence on the area (e.g. supporting pollinator populations; water management).



Knowledge and competence values

“In cooperation with another food forest, we do research on bee populations”

Through permaculture initiatives, knowledge is generated and shared. Farmers are often motivated to work with different parties to do research and give courses, work with governments, speak at events and give educative farm tours. By exploring opportunities (e.g. on organic pest management or fertilization) the farmers generate knowledge in cooperation with research institutes. Several farmers mentioned that they are motivated by the goal of showing this way of farming to other farmers or the wider public, and at times also to local governments.



Social values

“If people see a green landscape and are part of it, they are happier and healthier”

Social involvement is one of the key values of food forest production systems. In an urbanised life-style, many people feel the need to spend time away from the city and its crowds, and many feel isolated in the anonymity of cities. Food forests offer them recreation in nature, combined with perceived health benefits, and invite them to become involved in various ways. Active involvement is achieved by providing possibilities like self-harvesting and volunteering; Passive involvement through for example the recreational function of the farm and its attractive landscape; through improving general health and retaining and dispersing economic value in the local area.¹⁶

Transparency is achieved through involvement and the openness to visitors. This represents an important value, as consumers increasingly care about the origins of their food. Especially parents think it is important for children to learn where their food comes from, and food forests offer the opportunity to learn about it and even become involved in food production. Such involvement helps bridge the gap between producers and consumers and creates connection and trust.

5.1.2. Products and Services

Values are embedded in products and services that the farms deliver to their clients and surroundings. These differ per farm, but generally the following can be found.



A diversity of fruits and vegetables

“We grow over 400 different perennial edible species”

All farms grow a diversity of vegetables, fruits and exotics; some farmers a handful of species, others up to 400. The corresponding increased biodiversity is supportive to the farm, as it attracts ecosystem services that benefit the production capacity of the system and creates resilience.

Depending on the commercial attitude of the farmer, some have a number of cash crops that they grow in larger amounts. Other farms are less economically oriented and decide on the crops based on their appropriateness for the functions needed and their added values.



Societal services

“This area is freely accessible for people. They come to walk, bike or walk their dog.”

¹⁶ Claims on the health benefits of permaculture produce need to be handled with care, as not enough research is available that would prove increased nutritional value of such produce. A positive effect on health can be witnessed due to absence of artificial crop control agents and attention for well-nourished, healthy soils, it can be assumed that produce is assumed to be slightly more nutritious than conventional produce.

Permaculture farms deliver direct services to their customers, often in the form of side-activities of the farmers. More general, non-monetised services are delivered to society as well.

Examples of direct services are:

- Preparation of meals and education about food and its relation to health
- Logistical services, such as allowing customers to harvest themselves, or delivering products flexibly based on the changing wishes of the customer

An example of a non-monetised service is the provision of public space as a recreational area for surrounding citizens or eco-tourists. Farms are usually freely accessible, and enjoy the attention of passers-by, who appreciate the attractiveness of the system. Nature has perceived health benefits, and the uniqueness and pleasing aesthetics of the system motivate people to spend time outside.



Knowledge-related services

These services are related to educational elements that most interviewed farmers offer in the form of workshops, coaching, lectures etc. Next to this, several farms indicated to participate in research activities to generate knowledge, often in cooperation with research and education institutes.

“I have small research plots that are being used by the Louis Bolk Institute”



Ecosystem services

Permaculture farms have a large variety of elements that contribute to the resilience of the ecosystem within which the farm is operating. In many cases, farmers are compensated for some of these services in the form of subsidies. Examples of these services are the creation of wildlife habitats and the management of natural zones.

“Soil and water quality increase because I don’t use fertilizers or crop protection.”

5.1.3. Production and chain

“Production and chain” describes what is necessary for delivering value to the consumers. This includes inputs, the production process, and different ways of reaching the customers.



Inputs and investments

Almost all of the interviewees reported the requirement for a starting capital for initial investments. But as the farm designs are based on principles such as ‘using renewable resources and services’ and ‘catching and storing energy’, after an initial start-up period the farms create and sustain their own ecological functions and nutrient cycles. This decreases the need for investments and material inputs after the start-up period to almost zero.

“We don’t have big costs anymore. We don’t have to pay for seeds, fertilizers, pesticides: it is a self-sustaining system, without external inputs”

With regards to input of time and labour, a young food forest needs intensive care, and requires less and less attention as it matures. Labour for maintenance and harvesting will always be required, while the intensity of labour differs per farm: some only harvest, others also prune and some require

contractors during harvesting time. A common characteristic of all farms is that they were designed to produce throughout the season, spreading labour requirements more evenly over the year, and many farms fulfil labour requirements with the help of volunteers.¹⁷



Crop selection

Farmers tend to select their crops to fulfil a variety of functions. The product could be valued as a cash crop, for its special taste or uniqueness. Besides these economic motivations, farmers select crops based on properties like nitrogen fixation or attraction of beneficial species for pest control.

“In the hedge we used everything that would be logical to be found there.”

Selection was often influenced by observing the history of the specific crop in that area or climate, evaluating if the context and crop match. Experimentation was often a key in crop selection; farmers would experiment with a wide variety of crops in order to determine which are most suited. This reflects their attitude of working with the natural context and finding site-specific solutions.



Production process

Generally, farms are expected to become productive and self-sustaining within around 10 years, with an exponential increase of outputs after a slow start, as the quote below suggests.

“A forest grows exponentially, first nothing happens and after some time production explodes.”

The start-up period is characterised by a flexible ‘trial and error approach’, through which the system can be very flexible and specifically suited to the site. Maintenance is an on-going process. This allows farmers to use resources efficiently, to produce based on demand of their customers and to adapt the system to the local circumstances and demands. Processing of products is not common.



Reaching customers

In terms of logistics, most farms create short chains to their consumers and often aim at high-end outlets like restaurants and specialty stores. Some farmers want their products to be accessible for all consumers and offer it online at organic retail prices. Home delivery (or direct delivery to e.g. restaurants) is common, and some initiatives offer pick-up at the farm themselves.

“Every Monday morning, the chef comes and joins me in harvesting”

Marketing is commonly organised through online presence (own website, Facebook), guided tours and word of mouth. The story of the farm, the farmer, his vision, and how the food is produced is commonly shared with stakeholders like restaurants who also use it to appeal to their customers.

¹⁷ The notion to design a system which provides crops throughout the whole growing season is common amongst farmers not only for the benefit of an even workload: Farmers also enjoy the fact of having fresh produce available throughout the season. But most importantly, year round vegetation also provides year-round services: Wildlife habitat, soil structure, CO2 sequestration and water retention capacity, soil cover to prevent erosion and many more. Permaculture farmers see their fields not solely production assets. They are part of a sustainable landscape which supports the ecosystem and its inhabitants year-round.

The most direct way of reaching customers can be observed at all farms: People are often free to visit, join tours, pick themselves, go for walks, enjoy the landscape, learn and interact.

5.1.4. Valuation

A diverse stream of revenues is common amongst food forest farms, with produce revenues stemming predominantly from perennial polycultures. Thereby farms are resilient to changing bioclimatic and market circumstances: Faced with adverse weather such as late frosts, they will not lose a whole year's income. The following revenue streams were observed:



Produce-based income

Not all farmers had an accurate estimate of their yields or total income from farming activities, the reason being the (young) age of the farm or a lack of administration. The diversity of produce seemed to be a problem for documentation too: Yields were often noted only for cash crops, or not at all. Therefore, produce-based income streams were difficult to determine or generalise.

"I'd have to guess the total amount of last years' harvest"

Pricing was better documented: Most farmers base their price on organic retail prices. Produce revenues change over the years, since annual production is generally higher in the start-up phase and is slowly replaced by perennial production, as fruit tree and bush productivity increases.



Other revenue streams

As mentioned before, most farmers conduct side-activities that account for a part of their income. Exact amounts of earnings differ per farm and were not generalisable from the research. For most interviewed permaculture farmers, subsidies are a relevant income offering financial compensation for societal and ecological values, like hedgerow management.

"Yearly, we earn €1500 of subsidies for landscape management"



Future value

Food forest farmers continuously add value to the land they work. Improvement of soil fertility and maturing perennial plants has economic value. Even though farmers rarely consider selling their food forest, its establishment over the years is a way of generating financial capital.

"You could reason that our activities will increase the total value of the site"



Social revenue streams

Some farms have a business model that does not focus on the sales of produce as their main source of income. Instead they generate revenue through their focus on social values, which often does not come in the form of financial return, but in the form of labour or personal fulfilment. For example, one farmer opened up his farm for day care activities, for which he does not charge money. Instead, he receives free labour to manage and maintain his farming activities. These social values are sometimes compensated through subsidies, and always lead to involvement and loyalty.

“The day care people feel very proud when they maintain the hedges. For me this is the effect of shared wealth in permaculture, I can share a way to realise fulfilment.”

5.2. Typical business models

The gathered data regarding the values and key elements of the businesses paints a diverse picture: There are as many different production systems as there are farmers. It is however possible to categorise each farm by the type of value that is its focus, as well as drawing conclusions on its flexibility to react to future developments. These categories take the form of 12 food forest archetypes, and are described in Appendix II.

In the research presented in this paper, the social and production values were identified on almost all farms. Therefore, the following describes these two business model archetypes representing the main direction of the models encountered in the course of this research.

The social business model

The social focus of this business model is expressed in its products, services and underlying production architecture. As a permaculture farm, it is built upon ecological values; as a social space it is designed to look attractive and with at least 50 different varieties of fruits and vegetables, 90% of which is perennial. Income is supplemented by offering services such as a bed- and breakfast, courses and farm tours.

The farm is at least partially open for recreational purposes at all times, and directly sells its produce through a self-harvest system or a veg-box system. A social permaculture farmer prefers to have regular customers. This enables her/him to provide transparency and involve customers in the production process as much as possible, for example through volunteering.

Revenue streams are evenly divided over social activities and production activities. A small amount of income is derived from subsidies for ecological and social (recreational) services.

Reasons for farmers to focus on this archetype are related to the direct contact with customers, being of help to others, mutual and varied learning experiences, or showing that a better world is possible and inviting others to share it. Social permaculture entrepreneurs are often involved in voluntary activities themselves, for instance in supporting like-minded individuals or promoting permaculture.

The productive business model

This permaculture model creates social and ecological values, but the long-term focus lies on production. This is embedded in the production of over 50 different types of fruits and vegetables, with a focus on around 10 main crops. Perennial production accounts for about 70% of the total, but is less in the start-up period which is bridged by annual production.

The farm sells high-end produce to restaurants, reaching customers by home delivery and pick-up services. Intelligent systems, such as ‘just in time’ harvesting when products are ordered via a web shop, are employed to create quality and convenience for consumers. A productive permaculture farmer generally cooperates with like-minded people to sell produce or to generate knowledge.

Revenue streams mostly come from selling produce. A small amount is earned by offering social services such as lectures, and by receiving certain subsidies for ecological services.

Specific reasons for farmers to aim for a productive permaculture are very similar to the reasons for social permaculturists: Being of help to others by providing good food and access to nature and share a balanced life with on-going mutual and varied learning experiences. In this case, too, farmers often want to show that a better world (better agriculture) is possible and many want to prove this to for instance other farmers. With the productive system, farmers also want to become self-sufficient in the long run.

5.3. Transformative character

The transformative character of these two business models is determined by how they respond to changing discourses, relations, practices and institutional factors. Permaculture farmers often work from a trial and error perspective, where they observe their surroundings and respond in a flexible manner fit for the current situation. This is reflected by the permaculture principle ‘Creatively use and respond to change’ which is one of the principles that the business models are based on. Therefore, decision making about business is generally based on new developments in society, for example growing awareness and changing lifestyles. Next to this, many permaculture initiatives have the aim to show the regime that more sustainable and social alternatives for agriculture are possible. In order to create a growing movement, permaculture farmers aim to be inherently transformative.

The food forest production model mostly responds to societal developments by offering a green environment, involvement, new knowledge and healthy food to their customers. The productive permaculture model responds to societal developments such as lifestyle changes shifting towards more health orientated and low-footprint consumption patterns by offering suitable products and convenience services.

“People from the city believe in this area and in our way of producing food, and they want to pay for it”

Food forests respond well to an increased importance of connections within local communities, since they generate values and provide services and products that are sold and expressed locally. The involvement of local communities has added benefits for the farmer as well through, for example, volunteering or crowd funding activities.

“The way that nature and agriculture are divided is quite an artificial split. But governments are starting to learn that, together, we have to find solutions for this”

Relations between food forest farmers and governments are becoming more common as well, with a lot of space for dialogue and mutual learning. This is beneficial for food forest farmers, as their activities include those that are sought after by government institutes, such as the Dutch Water Board (Waterschap). Furthermore, they will work with stakeholder groups such as Natuurmonumenten in order to combine ecological values with attractive landscapes. Farmers experience interest from a multitude of governments and stakeholder organizations, which seem to see potential benefits in supporting food forests.

5.4. Conclusion

Even though there are diverse business models to be identified amongst food forests, it was up to the farm to identify how much value was attached to either social values or production. Thus a gradation was observed, with every business model attaching a different level of importance on each value, fitting the local needs and circumstances. This adaptability of the system to provide a certain value where it is needed makes it suited to respond to changes as they develop, and makes the system uniquely transformative.

This chapter has summarised the interviews conducted with Dutch permaculture farmers. The following quote shall conclude this section as it illustrates the mind-set of one of the farmers and thereby reflects the vision of permaculture.

“As humans, we’re moving further and further away from nature. We don’t have flowers or animals in meadows anymore, we don’t have beautiful hedgerows or birds, but we have monoculture and a landscape that is fully deprived of colour, scent and taste. I think we should be able to do this differently. Aren’t we ourselves a part of nature? Don’t we then have to work together with nature? To me, permaculture is not the ultimate solution, but at least, it offers a way of cooperation between food production and nature management, whilst creating mutualistic benefits between those two. That’s what I like about it.”

6. Performance of permaculture versus conventional agriculture

The purpose of this Chapter is to compare the performance of permaculture and conventional agriculture in view of the established future pathways as described in Chapter 4. Additional argumentation of individual statements and indicators can be found in Appendix II.

6.1. Establishing baselines

To be able to compare two very different systems, baselines are established and compared. The conventional system used for this comparison is food potato production on open field (ridges). The permaculture system used is based on the 'productive model' (Chapter The productive business model5.4) with apples, hazelnuts, blueberries, triticale and raspberries as the main crops, produced with light machinery.

6.2. Performance indicators 2017 and 2037

As introduced in Chapter 4, the following indicators are important for assessing the performance of agricultural systems in the future scenario:

- Independence of limited resources
- Positive impact on soil, water, air, biodiversity (landscape stewardship)
- Transparency (or trustworthiness) in relation to sustainability
- Provision of nutrition and contribution to human health
- Suitability of the produce for marketing and processing
- Potential for automation of the system and related sector
- Systemic resilience to changing bioclimatic circumstances

Table 1 shows the performance indicators and the expected performance of both systems in 2017 and 2037. The performance ranges from very negative (---), to neutral (0), to very positive (+++). This expected performance has been synthesised based on the subjective interpretation of data by the authors and is open to interpretation by the reader.

Table 1. Projected performance of both systems in 2017 and 2037

Indicators		Conventional now	Food forest now	Conventional 2037	Food forest 2037
Environment / indicators	Impact on soil	--	++	-	++
	Impact on water	--	+	-	+
	Impact on air	--	+	-	+
	Ecosystem services	--	++	-	+++
	Landscape stewardship	--	+	--	+
Societal indicators	Transparency and sustainability	0	+	+	++
	Health benefits of produce	+	++	+	+++
	Societal involvement	0	+++	0	+++
System indicators	Provision of nutrition	+++	+	++	+
	Ability to be processed	+++	-	+++	-
	Potential for automation	+	0	+++	+
	Climate Resilience	-	++	--	++

The table above shows that both systems have indicators for which they are expected to perform better than the other. In general, conventional agriculture performs better on aspects related to productivity and affinity with an industrial environment, whereas permaculture performs better for societal and environmental indicators. These differences result in unique selling points present in permaculture farming in 2037, which will be discussed at the end of this chapter. In Appendix II, each indicator and the reasoning behind the expected performance ranking is explained in detail.

The indicators of ecosystem services, provision of nutrition, climate resilience and societal involvement provide an example of the argumentation leading to the projected performance.

The indicators of ecosystem services, societal involvement, provision of nutrition and climate resilience were provide an example of the argumentation leading to the projected performance. The indicator of ecosystem services was chosen to serve this purpose because it expresses the combined effects of impacts on soil, water and air quality. Societal involvement is considered to have a major influence on future consumption patterns (Chapter 4) and provision of nutrition gives a rather objective outlook on the productivity of the systems. Lastly, climate resilience will be of major importance for future production systems and therefore is considered one of the most important indicators.

6.2.1. Ecosystem services

Ecosystem services are the expressed effects of the combination of soil quality, water quality, air quality and biodiversity. They result in a multitude of beneficial effects for humankind such as creating biomass, climate regulation and pest control.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Ecosystem services	--	++	-	+++

Being an annual monoculture, potato farming requires annual removal of all vegetation to start each production cycle on an empty field. Through this, potato farming produces very little ecosystem services, creates a demand for extra ecosystem services, and puts pressure on existing ones.

In 2017, conventional farmers are enticed to incorporate ecological services such as wildlife habitat in their production system by financial governmental incentives. As such, potato farming in 2037 will generate more ecosystem services as a side activity for which it receives subsidy.

Permaculture farms integrate ecosystem services and agricultural productivity as elements of one system. By using the services as part of the production system, costs of supplementing them (e.g. through artificial irrigation) are negligible. Reimbursements for providing such services are therefore additional income for farmers, and they are expected to be valued higher in 2037.

6.2.2. Provision of nutrition

Due to the increase of population and the possible movement away from animal protein, providing adequate plant based nutrition will be increasingly important in the future.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Provision of nutrition	+++	+	++	+

The caloric production of one hectare of potatoes is much higher compared to a standardised permaculture farm. Mainly due to the high carbohydrate content of potatoes, a hectare of potato produces around 2,000 times more calories¹⁸. For the production of protein however, the two systems compare much more evenly. A hectare of potato produces 1.5x more protein than a hectare of food forest, food forest protein mainly being found in hazelnuts. Additionally, a food forest produces 3x more fat than a potato field; fats that are monounsaturated and have been demonstrated to have multiple health benefits (Prins, 2017; Ware, 2016).

Potato farmers are facing multiple problems with their production system; problems that are expected to become bigger by 2037. Resistant diseases will put pressure on production, as will soil depletion, weather circumstances and stricter regulations on pesticide and fertilizer use. It can thus be expected that potato yield will stagnate, and even decrease by 2037.

6.2.3. Climate resilience

Dutch weather circumstances are expected to become more extreme and unpredictable in the years up to 2037. Longer periods of drought and heavier but less frequent rain showers are expected. Dealing with these circumstances will be an important aspect of a functioning production system.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Climate Resilience	-	++	--	++

Potato farming is dependent on being grown in full soil, and as an annual monoculture, has no inherent capabilities of dealing with weather extremes. Periods of drought make it necessary to irrigate due to low water retention capabilities of soil, while heavy showers result in water logged fields due to poor drainage capabilities. Due to the farmer's dependency on a single crop for income, a bad year for potato farming will add financial pressure to the farm.

The proposed permaculture system predominantly consists of perennials with a permanent root structure and a large amount of soil organic matter. This increases the systems' ability to manage water and thus enables it to handle different weather circumstances such as droughts or heavy rain. The food forest model contains multiple layers of crops, and therefore slows down heavy rains, which adds to these benefits. Additionally, the permaculture system generates income through multiple crops, which reduces the negative impact the loss of a single crop has on the financial health

¹⁸ The high production of potato enables the Dutch market to export a lot of potato and potato products, becoming one of the market leaders. This has generated a lot of knowledge and experience on potato farming and processing. The expert knowledge is also a valuable product that can be exported, and, together with the high amounts of exported produce, has significant benefits for the Dutch economy.

of the farm. Because of these reasons, permaculture is resilient to extreme weather patterns in 2017, and this resilience will be of more value in 2037 when weather extremes are more common.

6.2.4. Societal involvement

As nature in 2037 is expected to be highly valued by consumers as a place for spending their leisure time, and soil-based agriculture is expected to have an important function in this, involvement of society in the production system is an important parameter for the success of a system.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Societal involvement	0	+++	0	+++

Potato farms generally do not allow visitors. However, the fact that potato is an important part of Dutch culture may be used as an argument for potato farms providing a societal service as well.

Food forests inherently create broader involvement of stakeholders. They can function as a societal platform, for recreation, sharing knowledge and community building, which results in local residents feeling a connection with the area they live in. As in 2037 these functions are expected to be increasingly important, food forest farmers are expected to focus on these societal functions as a part of their farm enterprise. Selling food in the local area helps to retain local economic value, whereas potato farmers often sell to large companies and therefore do not contribute to a local distribution of wealth. Food forests also benefit from the values they create. The accessible systems have high affinity with volunteering activities, which is a common source of labour on such farms.

6.3. USPs

Both the potato production system and food forest system generate different values. The differences can be expressed as unique selling points of the permaculture approach: They are values of permaculture farms that are unique when compared to those of conventional farms. These USPs are divided into three categories: ecological, social and production system related USPs.

- **Ecological**
 - Use and provision of ecosystem services benefitting soil, water, air and biodiversity
 - Independence of limited resources
- **Social**
 - Attractive recreational space and beneficial health effects of green environments
 - Direct personal involvement possible, resulting in transparency (trust)
 - Landscape stewardship and food production can be achieved simultaneously
 - High health benefits of residue-free produce
- **Production system**
 - System resilience to bioclimatic extremes creating resilience of farm livelihoods
 - Flexible and adaptable to local circumstances and short, local supply chains
 - Applicable in locations unfit for conventional agriculture

6.4. Considerations and conclusion

These USPs form the basis of determining what permaculture based systems have to offer in 2037. They are a guideline for what stakeholders might expect from a permaculture system, and are important to take into consideration when analysing the potential of food forest business models.

The USPs create a positive picture of the potential of permaculture for future food systems. Yet niches typically do not develop in a black and white manner: the niche projects tend to adapt to the regime in order to increase their outreach, and the regime tends to adopt niche principles. The result can be seen as a form of cross-pollination between the two. The future will not be shaped exclusively by agro-ecological principles, or by the conventional approach, and both are likely to change throughout their development as cross-pollination will lead to alternative sustainable production models as well as additional new business models.

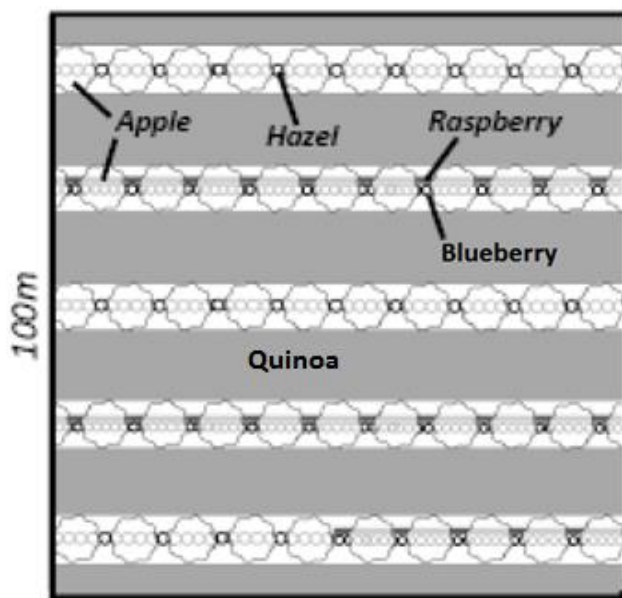
7. Permaculture and the industrial context

As today's dominant systems are agro-industrial in nature, permaculture principles can lead to productive applications in modern food systems by being flexible in its application. Compromise can lead to the most suitable and accessible solutions. This chapter puts forth a conceptual production system based on permaculture principles with application opportunities in the agro-industrial context, and analyses its strengths and weaknesses.

7.1. Production system and projected production potential

The proposed permaculture concept has not been found in practice in the way it is presented in the following. To develop the concept, it was necessary to make assumptions based on theoretical models, extrapolation from small-scale systems, and expectations. Hence, its literal application cannot be guaranteed, as a practical application is likely to require adaptation to the site specifics.

The suggested production system is similar to the standardised food forest system used in Chapter 5.2, with a few adaptations (see **Error! Reference source not found.**). The main rows are formed by



apple trees and hazelnut bushes. Able to deliver high value to farmer, quinoa has been chosen as the annual cash crop to be cultivated between the rows, and raspberry and blueberry as the perennial brushes. Quinoa is a “superfood” cereal suited for the Dutch climate, but rarely grown as yet, and it has a high salinity, shade and pest tolerance.

Not depicted in the figure is the edge of the field, which is proposed to be surrounded with green hedges, in which plants (possibly crops) are incorporated which fix nitrogen, provide habitat for pollinators and attract other beneficial insects (i.e. organic pest control agents).

Figure 7 – Standardised food forest system

In the resulting perennial polyculture, the selection of crops leads to various production cycles within one system. To provide annual means, yields were averaged over a 60 year period, which is the maximum lifespan present in the system, determined by the apple trees, as can be seen in Table 2. Quinoa is the main cash crop yielding an estimated annual income of € 8400,- per hectare and the total average income is estimated to be € 13.660,- per year, at organic retail prices (USDA, 2017) (KWIN, 2015).

Even though the other crops do not have the high and stable production associated with quinoa, they, too, deliver organic products and help to ensure the systems diversity and associated values. As a food forest, the system does not focus on maximizing production but on balancing economic viability with societal and ecological values. The diversity of crops and other farm elements like the hedge provide resilience of the production system as well as of the farmer's livelihood.

Table 2. Estimated yields and income of the standardised food forest system

	Price fresh produce	Fresh Yield	Income	Lifespan
General crop products	(€/kg)	kg/ha	(€/ha)	(years)
Apples	1	1700	€ 1700,-	60
Hazelnuts	3,5	55	€ 190,-	10
Quinoa	4	2100	€ 8400,-	1
Raspberries	4	273	€ 1100,-	15
Blueberries	8	284	€ 2270,-	15
Total			€ 13.660,-	

Due to the different life spans of the various crops, the annual yield changes, as depicted in Figure 8. As the only annual crop, quinoa production is even throughout the years, whereas apple trees need 15 years in order to reach maximum productivity. Raspberry and blueberry bushes need to be replaced periodically (every 15 years), which is also the case for hazel (needing replacement every decade). These crops show more fluctuating yields accordingly.

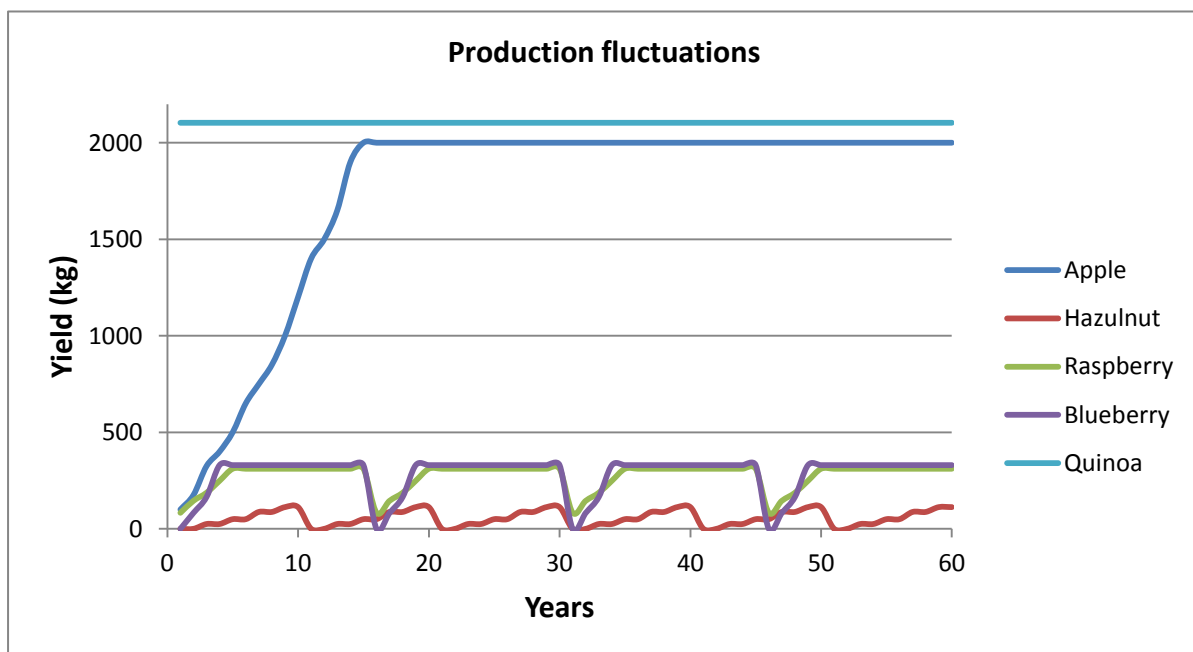


Figure 8 – Production fluctuations within the standardised permaculture system

The fluctuating yields result in a fluctuating annual income, which is shown in Figure 9. The presence of the annual crop quinoa and the stable apple production after 15 years counteracts the effect of the fluctuating yields of hazelnut, raspberry and blueberry. This causes income to never drop below €10.000,- after the apple trees enter full production.

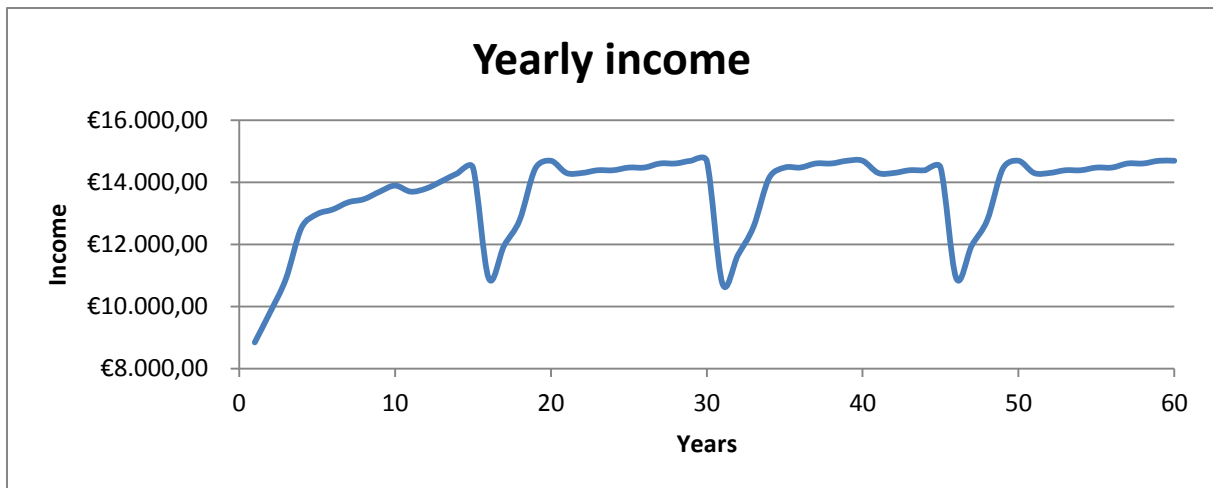


Figure 9 – Yearly income of the standardised permaculture system

The initial start-up phase requires investments for planting material and plant support such as trellises for the raspberries and stakes for the apple trees, which adds up to less than €7.000,- (Table 3) (Prins, 2017) (KWIN, 2015). The costs do not include soil preparation or land purchase; as such costs are highly site-specific. Additionally, Table 3 shows the annual costs associated with the mechanised cultivation of quinoa which is outsourced to a contractor, which is averaged over a 60 year time span. Additional activities such as pruning are managed by the farmer and as such do not contribute to the additional yearly costs.

Table 3. Start-up and annual costs of standardised permaculture system

Start-up costs		Yearly costs	
Apple	€ 3.000,00	Quinoa seeds	€ 400,00
Hazel	€ 1.875,00	Quinoa contractor	€ 1.100,00
Blueberry	€ 660,00		
Raspberry	€ 1.300,00		
Total	€ 6.835,00	Total	€ 1.559,00

Economic viability considerations

Summing up the data presented in the graphs, it can be stated that the proposed production system can be financially competitive with conventional farming. The latter generates an average annual profit of around €4.500,- per hectare at retail prices (Boerenbusiness, 2015) as opposed to a potential average annual income of around €13.600,- from the proposed permaculture system.

It should be noted that such a comparison is not as neat as it could be: The conventional system for instance is likely to include rotation of various crops on one field over the years, which would change the parameters that have been compared. Furthermore, the permacultural system offers additional yields of for instance lumber, which is a supplementary revenue stream based on the woody parts of the perennial vegetation. Lastly, as the success of a permaculture system also depends on its flexibility in selecting crops based on market demands, income might change dependent on the crops chosen in an actual practical application.

7.2. SWOT

The proposed system is conceptual as it is based on a theoretical models and small scale examples, which means that flexibility is required when managing and maintaining it. In the uniqueness of the system lie several opportunities but also shortcomings, as the following SWOT analysis (Table 4) summarises.

Table 4 - SWOT Analysis permaculture in industrial context

SWOT	Strengths	Weaknesses
Internal	<ul style="list-style-type: none"> • Provides various local products • Resilient in a changed climate • Residue-free production • Flexible annual production • Low start-up & maintenance costs • Balanced labour requirements • Long-term sustainable system • Provides diversification, thus enabling stable incomes 	<ul style="list-style-type: none"> • No uniformity of produce • Small amounts of diverse produce throughout the season • Possibly soil/insects on products • Yields difficult to predict initially • Requires flexibility in planning • Requires innovative logistics • No “permaculture” certification available to secure larger margin • “treehugger” association
External	<ul style="list-style-type: none"> • Growing demand for fresh, residue-free products • Not pressured by stricter regulations • Suitable for subsidies due to high ecological/societal values • Growing interest in enterprises combining nature and economy • Possibility to include side activities (social/educational/promotional) • Attractive working conditions offer benefits for labourers 	<ul style="list-style-type: none"> • Changing consumer preferences make perennials risky • Image of permaculture could develop negatively • Damage to the system in the start-up phase by extreme floods/frosts • Unconventional system may require additional farmer training • Mismatch between regime and permaculture business models represents a hurdle

7.3. Weaknesses

Some of the ‘weaknesses’ listed above are discussed in the following, focussing on the agro-industrial requirements of quality and predictability, which pose the greatest hurdle to growth of the niche.

The reason to develop a case of an adapted permaculture system that better suits the demands of the agro-industrial system is the mismatch between common permaculture business models and the scale-oriented regime system. This mismatch reflects a weakness of the permaculture system, because since the dominant system is agro-industrial, all related systems throughout the supply chains are also geared towards the end of dealing with uniform bulk produce. The permaculture business models would have it difficult to comply with the requirements.

7.3.1. Quality

The produce from the proposed system is organic, though certification would have to be organised and would add to the costs. Its quality is in fact above organic, as production is managed without any artificial inputs, creating possibilities for new certification or making permaculture products

recognizable. A standardised appearance cannot be guaranteed, as the establishment of a permaculture system usually includes genetic diversity to some extent. The products will reliably meet the maximum residue level (MRL) requirements of major conventional outlets like supermarkets, a requirement that is expected to be more important in the future.

7.3.2. Predictability

Due to the experimental nature of the production system, many predictability requirements cannot be assumed to be met. Crop parameters such as yield and quality are difficult to estimate, especially with regards to how the ecosystem develops during the start-up phase and over time. In the absence of factual data, judgements of yield size, quality and temporal predictability¹⁹ are unfounded, since the proposed model was only tested by digital means.

Part of the unpredictable nature of the system is caused by the continuous growth of the elements. After the initial phase, having gained experience and insight into the functioning of the ecosystem, better understanding of crop performance and interactions will allow for more accurate predictions. It is, however, possible to intervene in the system, allowing measures to be taken to reduce diversity and add predictability, if the trade-off for ecosystem development and related services is desired. The flexible nature of growing crops in alleys allows a new annual cash crop to be selected each year. This flexibility contributes to a secure income, since the system can be adapted to market demand.

7.4. Strengths

Strengths arise from the resilience of the system. It is to be expected that international supply of agricultural products will be increasingly unreliable. Resilience is therefore already beneficial today, and will be of growing importance in the future, as a way to secure supply in the long run.

The steadily growing demand for sustainable and residue-free products by consumers and therefore by supermarkets represents another direct strength of permaculture produce. Being organic, they already have an inherent added value, and being “permaculture”, they are likely to have a greater added value compared to the “organic only” counterpart.

This added value can lead supermarkets to be lenient towards the shortcomings of the products when it comes to appearance or predictability, as is the case with German supermarket chain Real. Real has developed its “Real Permakultur”²⁰ brand and advertises the products as only being available seasonally. Thereby the retailer transforms a shortcoming of the production system into added value of the product for the consumer.

¹⁹ Its strength does not lie in delivering precise amounts at predictable times, but to deliver independent from circumstances. The ecosystem approach; higher biodiversity and higher permanent plant cover make the system more resilient to weather extremes, thus increasing its predictability to be able to generate yields in adverse weather.

For the farmer, this predictability is likely to be more valuable than knowing at what time he will harvest which crop, because through the reliability of the system as whole, not individual parts of it, he can be sure to generally experience increasing yields for the coming 60 years.

²⁰ They source from a single 50 hectare farm in Spain owned and operated by Lehmann Natur, and aim to independent from the agricultural industry while providing ecosystem services in an area subjected to degradation of agricultural productivity. Real advertises the products as being 100% natural and exclusive, and only offer seasonal products with limited availability throughout the year.

7.5. Considerations

The last point made implies that creative management of the permaculture system and its related chain actors can transform weaknesses into potential benefits. In the following, some of the other aspects mentioned above (SWOT) as well as their implications and opportunities they may provide are therefore discussed.

7.5.1. Sourcing Dutch permaculture products now and in the future

Sourcing of permaculture products for conventional supply chains is accompanied by some hurdles, as at this point, only very small permaculture farms are productive in the Netherlands, and they produce too small yields to become a supplier of relevant quantities. The movement is a niche, but it is growing. The number of permaculture farms, food forests and related systems is increasing in the Netherlands, and within ten years there will likely be a significant supply of permaculture products.

It would be a costly initiative to develop large systems related to Dutch permaculture farms before sufficient supply exists. It is also questionable whether the farmers would be interested in selling through conventional channels. Observing the niche throughout this research resulted in the impression that for food forest farmers, it is more valuable to meet their customers eye to eye than to have a guarantee of selling at the best price.

Permaculture products are expected to have an increased added value in the future, probably representing a similar difference in margins as can be observed between conventional and organic produce today, hence investing in it has a high potential of being profitable in the long run. An economically unprofitable start-up phase can be creatively bridged through flexible agreements with innovative farmers. The resilience provided by the maturing system will pay back for the comparatively low investments required at the start, especially when taking into account that such resilience will only become more valuable as for instance intensity of climate change progresses.

Regardless of the perceivable hurdles listed in the SWOT above, it is valuable to develop strategies within the regime that provide inspiration regarding sustainable food systems amongst farmers. As will be explained in the following chapter (Discussion), inspiration is the drive that can enable sustainable growth. How this can be achieved in practice, unfortunately goes beyond the scope of this research, but the epilogue contains the authors' views on the potential of suchlike inspiration.

In this context, a general recommendation is made regarding the inclusion of the permaculture principles in agricultural production systems in the Netherlands, but also internationally.

7.5.2. Applying permaculture principles (NL)

Permaculture production embodies high sustainability values. It represents a strategic choice that shows recognition of the importance of producing and consuming differently. The analysed business models also reflect the farmers' strategy to clearly communicate this goal to locals and consumers, which the findings of this research identified to be a smart strategy in view of the likely development of the effectiveness of this approach now, and even more so in the future.

It is recommended to build upon this development and emphasise the focus on sustainability and communication thereof. Following the conclusion that consumer preference will move into the direction of placing more value on these aspects, it is highly recommendable for the Dutch agrifood sector to analyse incorporation opportunities of the sustainable permaculture principles. In this, the

production methods should be analysed with regards to the various values they can provide as well as the marketability of the observable values and functions now and in the future.

Permaculture principles offer a strategic opportunity to diversify farms in order to generate added values, resilient production and sustainable lifestyles. They can help to achieve sustainable crop production in the Netherlands.

7.6. Conclusion and recommendations

Permaculture has the potential to contribute greatly to establishing sustainable food systems if certain requirements are met. Firstly, the predictability of yields and production schedules should be researched further and in combination with practical application and monitoring, thus creating certainty on these factors. Secondly, alternative business models focussing on direct producer-consumer relations and short chains should be developed and tested, or conventional players could be identified that are interested in the products, like Real in Germany, and which would be lenient towards the less predictable production, as long as the added value of the products can compensate. At present, this is unlikely to be the most effective path, as Real appears to be an exception, and permaculture supply is limited. However, it is expected that supply will increase substantially in the future, and current consumer trends indicate that permaculture products will be in higher demand in the future, while the qualities of products will be of greater value.

Due to these factors, it is highly recommendable for farmers to transition to a production system incorporating permaculture or agro-ecological principles, not with the expectation of guaranteeing a predictable source of product based income in the short term, but with the wish to guarantee their own income in the long run, and to contribute to sustainable agrifood systems with associated products and lifestyles that are healthy and ethically sound. The transitioning phase can be long, but the system can be designed to pay itself back with a low risk, while showing promising potential also for future financial returns. To empower farmers to make this step and eliminate their concerns as to how to cover the transition period, innovative schemes for bridging this period are required.

The production system should also be seen as one with a high social values, which results in less value being placed on its predictable financial return and seeking instead to improve the local area as a whole. This holistic approach will benefit the farmer, farm employees, local residents, visitors, citizens and the environment and its natural inhabitants alike. Hence, investment does not have to take the form of charity, but will result in real benefits for all stakeholders belonging to a sustainable global food system²¹.

²¹ Except, perhaps, for stakeholders of multinational chains supplying artificial crop control agents, who have a vested interest in retaining the power of the regime, whose current influence is such enterprises' main asset.

Discussion, research recommendations and conclusion

This report was started from a big picture perspective, and zoomed in to some of the details of the Dutch agrifood system. Assumptions were made to be able to describe an imaginary future pathway. Further assumptions were required to compare both systems in terms of viability within the made-up future scenario. This final Chapter aims to take into account factors that were not mentioned previously, and discusses what their impact might be. It should be kept in mind that:

Especially futuristic aspects presented in this paper are far from being undisputable.

The arguments brought forth in this research aimed at providing a birds-eye perspective on contemporary and future issues that may be anticipated by the agrifood sector. Hence, it is about establishing a perspective that places the reader in a different mind-set and triggers different, and long-term thinking. Only heroic assumptions on future developments could enable a coherent reasoning that could provide such a perspective to the reader.

It follows that the conclusions and views presented here need to be studied with caution. The argumentation is valid in its own right, and this discussion places it into perspective of the bigger picture, in which some freedoms are taken with regard to the accuracy of details.

Considerations: Societal context in 2037

The future pathway of Chapter 4 has provided an impression of what the future may look like, but the scope of this report limited the amount of topics covered. Many of the following additional aspects could strongly impact the context of countries like the Netherlands in the future:

- Successes in automation technology lead to reduced need for human labour, making widespread unemployment likely
- But: Growth in new jobs connected to big data, automation and AI, as well as connected to leisure, health, care, tourism and recreation
- By 2037, many developed countries are therefore likely to have implemented basic income and people will no longer seek “employment” but fulfilment and self-actualization
- Internet to gain skills on a global level enables new economic and work concepts: Open-source kickstarter-programmes, self-employment, freelancing, crowd-sourcing, DIY support platforms, possibly open-source AI tools, etc.
This could lead to more people working flexibly or at home; less people commuting
- Transitions of energy and transport will probably progress significantly, implying personal car ownership might disappear, as public transport and ride-sharing systems develop further, and as shopping will likely take place online and deliveries directed at home/pick up points
- These and other aspects lead to the assumption that in the future, people might leave their homes less for activities related to “duty” (work, shopping), but increasingly for personal fulfilment.

The picture of the future refined with these points is one of a changing economy: The “maker and self-employed economy”, which could lead to wider distribution of wealth as well as opportunities. In this type of “maker” economy, unemployment would not be a problem, but an opportunity.

All of this would strongly influence the shape and functions of agricultural enterprises.

Implications for agriculture

Many of these changes imply a shift in the job market, and the purpose of work in general. Were jobs before seen as a way to earn a living, their future role would be one of personal fulfilment: spending time in line with an individual's feeling of purpose and contribution to a meaningful cause.

This can mean many things for the agrifood sector. Firstly, many contemporary labour requirements are likely to be replaced by automation, which would reduce costs in the long run while increasing efficiency. Especially the need for seasonal workers could be greatly reduced. Secondly, however, this could create structural unemployment. New technologies will provide new types of work, as was the case during the industrial revolution, though in this case, it is to be expected that more jobs will be lost than created. Lastly, in view of contemporary food-related trends, it opens the question if agriculture could then represent a way for people to achieve personal fulfilment.

These developments imply possibilities for both high-tech farming and permaculture farming. Where high-tech farms benefit from automation resulting in increased efficiency, permaculture farms would benefit from the fact that people would have more time to seek personal fulfilment, which often entails the kinds of values permaculture farms represent. The farms with their more social approach to work may benefit from the "self-actualizing maker economy" mentality that is likely to grow.

(External) motivations influence decisions

Fundamental to the decision making process between adopting high-tech farming or permaculture farming is the difference between individual motivation. Ecological solutions are easier accessible for the majority of farmers than the more expensive and complicated high-tech solutions. It is not clear why some farmers choose for ecology, while others place their trust in technology.

It is an interesting endeavour to analyse the decision-making process and the underlying motivations of farmers in their choice, and one that opens this discussion up to a different level altogether. This part of the discussion has therefore been included in the epilogue of this paper, as the reasoning behind it is speculative and very biased by opinions of the authors (see Epilogue). Here, the different motivations which underlie a farmer's decision are neglected and in the further discussion it is assumed that individual motivation in general is the main aspect guiding a farmer's choice.

Motivations, however, are external, and are therefore influenced by a number of factors, specifically by how a farmer perceives potential opportunities and especially restraints. The following aspects give a brief impression of existing lock-ins of the regime, which represent **lock-ins for farmers**:

- Policy incentives for large monocultures outweigh those for smaller or diversified systems²²
- Many efforts to adapt aim at biotech solutions (e.g. drought-resistant crops), driving agriculture towards more intensive and expensive management
- Mechanization is the status quo in most countries; It is most efficient in monocultures, as related systems (e.g. planters, harvesters) are designed for systems of one crop type
- The common belief that net biomass production is always greater in mono-cropping systems

²² Such incentives are often based on farm size, leading to much of the money going to farmers who are already capital strong, which negates the intent of such incentives to enable a sustainable income for farmers

These are external factors that influence a farmer's motivation and resulting decisions. With such lock-ins present, farmers are less free to make up their own mind concerning farm management, as the incentives and lock-ins represent external, not inherent, motivations²³.

If this is the case, then steps should be taken to remove the bias from the farmers' motivation and empower them to decide and act in accordance with to their own, inherent drive. As future farmers will be seeking purpose in their work, and as they are expected to demonstrate a high digital literacy themselves, the assumption could follow that if such lock-ins remain in place, farmers may increasingly turn away from the regime that restricts their freedom. Future farmers might decide to find motivation elsewhere, for example in themselves, or within the "maker" economy.

Distribution of wealth

High-tech solutions often come from high-income countries, whose private and public sector have the means to invest in the required R&D. Combined with high returns on investment, this can result in the accumulation of technologies, knowledge and wealth within the private sector of high-income countries. **The resulting distribution of power would be mainly corporately controlled.**

The development of agro-ecological approaches would likely attract less private investment, but have a high chance of being crowd-funded due to its high societal values. Combined with the personal connection between farmer and consumer in most such systems, this could lead to an **even distribution of knowledge, wealth and power between more actors, representing social control.**

What is important to take from this train of thought is the notion that deciding for different directions in a fundamental topic like this can have vast implications. Based on the underlying drive of the decision, extremely different outcomes are imaginable, which has the potential to impact as fundamental a development as the future distribution of wealth. Whatever motivates future farmers in their decisions will contribute to shaping the agrifood sector on all levels²⁴.

The potential of permaculture internationally:

Ecosystem restoration and sustainable development

In international development contexts, the approach may potentially have even greater positive impacts than when applied to Dutch agriculture. Due to its low-tech nature permaculture is easily accessible to farmers in any context, as it stimulates the use of the naturally occurring functions like irrigation through rainfall and fertilization through biomass decomposition. As the system creates year-round vegetative cover, it is highly suitable for tropical conditions, where the favourable climate enables year-round production of crops. Permaculture principles are ideal to improve farming conditions in regions experiencing productivity issues due to changing bioclimatic conditions or due to degradation of soils, as they enable re-establishment of such lost ecosystem functions, and the related systems of the approach can empower farmers and redistribute wealth internationally.

²³ If this distinction between inherent drive and external motivation is unclear, refer to the epilogue for clarification

²⁴ In the course of this section, the focus was slightly less placed on agriculture for the purpose of bringing to mind the big picture. This sentence shifts attention to the role of farmers once more, but it could also read "Whatever motivates future entrepreneurs in their decisions will contribute to the shape the economy of the future". Asking what would motivate entrepreneurs in the future leads back to the growing valorisation of self-actualization and possible growth of the maker economy.

Permaculture in restoration contexts

These characteristics make the approach applicable in restoration situations, where degraded landscapes need to be restored to productive capacity by reviving lost ecosystem functions. For example, restoration agriculture, a practice that uses several permaculture principles, is being implemented by various farms in the US to restore soils while producing food (Shepard, 2013).

In large-scale international landscape restoration efforts, permaculture principles in fact play a major role, as is demonstrated by the efforts and achievements of organisations like Commonland and the concept of 'Ecosystem Restoration Camps'. Both organisations cooperate in large-scale ecosystem restoration and part of the solution to the sustainable development and maintenance of their projects rests on agro-ecological or permaculture principles.

The results are vast landscapes which are revived from degraded states through the re-establishment of the natural functions of the ecosystem, and which thereby become productive systems again.

Permaculture in international development contexts

In developing countries, the use of permaculture principles in smallholder circumstances possibly has the greatest potential of supporting the global agrifood transition towards sustainability. It is in such contexts that many farmers give up their activities as external pressure becomes unbearable, and where youngsters leave farming communities as they see no future in the traditional life.

It seems that the pressure to compete with bulk production through artificial control agents creates a lock-in for farmers worldwide, which is critical especially for smallholders in developing countries.

Working with permaculture principles has the potential to remove much of that pressure from smallholders. The ideology aims at bringing to awareness the farms' potential to make use of the ecosystem services that are naturally available to farmers for free. Farms can be designed to maximise the use as well as the provision of such functions, which results in natural farm-ecosystem resilience rather than continued dependence on external inputs to replace the natural ecosystem functions. The conventional system traps farmers in the need to purchase inputs they cannot afford, as specialization on a few farm elements (one crop) removes the inherent functions from the system.

Empowering farmers in developing countries to understand the functioning of a resilient ecosystem and develop their farming systems accordingly brings back a sense of cultural historic identification. However, a simple turning back to such more traditional ways will not offer the solution required for developing countries, as youngsters will likely still prefer to search for more wealthy, convenient and fulfilling lives in cities. The empowerment of using and valuing traditional, local knowledge is, however, an important part of the solution. Empowered farmers do not feel trapped, and it can be assumed that they would rather look for solutions that are available to them in their communal and local context, instead of seeking artificial solutions to systemic issues.

This is not to say that technological solutions are not desirable in international sustainable development approaches. In fact, quite the opposite may be the case.

Attracting youngsters to farming

As farming is not seen as a desirable profession by many young individuals, permaculture farming by itself would still not be the most desirable profession for most. It is true that for example in the Netherlands, youngsters are showing an increasing interest in such socially and environmentally

sustainable agricultural activities and related lifestyles, which is a good sign for the future of the approach. Yet their interest in the method has developed from a perspective of having everything, as is the case for the authors of this paper and was laid out in the prologue.

In developing countries, farming should offer different values than reconnection to nature and sustainability in terms of 'people, planet, profit'. All of this should be guaranteed, yet to make the profession attractive to the young, technology should be incorporated to give it a more modern face. For instance, crop combinations could be developed for specific local circumstances of soil and climate by use of GPS and smart sensors; Management decisions could be backed by smart analytical and modelling systems; Labour intensity for maintenance and harvesting could be reduced by innovative appropriate technologies like drones and robots. The resulting picture of modern food production could be amongst the most inspiring professions in the eyes of the young, and the incorporation of agro-ecological principles would ensure a low entry threshold in most areas.

This argumentation is far from complete, and at this point, the required appropriate technologies envisioned do not exist, nor is it clear which direction the related new business models would take in developing countries. Aiming to describe this vision in detail would be counterproductive in the context of this paper because the question exceeds the research, but also because of the distance between the research, having taken place in the Netherlands, and the potential areas of application on the other side of the globe. Empowerment of farmers is key in developing sustainable food systems to which every farmer should contribute with his or her experience, and the notion to prescribe solutions from our Dutch research perspective might be part of the mentality that places the before-mentioned pressure on smallholder producers.

Therefore, without further discussing the practical details, we offer the preliminary conclusion that stimulating farmer empowerment as well as the inclusion of agro-ecological principles in international development approaches would not only mitigate some of the negative outcomes of the conventional approach, but would also have vast implications with regards to: Enabling locally adapted sustainable agriculture; empowering the poor; offering a perspective to struggling or young farmers; facilitating equal distribution of wealth; mitigating climate change; and overall strengthening an ethical perspective on agriculture as well as human culture as a whole.

Farming motivation in the future

Much is still required for such a vision to become reality, and the details should be researched in theory and practice to form an more complete picture of the possibilities and obstacles. To come back to earlier statements of this discussion, the question remains of what lies behind the individual motivations of farmers in deciding about their approach to (or departure from) farming.

- *What would motivate farmers in a future of, for instance, unconditional basic income?*
- *What would they value and how would they farm accordingly, in the Netherlands as well as internationally?*
- *How can their free choice be guaranteed, and what impact would their free choice have?*

Research opportunities

Since the purpose of this section is first and foremost to trigger thought, the discussion fittingly concluded with a question. Answering such and related questions may potentially provide more reliable insight on how to direct the agrifood transition.

Many of the assumptions made in the course of this research could be validated with additional research, which is why the following summarises suggestions for further research with regards to expanding this research itself, as well as a more practical suggestion, directed at the HAS research group “New Business Models” and other readers of this paper.

One hypothesis following the above argumentation is that a farmer’s intrinsic drive in a context unbiased by financial lock-ins would more likely result in the creation of agricultural systems with high social and ecological values as well as secure economic values. To test this hypothesis, and to discover what would happen to farming activities within, for example, the context of basic income for farmers, the authors recommend additional research on questions A and B:

Why farmers farm – today and in the future

- A. What drives farmers in their decisions concerning farm management, and are these external or internal drivers²⁵?
- B. What would drive farmers in the future, if economic security was guaranteed through for instance basic income²⁶, and how would this influence the values involved, decisions, activities and impacts of their farm in the future?²⁷

To deliver concrete answers instead of further assumptions, **a practical study is recommended**. Such a study could for instance aim at farmers who demonstrate long-term vision that helps them to take time to transition and develop a new business model delivering new values. A number of farmers should be involved and supported to develop own sustainability solutions on their farms without prescriptions on how they should reach a certain goal.

General directions should be indicated (e.g. reducing artificial inputs; sequestering CO₂; improving soil fertility; diversifying production; providing flood control), but the farmer should be allowed to develop his/her own solutions. The transition period would need to be supported. The “Green Deal” is an example of an exception which enables farmers to seek solutions within all possible options instead of being restricted by lock-ins like paying off debts on their farm land.

The following questions C and D would be most interesting to answer in such practical settings, but could also deliver insightful answers through conceptual modelling.

How farmers farm – today and in the future

- C. Which business models and related systems would allow farmers to incorporate new values?
- D. How would national (/international) agriculture change if such business models became common-place?

The proposed, differently managed farms would require time and support to stabilise, and measuring and monitoring of the development of economic, social and ecological values should be conducted on the farm. Subsequent results could provide deeper insights in farmers’ decision making processes.

²⁵ As with footnote (25), refer to epilogue if this distinction between internal and external drive requires clarification

²⁶ In case the researcher would not agree with the likelihood of a basic income in the future, this aspect may be adjusted towards a situation in which policy incentives and subsidies would be more balanced instead of promoting a specific approach, thereby also granting greater freedom to farmers.

²⁷ This question could be extrapolated to the economy in general, asking what would motivate entrepreneurs in the future if economic security was guaranteed.

It could empower farmers to find specific solutions for their farm's location and context in accordance with their individual values.

With this, local knowledge would be generated and will more likely be shared within the farm's sphere of influence, and the approach could re-establish a feeling of ownership regarding farm management as well as empowerment and interconnectedness with regards to the local economy.

Further remarks concerning the research

In order to more accurately describe the role of permaculture in the agrifood transition, more extensive research should be undertaken, and more developed farms should be analysed. In order to further develop the way of thinking described earlier and to provide more practical knowledge on the potential of food forests, the authors recommend the following:

- Developing a more detailed and well-founded future scenario would greatly improve the insights gained in the role of permaculture principles in the future of agriculture. By more accurately describing what society in 2037 will need and want, it will be possible to better describe if, and especially how, permaculture principles can fulfil these needs and wants.
- Only a small amount of interviews was conducted in this research due to the focus on certain characteristics in food forests (e.g. certain age and size required to be relevant) and the extensive nature of the analysis. It is therefore likely that not all the values present in permaculture enterprises have been described. The authors recommend further interviews be conducted in a wider, ideally international scope, which should be documented but not necessarily analysed as was the case in this research (see Chapter 3:chapter 1: Methodology).
- In connection with the possibility of conducting further, possibly international farm interviews, the focus should lie on larger scale, more commercial permaculture farms and their business models and impacts. With this, quantifiable information on for instance production potential could be gathered, delivering a more accurate impression of aspects like production potential than the conceptualised food forest of this report could.
- While conducting the interviews, the authors observed a lack of commercial knowledge amongst interviewees, and therefore relied on theoretical models for quantitative information regarding the food forest business model. It is therefore recommended to conduct interviews at food forest farms that have better insights in their commercial activities, which are to be found abroad if necessary.

This discussion has shown that different perspective can be taken on, for instance, an issue, which can change the meaning of the issue itself (e.g. a perspective in which unemployment may be helpful). It also opened up the perspective to examples of how vast reaching certain developments could be in changing society itself (i.e. the discussion of the potential impact of certain trends).

This section also directed attention to the question of what it is that drives transitions; what it is that makes people change their mind, and suggested that the 'internal drive' of an individual could be the answer. In the epilogue of this paper, we share some personal speculations concerning the nature and future of this internal drive.

Conclusion

This report has described the contemporary agrifood system and an assumption on how the regime and landscape will have changed by 2037. An investigation of the permaculture niche has shown the characteristics of its current business models, and its Unique Selling Points were determined by comparing the expected future performance of a standardised permaculture system with a 'business-as-usual' system. The findings have led to an answer to the main question:

How can a production system based on permaculture principles contribute to the agrifood transition?

An investigation of Dutch food forest business models show that they are founded on a holistic approach and mind-set, focussing on maximising ecosystem functionality and interactions, while internalizing social values. Hence, permaculture business models generate diverse values, each farm balancing ecological, social and economic values, having designed the production system accordingly. Social values are most often achieved by creating social involvement (e.g. participation, education, transparency and also belonging); while ecological values are created by biodiversity of the perennial systems and related functions (e.g. water retention, wildlife habitat, and carbon sequestration).

The mind-set of the permaculture farmer is a flexible one; observing, anticipating and reacting are important to ensure a successful production system. Thus, farm management is flexible, resulting in the ability of permaculture models to adapt to landscape changes. This is reflected by the manner in which permaculture farmers currently respond to changing discourses, relations, practices and institutional factors. The flexibility of the use of permaculture principles is illustrated by the fact that up to twelve archetypes can result from applying the principles (see Appendix II), two of which were observed within farms analysed in this research; one focussing more on production, the other one on creating and sharing social values.

The values generated by permaculture initiatives are expected to be increasingly important in the future and farmers are likely to have the opportunity to be reimbursed for sustainable land stewardship. Such developments will facilitate the adoption of more ecologically oriented measures on farms. At the same time, consumer demand is expected to develop in line with the values provided by permaculture systems, the former increasingly demanding what the latter has to offer. These values result in the following **USPs of permaculture in 2037** compared to conventional farms.

- **Ecological**
 - Use and provision of ecosystem services benefitting soil, water, air and biodiversity
 - Independence of limited resources
- **Social**
 - Attractive recreational space and beneficial health effects of green environments
 - Direct personal involvement possible, resulting in transparency (trust)
 - Landscape stewardship and food production can be achieved simultaneously
 - High health benefits of residue-free produce
- **Production system**
 - System resilience to bioclimatic extremes creating resilience of farm livelihoods
 - Flexible and adaptable to local circumstances and short, local supply chains
 - Applicable in locations unfit for conventional agriculture

The potential of the principles

The presence of these USPs in a transition scenario leads to the conclusion that permaculture principles generate a variety of transition-oriented values. Due to its diversity and inherent social and ecological values, permaculture is expected to be able to respond well to future bioclimatic conditions and consumer demands, which conventional systems are less likely to excel in. The underlying ethics and principles foster resilience and flexibility and can be applied in any context.

Permaculture principles are therefore expected to contribute to the agrifood transition by creating values that respond flexibly to future developments, and by providing options to the conventional system to adopt a broader sense of valorisation. Especially social values will be a decisive factor of a future food system's performance, and permaculture principles can be used as a tool to incorporate such key values into a production system.

The permaculture principles are generally not adhered to dogmatically, but represent a way of thinking and acting to provide production, social, and ecological values. This inclusive way of farm management is inherent to permaculture farmers and reflects the intrinsic motivation driving them.

It is therefore not exclusively the principles that empower farmers and enable the permaculture principles to become manifest in a multitude of beneficial values created on farms. **Moreover, it is the mind-set of the empowered farmer driven by intrinsic inspiration allowing the potential of the principles to become reality.**

Epilogue

The following epilogue expresses the personal opinions of the authors: Koert van Bommel, Katharina Grimm and Sandra van der Maas.

Many of the conclusions that were drawn in the course of this report share an underlying personal orientation not discussed in the main body, since it does not match its formal and evaluative character. This Epilogue is intended as further food for thought, and as an invitation to think with us.

We begin with a return to a selection of the assumptions and conclusions in this report:

- Transitions happen all the time, we are in the middle of one that aims at developing a long-term sustainable society
- Changing value systems of people, and changing landscapes, cause and shape transitions
- “Changing value systems of people” indicates that an increasing amount of people change their mind and act differently, according to changed underlying motivation
- Such a change of mind on a collective level is fundamental to transition
- It was said that bioclimatic circumstances and resource scarcity seem to jeopardise the stability of the global food system, which asks for fundamental change

The fundamental change that is a transition also is a fundamental change of mind.

With that in mind, we wondered about our own mind-set.

The authors' bias

What is our personal stance on some of the points discussed in the report? First, in our view, the world is *not* at stake. There may be problematic circumstances and outcomes of our current systems, but we are in no way concerned about the future of the Earth, which will continue to be just fine. We do, however, seem to be compromising Earth's ability to continue to provide us with comfortable, meaningful lives. Indeed, we might be harming our and others' livelihoods in fundamental ways.

We don't think that the on-going transition is confined to the agrifood sector or all the economic sectors combined, but that it is coming about on all levels of human life, through a fundamental, on-going change of mind. The topics discussed and findings highlighted in the research point in a similar direction: the permaculture farmers indicated that they were drawn to work in better balance with their surroundings, especially nature and other people. And they explained what it was about nature that inspired them to do so: The inherent logic, beauty and abundance of life that nature brings; The experience of learning and sharing with the many individuals involved; The feeling of doing purposeful work, and the care and love related to such a working attitude. Not to mention the positive effects on personal health and wellbeing that comes with their work and experiences.

What has been the drive for the farmer in general? Perhaps the urgent desire to contribute to a stable supply of food for everybody. In view of the losses people experienced during World War II, this was exactly what was needed, to rebuild a plentiful food supply and to avoid anything like the post-war struggles of hunger and scarcity from happening again. Loaded with the new technologies that were looking for new applications after the war had ended we made sure that this time, and for all time, there would be enough of everything. A noble purpose. Farmers did their part and intensified. The adapted post-war technologies helped them produce more and the successes of the

approach were extremely motivating, so more farmers scaled up. More was possible, more was successful, and more was what everybody seemed to want. But now we think that, perhaps, it is time for something different. Perhaps we can do even better.

Growing up with abundance does not eliminate the fun of *having*; we also experience the exhilaration of having this, or that, or more. But abundance might also mean something more. For us growing up with material abundance has been the standard. And now it serves as the basis for a wish for non-material abundance. We are standing on the shoulders of giants. The generations before us have created a world for us in which everything is basically taken care of and in which we have the freedom to look for purpose without any major worries on our mind. Our greatest worry is how to perfect the system we have inherited; How to bring it to the next level.

Motivation and inspiration

We are surely enthusiastic to play a role in the transition discussed in this report – indeed, we feel *inspired* to do so.

We would like to distinguish between two different kinds of drivers here, which stem from different mind-sets. *Motivation*, which often comes from the outside and is usually based on reward or punishment principles to motivate people to do something, which may include earning an income, paying the rent, building a reputation or needing to excel. In any of this, the source of our actions is defined by something outside of ourselves and we can muster willpower and do it. But most are not inspired to pay our rent, they are motivated to do it because the reward is a house, symbol of safety and achievement for many, and the punishment could mean to lose that house.

In contrast, we see *inspiration*²⁸ as a drive that comes from within; internal stimuli, almost a spiritual drive originating within a person, inspiring him or her to do what he/she feels is good.

In a balanced life, we need both. Our ability to motivate ourselves is required to indeed pay the rent in time and get our day-to-day duties done, but when we are pushed only by external motivators, we need a lot of willpower and soon lose energy; We worry, feel stressed, and risk exhaustion. Acting from inspiration on the other hand does not require such willpower and therefore represents a drive that is more easily sustained. Inspiration is that which gives you trust, makes you turn around and think “there must be a better way”, and then head out to find that better way.

Someone who becomes active triggered by external motivators perceives the reward and punishment principle behind the motivator. This indicates that the individual perceives some form of need or lack which is to be fulfilled, or even acts from fear of loss. Someone may for instance take on a job that does not inspire him or her but is necessary for generating an income.

What this also shows is the fine line that distinguishes motivation and inspiration: for some individuals, the need to earn an income may be perceived as an external motivation, a demand even,

²⁸ “What people need is not motivation, but inspiration”: Good leaders and good examples inspire people, calling upon their intrinsic drive to do something better, and they then motivate themselves. As management advisor Adler puts it: “Whereas 20th-century managerial frameworks focused primarily on motivation, often attempting to identify sets of rewards and punishment that would motivate workers to produce more, 21st-century leaders know that **such motivation is not enough. The leadership challenge today is to inspire people, not simply to motivate them.**” (Adler, 2006)

Note, by the way, that the word ‘inspiration’ itself contains the word ‘spirit’.

when they feel they do not have enough or they will not have enough if they do not earn more. Another individual may see the chance to sustain a family and enable the children to study, and feels inspired to earn more, or even amass wealth. A motivated person will have to push, asking “what” or “how”, while inspiration is like a pull, directing action by asking “why”. Motivation is thus useful when directed with good intentions, but it does not come from an intrinsic drive and we need willpower and short-term successes to keep going, and personal fulfilment is rarely achieved through motivated action.

What is important in such differentiation, therefore, is the underlying perspective of the individual.

Does the individual feel like an external demand is present, telling him he should do what is asked of him, that he is ‘supposed’ to do something, ‘or else...’; Or does the individual feel an own, internal drive? **One leads to fulfilling a need, while the other enables us to fulfil goals bigger than ourselves.**

With inspiration we can aspire to live better, more fulfilling lives, because an inspired eye sees beyond the lacks or needs which are often the base of motivators. Hence, the difference between the two is a very fundamental one and can be traced back to the distinct underlying mind-sets.

The two mind-sets depend on the perspective of the individual. Does he perceive a lack which he is asked to fill, then the act is motivated by scarcity. Does the individual perceive an inner calling of sharing his purpose with the world; the act is inspired by abundance.

We will come back to abundance versus scarcity in a minute, but first let us see:

How does this statement relate to farmers and this research as a whole?

It does so by illustrating what may be the driver behind the activities of the permaculture farmers as opposed to what may be the common drivers for conventional agriculture.

The permaculture farmers interviewed during this research demonstrated inspiration in the sense that none of them were looking for confirmation, prestige, riches or status from their activities. None of them used external factors as main motivators for starting the farm, but softer reasons, like wanting to live in balance with nature, learn and share with others, build a future for the children.

What all farmers also had in common was perceived security. All of them either had trustworthy partners they could rely on during the slow start-up phase, or they had financial cushions saved from a former day-job. None of the farmers started a food forest because he urgently needed to make money. Hence it can be stated that none of the permaculture farmers is pushed to fulfil an external demand or a need, but that they unanimously act based on inspiration.

Abundance and scarcity

The two distinct mind-sets that were mentioned, and the underlying differentiation of these mind-sets, can be categorized as being manifestations of either perceived abundance or perceived lack, or scarcity. The perceived security or trust, which permaculture farmers share is part of the abundance mind-set, and trust is not the only manifestation this perspective brings with it.

Perceiving the world from a place of abundance fosters trust and sharing. Individuals do not perceive that they or their lives are lacking anything, hence there is little need for 'getting more' and people are free to listen to the inner voice rather than external demands, leading to inspired action. Such a perspective of abundance is reflected in the way permaculture farmers use resources. Generally, the approach embraces naturally abundant ecosystem functions which are unlimited and work for the farmer, like sunlight, rain, natural nutrient cycles or healthy soil life. All of these functions are abundantly available, which the farmers see and appreciate, and by using them, they become more abundant.

Perceiving the world from a place of scarcity on the other hand can foster separation and perhaps jealousy, as individuals may experience having less than others. The industrial approach to farming demonstrates this mind-set of scarcity: There is not enough and we need to make more. Also this perspective is reflected in the farming approach. Year after year, an empty field is the starting point of the industrial farmer, which requires inputs that are no longer available in the deprived ecosystem. There is no natural abundance to make use of, and everything the field needs is to be provided from outside. The need for production is dominant, as clearing the land and obtaining the equipment involved required investment. Hence there is already a lack to be filled: Money is not sufficient, and its lack is aimed to be met by selecting a productive strain of a crop which is in demand. On an empty field, ecosystem functions are scarce, and the crop's needs have to be fulfilled artificially.

There is no abundance involved.

Or is there?

The preface of this paper has thanked the agro-industrial system for the abundance it has provided us with. Yet the argumentation above indicates that this conventional systems uses anything but abundance. And in fact, as we follow the implications of the argumentation, the notion crystallizes that the industrial abundance may be an illusion.

The introduction of this paper referred to FAO Director-General da Silva who stated that "We cannot rely on an input intensive model to increase production and [...] the solutions of the past have shown their limits." These limits stem from a systemic misperception, and da Silva's statement includes the hint required to realize the misperception.

The industrial model is "input intensive", using a lot of limited resources to deliver the impression of abundance. But with limited resources at the basis of the system, such an abundance cannot be sustained, in is therefore short-lived, and more an illusion of abundance than the real deal.

Real abundance can be observed in agro-ecological systems. By using the abundantly occurring functions of the location, crops can be produced without first creating a debt, and the resources required are not only continuously supplied naturally, they actually increase by being used.

A system is the result which uses unlimited resources, replenishes those resources as they are used, while generating a yield that is bound to increase over time, as the system matures and all elements of the system become more and more abundant²⁹.

Da Silva is right: The input intensive system has reached its limits, and these limits are, in our opinion, factually inherent to the system itself. Let us not try to push harder, foster more willpower and ‘fight’ for food security. Let us perceive the abundance that is already there and work to increase it, trusting that this mind-set in itself already contributes to achieving security.

Perhaps, our culture has veered off too much in the direction of external motivation. We feel pushed to keep up with others, compete and measure ourselves against them. And when those things are achieved – does that lead to lasting fulfilment? If we want to find and fulfil our very own purpose, inspiration must be found within. Like the permaculture farmers, we seek to act from inspiration and work with natural, real abundance.

We know many readers – farmers (conventional as well as ecological ones), policy makers, and citizens – will feel the same way and see that fundamental change for the better is inevitable. Let’s inspire each other on this path³⁰.

The actual transition

History has taught us that change comes through crisis. The example of the transition of organic agriculture showed that, even though there was some support for the movement for quite some time, it took external pressures at the scale of critical pollution and a nuclear disaster for the niche to develop a good business model. And even now, organic agriculture is a niche in the overall market.

But such crises increasingly affect us, not only in agricultural regards, but on a much broader scale. And though the great societal moves beyond the boundaries of agriculture, it does seem a good place to start. That is because agriculture provides a link between nature and people: **Food**. The agricultural transition is indeed at some kind of crossroads. At that crossroads, we need to choose well. And in this, we strive to choose from within, from our inspiration.

And permaculture farmers, in that regard, provide inspiration because they demonstrate that they regard food as such, as a link between earth and people. If we take this inspiration further to other (conventional?) farmers, agriculture might become a great force in this on-going change, as it is a way to shape and give function to the space in which we live, and farmers are the ones who have the closest relation to all elements involved. This is why we have studied agriculture in the 21st century: **Because food represents one simple key to strengthening the link between nature and people.**

²⁹ This perspective on real abundance can be better understood by looking at other examples. It aims to describe that real abundance entails that something becomes more when it is shared; By giving something you will have more of it yourself. In the context of ‘ideas’ or ‘love’ for instance, it is easy to see how both concepts increase and grow stronger when they are shared. Natural abundance adheres to the same principle.

Note also that abundance does not necessarily refer to material abundance, and in this case, it does not. The kind of abundance permaculture works with is the natural kind, it is the attitude of seeing and appreciating the abundance that is already here. Again, the distinction can be made between internal and external: Abundance is not achieved or gathered from the outside, it is an inner state to tune into

Now that we have reached the end of this report, and as three of the authors herewith reached the end of their studies, we will find a way in which to strengthen this movement further through our own inspiration. Permaculture's spirit resides in its use and supply of natural abundance and its suitability to provide for our needs as long as ecosystems exist. It relies on inspired individuals like us and you, who share it to make it grow.

It is this inspiration we seek to share, and it is what we propose: That the world's transition of today is, in fact, a spiritual one. Inspiration is the tool, sharing of abundance the attitude. And it is as straightforward and accessible as a tool can get:

All of us already have inspiration — we simply need to decide to tune in to that inner voice.

Motivation is of the voice of the ego and inspiration the voice of the soul³¹. Listening to either of these voices reflects a mind-set of abundance or scarcity respectively, a 'giving' versus a 'getting' attitude.

This shifts the level on which we are offered to make a choice, also in the current agrifood transition, as the question now is as simple as becoming aware of how we chose to perceive the world, moment to moment.

“Though the problems of the world are increasingly complex,
the solutions remain embarrassingly simple.”

(Bill Mollison)

Moment to moment, we choose to perceive the unlimited potential of real abundance,
and we are inspired to share it with you.

Koert van Bommel,
Katharina Grimm,
Sandra van der Maas

³¹ This conclusion has become a personal learning goal to the authors, and learning about the ego is part of this. In the way it is used here, the ego can be defined as a person's image of himself, a sense of self-esteem or self-importance, which is not necessarily based on truth, but more likely derived from how someone would like to see himself, or would like others to see him, reflecting external motivation (Dern, 2010)

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Appendices

Appendix I – Interviewees and interview guideline

Description	Name	Location
Farm	Fruitzforlife	Zeeland
Farm	Ketelbroek	Groesbeek
Farm	Doornik Natuurakkers	Bemmel
Farm	Levensland	Winterswijk
Farm	Fruitproeverij Zandberg	Rijswijk
Farm	Voedselbos Vlaardingen	Vlaardingen
Farm	Voedselbos Haarzuilens	Utrecht
Farm	Makeblijde	Houten
Farm	Voedselbos Weerwoud	Almere
Farmer	Louis Dolmans	Bemmel
Consultant	Malika Cieremans	Wageningen
Expert	Linder van der Heerick	Sint-Oedenrode
Expert	Stan Kerkhofs	Oirschot
Expert	Marianne Verhees	Eibergen

Farm interviews

Fruitproeverij Zandberg

This four-year old, 3-hectare farm is located in Zandberg (Gelderland) and run by Laurens Smiths and his wife. The food forests was set up with the original aim to create a self-harvest system, but is currently selling fruits and other produce to a restaurant in Amsterdam and a local specialty store. Next to this, he rents accommodation for meetings and yoga classes, runs a bed&breakfast, and his wife gives cooking courses at the farm.

Voedselbos Haarzuilens

This developing food forest is located close to Utrecht and set up as part of the nature-preservation area 'Landgoed Haarzuilens'. The food forest is around 5 hectares large and consists of a public food forest with recreational purposes and a more private part that is aimed to be seriously productive. In 2018/2019, Jan Degenaar, one of the initiators of Voedselbos Haarzuilens and the interviewee for this research, plans to offer the first self-harvest subscriptions to local people.

Levensland

Located on the German border, close to Winterswijk (Gelderland), LevensLand combines food production with nature on a former cornfield. More than 400 edible species were planted between species that arose from natural succession. LevensLand is run by 5 owners and is rather meant to provide food and a (spiritual) living environment for its owners than to have an economical purpose.

Voedselbos Ketelbroek

Food forest Ketelbroek is one of the oldest and therefore most developed food forests in the Netherlands. Since 2009, Wouter van Eck, the initiator of this project, is developing the food forest as a unique productive biotope on a former arable field of almost 2.5 ha. Ketelbroek is operated in close

cooperation with the Dutch Water Boards in order to maintain pieces of wetland in the food forest that serve as water retention facilities. The large variety of different products of Ketelbroek is sold to a restaurant in Nijmegen.

Doornik Natuurakkers

In Bemmel (Gelderland), Louis Dolmans grows old species of grains in a natural (biodynamic) agriculture. He maintains flower- and herb edges, hedgerows, forests and natural grasslands. Doornik Natuurakkers is meant to slowly develop towards a more permanent agriculture by planting food- and medicine-producing trees, shrubs and plants. Next to maintaining Doornik Natuurakkers, Louis Dolmans is the initiator of Stichting Van Akker Naar Bos, a foundation that promotes natural agriculture, agroforestry, permaculture and food forests.

Fruitzforlife / Fruithof de Brand

Fruitzforlife is the company of Sjef van Dongen, who designs and advises permaculture gardens, and next to that maintains a permaculture garden and food forest in Zeeland (Noord-Brabant), called Fruithof de Brand. This garden was set up as a demonstration and experimentation-site, but currently the owner is developing plans to sell some of his produce (fruits, vegetables, honey) through a webshop organised by a cooperative of like-minded farmers.

Expert interviews

Stan Kerkhofs

Stan Kerkhofs is a farmer and expert in the field of permaculture. During the interview, he expressed his opinion that permaculture is a means to retain economic value in local areas. The interview was joined by Alex Schreiner, a permaculture farmer who manages Tuinderij De Voedselketen. He provided perspective on permaculture business models

Marcel Webster

Marcel Webster is manager of the 'Transitieteam Brabantse Agrofood and FoodUp! Brabant'. In his role in the provincial government, he promotes and facilitates transitional food-related initiatives.

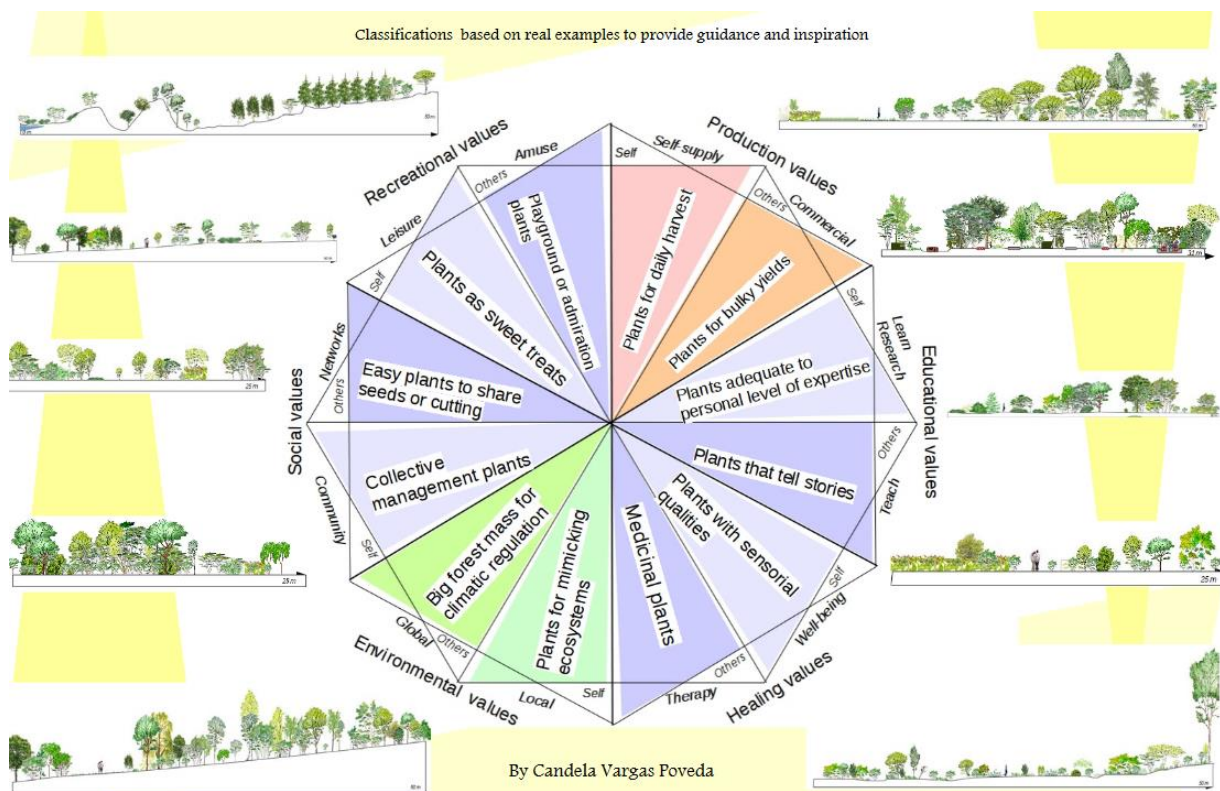
Interview guideline

1. Outline of the farm's business model
 - a. Reason to start the enterprise: which values were relevant for the individuals who started the permaculture enterprise?
 - b. Size, age, farm products, services
 - c. What are social/environmental benefits of the activities? (to find out values)
 - d. Production: How much produce, what type? How did it develop over time? Quality? Seasonality? Customer reaction? Production spikes?
 - e. Which sales outlets are used and why? What are rough price indications?
 - f. Who are your customers/consumers (and why do they buy your products)
 - g. Revenue model (ratio of revenue from side activities vs permaculture activities)
 - h. Which investments were necessary at the beginning of the enterprise? Which main costs are present at the moment? How did costs/investment requirements develop over time?
 - i. How much labour is needed (now, and how did it develop over time?)
 - j. How do you picture the future of your farm? Why?
2. Trends
 - a. Which trends and developments do you see in your sector?
 - b. Which developments do you see amongst your customers?
 - c. How do you see the future of food production? Why?
 - d. How do you see the future of permaculture? Why?
3. Opportunities/ Obstacles for the permaculture enterprise
 - a. Do you see a change in how people respond to for example your approach/products? Which opportunities and which threats do you see in this development?
 - b. What kind of possible relationships with other parties do you see developing? Which opportunities and which threats do you see in this development?
 - c. What kind of developments do you see in the common business practices? (to be specified according to trends; eg. Changes in logistics, online purchases, local or shorter supply chains, transparency, ...)
 - d. How do governmental rules and regulations affect your enterprise? Do they pose opportunities or obstacles?
 - e. What is needed for your permaculture business model to be successful?
4. How do you deal with these developments, opportunities and obstacles? How do you adapt?
 - a. How do developments amongst your customers influence your activities?
 - b. How do developments of stakeholder relations influence your activities?
 - c. How do developments of common business practices influence your activities?
 - d. How do developments of institutional rules and regulations influence your activities?

Appendix II – Food forest archetypes

Numerous similarities could be found amongst the farms, especially with regards to personal attitudes. What all farmers had in common, for instance, were some of the reasons for starting with permaculture: A wish to live a more balanced, healthy and happy life with positive impacts on the surroundings. All farms shared great valorisation for ecological aspects and reflected inherent valorisation of the permaculture ethics. These characteristics all benefit society in different forms.

Existing research, too, indicates that the outlook of farms differ to a certain degree, according to the personal drive of the farmer. Because of different values amongst practitioners, numerous archetypes of food forests can be found, reflecting which dimension the farmer values most. This finding is illustrated in the model below where an overview of twelve different forest farm archetypes is given which can be observed in international food forest initiatives.



Food forest archetypes (University of Copenhagen, 2012).

The illustration shows that the strategy behind the design of a system (depicted on the central axes of the wheel) determine the types of values a system will provide (edge of the wheel), and influences the shape the mature system will exhibit (illustrated on the right and left).

Appendix III – Complete comparison (details of chapter 5)

This appendix contains the comparison between the permaculture and the conventional approach to agriculture, which was summarised in chapter 5 and is presented in detail here. The initial comparison with relevant performance indicators is shown, after which the reasoning behind each expectation is explained in detail.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
<i>Environmental indicators</i>				
Impact on soil	--	++	-	++
Impact on water	--	+	-	+
Impact on air	--	+	-	+
Ecosystem services	--	++	-	+++
Landscape stewardship	--	+	--	+
<i>Societal indicators</i>				
Transparency and sustainability	0	+	+	++
Health benefits of produced food	+	++	+	+++
Societal involvement	0	+++	0	+++
<i>Indicators related to productivity and affinity with an industrial environment</i>				
Provision of nutrition	+++	+	++	+
Ability to be processed	+++	-	+++	-
Potential for automation	+	0	+++	+
Climate Resilience	-	++	--	++

The table above immediately shows that both systems have indicators for which they are expected to perform better than the other. In general, conventional agriculture performs better on points related to productivity and affinity with an industrial environment, whereas permaculture performs best for societal and environmental indicators. In the following sections, the indicators and the reasoning behind the expected performance ranking are explained in detail, after which conclusions regarding the unique selling points of permaculture are drawn.

5.1. Performance for environmental indicators

5.1.1. Impact on soil

As soil is already an important topic on the global agenda, developments towards more sustainable management of soils are expected throughout the whole agricultural sector. Soil organic matter (SOM) is one of the most important factors in effective soil management and an important indicator of soil health. It improves soil structure and benefits soil life, which results in better water retention, increased nutrient availability and reduced erosion and leaching (Verhulst, 2010). Hence, how both systems influence and manage SOM content is a key parameter regarding their impact on soil. To illustrate the difference between the two approaches, comparative research between tilling and no-tilling methods were used in the absence of data on permaculture farms.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Impact on soil	--	++	-	++

A prominent aspect of conventional potato farming is the active processing of soil, which is done to improve soil structure, which results in a temporary improvement. After the production cycle, potato foliage is left on the field, depositing around 800 kilogrammes of effective organic matter per hectare per year, resulting in an average organic matter content of 5% in the average potato field, depending on soil type (Timmer, 2004). Before the next production cycle, soil is tilled, exposing it and causing it to break down (loss of SOM). A direct effect of this is a loss of soil life (Verhulst, 2010), as well as increased leaching of nutrients, reduced water infiltration capacity and a higher risk of soil slaking, erosion and run-off compared to non-tilling systems (Reubens, 2010). Exposure of bare soil surface in potato farming is increased through the forming of ridges and makes it more vulnerable to weather circumstances, as it leads to higher soil temperatures and faster drying out of the soil.

Through for instance precision farming, conventional agriculture will move towards a more sustainable way of producing with reduced negative impacts. Therefore, the impact of potato farming on soil is expected to be less negative in 2037. However, as potatoes are tubers, soil processing will remain a necessity and therefore negative impacts remain inherent to the system.

Because there is little soil disturbance, a focus on biomass production and frequent pruning, food forests have a positive impact on SOM. The standardised food forest system is estimated to deposit up to around 2500 kilogrammes of effective organic matter per hectare per year (Prins, 2017), which is about four times more than the potato production system. Preliminary sampling of SOM in existing food forests have given an indication of organic matter contents ranging between 8% and 12% (Bionext, 2015).

This has multiple benefits for the soil. The depth of the top layer increases, the soil becomes more stable, and the structure of the soil improves (van den Putte, 2011). In combination with permanent vegetation covering the soil, the improved structure reduces the risk of the soil drying out. Nutrient availability and nutrient storage capacity of permaculture soils are high, which is beneficial for plant growth (Verhulst, 2010).

5.1.2. Impact on water

Water quality is an important factor to determine ecosystem health, biodiversity and safety of drinking water. This is especially the case for a country where water management is as intensive as in the Netherlands. Common parameters determining water quality are phosphate and nitrogen levels.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Impact on water	--	+	-	+

Currently, agriculture contributes nearly half of the total nitrogen and phosphate burden on surface waters (47% and 46% respectively). Potato is classified as a “leaching sensitive cultivation”, indicating that it has an above average risk to contribute to nitrate and phosphate burdening (van Dam, 2016). A report published in 2016 has found that 60% of sweet water bodies in the Netherlands are eutrophic, resulting in a loss of biodiversity and signalling an imbalance in the nutritional content of the water (RIVM, 2016).

Due to the previously discussed benefits of permaculture systems on soil, capillary ability and water retention capacity of permaculture soils are high, and accordingly, risks of erosion and water logging are low. The most important factors contributing to these benefits are soil cover, permanent vegetation (above and below ground) and the presence of plant residue (Verlinden, 2005). Additionally, because of the improved nutrient storage capabilities of the soil and the absence of chemical fertilizers or crop protection, little to no chemicals, mineral nitrogen or phosphate leaches into surface waters. Instead, being filtered by the vegetation, polluted water is cleaned.

As regulations for use of fertilizers and acceptable residue levels are getting stricter, conventional farmers invest in improving fertilization efficiency and decreasing nutrient leaching through precision farming. This ensures constant yields and crop quality while eliminating risks related to over fertilization and improves environmental sustainability. Developments like this are expected to drastically decrease the negative impacts of potato farming on water quality in the future (STERF, 2013). However, necessary soil disturbance as mentioned in chapter 5.3.1 will continue to create a certain risk of high evaporation rates and some nutrient leaching. Moreover, little improvements concerning SOM content are to be expected, water retention capacity will remain low. Therefore, negative impacts on water quality by potato farming are expected to decrease, but not become fully neutral.

Permaculture approaches will continue to filter rather than pollute surface waters in 2037 and provide space for water retention and protection against flooding. With maturing permaculture ecosystems, increasing amounts of vegetation present, and increased root filtration capabilities, water holding capacity will increase. This gives nutrients more time to be absorbed by the soil rather than to be leached out into surface waters.

5.1.3. Impact on air

Quality of air is an important factor in public health and agricultural productivity. Fine dust and CO₂ concentrations are commonly used parameters for public health and the greenhouse effect respectively. The density of fine dust and ozone (or smog) in the Netherlands is the highest of all of Europe, except for regions of southern Poland and Romania (UNECE, 2016).

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Impact on air	--	+	-	+

Due to fertilizer use, agricultural activities such as potato farming release ammonia into the atmosphere. Ammonia reacts in the atmosphere with nitrous oxides released during fuel combustion, and forms particulate matter. This so called secondary particulate matter makes up 60% of the total fine dust concentration in the Netherlands (UNECE, 2016). It is estimated that agricultural yield loss due to ozone and fine dust concentration can reach 15%, depending on crop sensitivity, while fine dust and ozone strongly promote the greenhouse effect³².

In the absence of fertilizers or crop protection, little to no ammonia or ozone is emitted from a permaculture system, and CO₂ emissions are significantly lower (KWIN, 2015) (Prins, 2017). The food forest system avoids negative impacts on air quality, and due to its large amount of plant biomass it also has a function in remediation of polluted air. Pollutants like fine dust are intercepted on the plant surfaces and other gaseous pollutants can be absorbed through the leaf stomata (Nowak, 2014). Improved air quality has also been perceived by farmers who were interviewed for this research.

The negative impacts of potato farming on air quality are expected to significantly decrease by 2037, as transportation will be cleaner, diminishing the formation of particulate matter. Although regulations regarding the use of agrochemicals will be strict in 2037, potato farming will not be able to eliminate its need for them; hence a certain negative impact on air quality will remain.

5.1.4. Ecosystem services

Ecosystem services are the expressed effects of the combination of soil quality, water quality, air quality and biodiversity. They result in a multitude of beneficial effects for humankind such as creating biomass, climate regulation and pest control.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Ecosystem services	--	++	-	+++

Being an annual monoculture, potato farming annually removes the existing ecosystem, and starts a new one at the start of the production cycle, never allowing a biodiverse ecosystem to develop. As such, potato farming produces very little ecosystem services, and in fact creates a demand for extra ecosystem services, and puts pressure on existing ones.

In 2017, conventional farmers are enticed to incorporate ecological services such as wildlife habitat in their production system when motivated by governmental incentives. The costs that are associated with these services, or the opportunity costs for not producing on a part of the land, are

³² The impact of agricultural processes by releasing fine dust and ozone on air quality also has an economic impact. The 15% reduction of crop productivity by polluting gasses leads to economic losses of billions of euros (UNECE, 2016). Next to the economic impact of reduced crop productivity, the health impacts of fine dust and ozone in Europe are estimated to be more than 10% of combined GDP (1 trillion euro) (Harmsen & van Vilsteren, 2016). Forest canopy has the ability to catch or filter air pollutants like ozone and fine dust. The removing capability of a regular forest of ozone and fine dust is estimated to result in a human health value of €23,25 per hectare (Nowak, 2014). In addition to human health benefits, similar results can be expected to reduce the 15% agricultural productivity loss associated with air pollutants (UNECE, 2016).

refunded by the government. In 2037, potato farmers will have to deliver certain ecosystem services and will be reimbursed for them, resulting in more ecosystem services being generated. However, this is not an integral part of the production system, and seen as a side activity.

Permaculture farms integrate ecosystem services and agricultural productivity as elements of one system, strengthening each other. This means that costs of ecosystem services are negligible, making the reimbursements additional income. As even more incentives and regulations are expected to have been put in place in 2037, permaculture initiatives are expected to benefit more from these incentives when compared to conventional agriculture.

5.1.5. Landscape stewardship

Landscape stewardship will be an important aspect in 2037. The countryside landscape will have to provide increased value to society, and at the same time governments are looking at entrepreneurs to create initiatives that produce these values incorporated in a business model. Furthermore, agriculture has the opportunity to be seen as a way to shape a green belt around cities, creating attractive surroundings and an incentive for citizens to leave the city and enjoy the health benefits and recreational benefits of spending time outside.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Landscape stewardship	--	+	-	++

Stewarding landscape with the purpose of generating social values is not inherent in the potato production system. In 2037, incentives will be put in place for environmental management, for example regarding biodiversity and aesthetic attractiveness. Financial rewards for land stewardship will encourage farmers to perform nature-preserving and landscape management activities in order to comply with regulations.

Permaculture farmers incorporate landscape stewardship in their business models intrinsically; it is part of the permaculture ethic ‘earth care’. This makes them an interesting party to work together with for governments, which could be mutually beneficial for both parties. As such, it is expected that the food forest business model will better utilise the increased need for land stewardship.

5.2. Performance for societal indicators

5.2.1. Transparency and sustainability

By 2037, consumers will have an increased preference for sustainable foods. Through digitalization, it becomes easier for them to find information on food production, increasing their demand for transparency.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Transparency and sustainability	0	+	+	++

In 2017, consumers have little to no concept as to what was needed for their food production. This is part due to their disinterest, and part to the opaque nature of the agricultural system. As their disinterest is replaced by higher standards by 2037, so the agricultural system will become more transparent. Potato farmers plan and record the use of their inputs closely, making information on

sustainability easily available. It is expected that by 2037 this information is publicly available; if not specifically for each farm, an average that gives the consumer accurate insight into the requirements of the production process.

Permaculture farmers monitor their system less literal, not so much thinking in required kilogrammes of nitrogen, but creating inherent fertilizing services within the system. This makes permaculture farms unable to provide factual transparency on its production process. However due to its ability to internalise social values, food forests are able to offer a much more direct, personal form of transparency. This form will be equally important by 2037, as a development towards identification with food and self-actualization through food in a recreational manner is expected to increase.

5.2.2. Health benefits of produced food

As the motivation to eat and be healthy becomes more prominent in the future consumers’ attitude, more value is attached to the health benefits of specific products.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Health benefits of produced food	+	++	+	+++

A potato production system can be regarded as providing a part of a potentially healthy diet, as potato is a source of dietary fibres, potassium, calcium, magnesium, vitamin C and vitamin B6 (Ware, 2016). However, since it is also a product often processed into frozen or deep-fried products, potatoes do have their place in unhealthy diets as well.

The rise of fortified and crossover products (e.g. products that have added nutritional or medicinal value), is expected to continue within the conventional sector. Through modification, products like potato could be fortified to contain for example more vitamin A (Waldron, 2015). Therefore, in 2037 the conventional sector is expected to produce more foods with health benefits than it does now. Studies have been conducted comparing the health benefits of organic products with conventional products, which can be extrapolated to compare permaculture products with conventional products (Baránski, 2014)³³. These studies imply that permaculture products have higher health benefits than conventional produce. Combined with the facts that food forest products have no residues, and that food forests produce a greater variety of foodstuffs that fit in a healthy diet, the conclusion can be drawn that food forests will produce a larger variety of beneficial nutrients and, therefore, make a larger contribution to human health in 2037 compared to a potato production system.

It is expected that in 2037 more research will have been conducted on the health value of various foods, and that society has more knowledge on what makes a product healthy. Since the definition of healthy for conventional products is based on contemporary research, it is therefore concluded that food forest products will be perceived as healthier in the future. As a great share of consumers in

³³ Most importantly, the concentrations of a range of antioxidants were found to be substantially higher in organic foods (with organics containing 20-95% higher contents of numerous antioxidants such as phenolic acids, flavonols and stilbenes. Many of these compounds have previously been linked to a reduced risk of chronic diseases, including CVD and neurodegenerative diseases and certain cancers, in dietary intervention and epidemiological studies.

2037 is expected to greatly value health benefits of certain foods, and choose certain foodstuffs specifically to increase their personal health, food forests products are expected to be a popular choice.

5.2.3. Societal involvement

As nature in 2037 is expected to be highly valued by consumers as a place for spending their leisure time, and soil-based agriculture is expected to have an important function in this, involvement of society in the production system is an important parameter for the success of a system.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Societal involvement	0	+++	0	+++

Potato farms are exclusive systems which generally do not allow visitors on their farm. However, the fact that potato is an important part of Dutch culture may be used as an argument for potato farms providing a societal service as well.

Food forests inherently have affinity with creating much broader involvement of stakeholders. They can function as a societal platform, for recreation, sharing knowledge and community building. As in 2037, these functions are expected to be increasingly important, food forest farmers are expected to choose these societal functions as a part of their farm enterprise. Selling food in the local area helps to retain local economic value, whereas potato farmers often sell to large companies and therefore do not contribute to this.

Next to this, systems that involve consumers in developing the system and the production process are expected to help local people feel a connection with the place that they live in. When, for example, they participated in planting trees in a food forest when they were children, as adults, they will still feel a personal link to this food forest.

5.3. Productivity performance in an industrial context

Due to factors like population growth and an increased preference towards convenience foods, productivity and affinity with industrial environment represent important characteristics for the performance of agricultural systems.

5.3.1. Provision of nutrition

Due to the increase of population and the possible movement away from animal protein, providing adequate plant based nutrition will be increasingly important in the future.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Provision of nutrition	+++	+	++	+

The caloric production of one hectare of potatoes is much higher compared to a standardised permaculture farm. Mainly due to the high carbohydrate content of potatoes, a hectare of potato

produces around 2.000 times more calories³⁴. For the production of protein however, the two systems compare much more evenly. A hectare of potato produces 1.5x more protein than a hectare of food forest, food forest protein mainly being found in hazelnuts. Additionally, a food forest produces 3x more fat than a potato field; fats that are monounsaturated and have been demonstrated to have multiple health benefits (Prins, 2017) (Ware, 2016).

Potato farmers are facing multiple problems with their production system; problems that are expected to become bigger by 2037. Resistant diseases will put pressure on production, as will soil depletion, weather circumstances and stricter regulations on pesticide and fertilizer use. It can thus be expected that potato yield will stagnate, and even decrease by 2037.

5.3.2. Ability to be processed

With consumers increasingly opting for convenient meals in the future, demand for products that are able to be processed into ready-to-eat meals will be high.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Ability to be processed	++	-	+++	-

A large portion of conventional food potato is processed. In order for the produce to be manageable in processing facilities, the products are expected to be uniform and delivered in large quantities. Conventional agriculture excels fulfilling these requirements and is expected to do this even better in 2037.

Permaculture, being a polyculture, yields lower quantities of different products, and uniformity is difficult to ensure since the production process is less controlled and focussed on generating diversity rather than uniformity. Therefore, in 2037 permaculture produce is expected to be sold as whole or be processed on a small scale.

5.3.3. Potential for automation

As technological innovations advance, agriculture and agricultural industry is enabled to utilise automated processes for increased efficiency and reduce labour requirements. Entire processes can become automated in the agricultural industry, whereas agricultural production enjoys increased precision and efficiency.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Potential for automation	+	0	+++	+

Since conventional agriculture is practiced on a large scale and already mechanised, automation will have a high positive impact on its performance. Resources will be used more efficiently, resulting in a

³⁴ The high production of potato enables the Dutch market to export a lot of potato and potato products, becoming one of the market leaders. This has generated a lot of knowledge and experience on potato farming and processing. The expert knowledge is also a valuable product that can be exported, and, together with the high amounts of exported produce, has significant benefits for the Dutch economy.

lower environmental impact. Additionally, automated processing will reduce labour costs for agricultural industry, and enables the industry to be operational around the clock.

The food forest production system is labour intensive, due to most labour being done manually. Automation could be beneficial for farms based on permaculture principles, since automated harvesting would greatly reduce the labour intensity of the system, making the option of upscaling permaculture farms more viable.

In relation to logistical automation, both systems are expected to benefit. Permaculture farms often work with direct sales to their customers; automated deliveries will reduce logistical costs and make deliveries more reliable. This enables the permaculture business model to move towards reliable at home delivery rather than relying on customers to pick up products which is more time consuming and makes the products less accessible. Conventional agriculture benefits from this by reducing the cost of transport to and from processors and wholesale.

5.3.4. Climate resilience

Dutch weather circumstances are expected to become more extreme and unpredictable in the years up to 2037. Longer periods of drought are expected, as well as heavier but less frequent rain showers.

	Conventional now	Food forest now	Conventional 2037	Food forest 2037
Climate Resilience	-	++	--	++

In 2017, potato farmers experience negative influence from unpredictable weather patterns. This results in the requirement of additional inputs such as irrigation, changes made in the production schedule, or parts of the crop being lost.

Weather patterns are predicted to be more irregular and unpredictable in the future, causing a greater impact on potato farming. Conventional agriculture businesses are finding their solutions in high-tech, closed systems, while potato production will lag behind regarding weather-resilient solutions due to its dependence on being grown in full soil. Therefore, potato production in 2037 is expected to be under high pressure especially by droughts and waterlogging.

The proposed permaculture system predominantly consists of perennials with a permanent root structure and a large amount of SOM. This increases the systems’ ability to manage water and thus enables it to handle different weather circumstances such as droughts or heavy rain. The fact that the food forest model contains multiple layers of crops, and therefore slows down heavy rains, adds to these benefits. Because of these reasons, permaculture is resilient to extreme weather patterns in 2017, and this resilience will be of more value in 2037 when weather extremes are more common. Through the diversity of produce, permaculture production is resilient to unavoidable circumstances such as late frosts as well: a permaculture farm will never lose a whole year’s harvest.