The rise of bottom-up initiatives in the Dutch agricultural sector

The possibilities for sustainable innovations to be implemented in a path-dependent policy sector

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Abstract

This research looks into what room there is for sustainable innovation within the Dutch agricultural planning system. According to the literature research, existing power structures, state-dependency and path-dependency make sure that production-based agriculture is desired, which has consequences for farmers, consumers and the environment while leaving little room for sustainable innovation to be promoted. Environmental measures are present in the current version of the Common Agricultural Policy, but these are often ineffective and can even work counterproductive. Given this institutional context, four promising sustainable agricultural innovations (Agricycling, community-supported agriculture, strip cropping and agroforestry) are researched and scored according to a "Sustainable Innovation Performance Index". Since institutional context is lacking in existing sustainability monitoring systems of agricultural business models, an index had to be developed for this research. Through interviews with experts, each innovation received a "sustainable innovation" score. According to the performance index, strip cropping is the most promising sustainable innovation due to its versatility in both implementation and environmental performance. This versatility also allows other sustainable innovations such as Agricycling to be applied simultaneously, which is advised to do because this combination allows strip croppings' potential to be fulfilled. Results show that CSA and agroforestry are not suitable to replace production-driven agriculture, however these projects can play a role in educating society about sustainable food production. The national government can contribute by using its central position to promote sustainable innovation in agriculture via *green* subsidies.

Keywords: Agriculture, Sustainability, Innovation, Biodiversity, Land degradation, Governance, Bottom-up initiatives, Path-dependency, Power structures, Multi-Criteria Analysis

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1. Introduction

1.1 Background

The year is 1950, the Second World war has just finished and the Netherlands is desperately trying to rebuild the country. A food shortage as a result of the war has the Netherlands in its grip. Sicco Mansholt, minister of Agriculture, Fishery and Food Distribution at the time, came up with an integrated plan to both solve this food shortage and even enlarge Dutch agriculture in such a way that large export volumes were possible. In 1962, when Sicco Mansholt was appointed European Commissioner, he expanded the same plan to Europe, calling for a uniform supranational agricultural policy. Referred to as "The Mansholt Plan", this policy plan ensured growth within the agricultural sector (Mansholt, 1970), which resulted in "export-based" agriculture. This was especially the case in the Netherlands, since the Mansholt Plan was already implemented as a national policy plan a priori.

The Mansholt Plan was introduced shortly after WWII and expanded to Europe into what we know today as the Common Agricultural Policy (CAP). Multiple scholars argue that the current agricultural policy framework (both CAP and the national policy) has not changed much since its initial launch (e.g. Evans et al., 2002; Frison, 2020; Klootwijk, 2016) . This can be seen in the Dutch agricultural policy plan because the same objectives are in place as in the original "Mansholt Plan", where Mansholt (1970) says that in order for the plan to work, "(…) there must be a programme of restructuring and rationalisation and that finance must be made available from the Government to ensure that the necessary changes take place". This quote shows that a centralised government is necessary in order for the plan to work, according to multiple studies (e.g. Wilson & Burton, 2015; Boonstra & Van den Brink, 2007). Moreover, Mansholt says that subsidies should be put in place in order for this plan to work. This reliance on subsidies has not changed much either (Frison, 2020). Although one might argue that it is 'strange' that a policy framework is still based on historic actions such as a food shortage, it is not uncommon. An institutional context can be an important instrument when choosing a planning approach, which will be explained further in chapter 2.2.4.

Whilst the common trend within spatial planning shifted from centralised to collaborative planning, one could argue that it is different within the agricultural sector. One potential downside of centralised planning is the supposed lack of innovation that is possible when (supra)national regulations are in place (Hendriks & Tops, 1999). This problem is elaborated upon in chapter 1.2.2.

1.2 Problem definition

Spatial planning has seen a paradigm shift over the years. Planning sectors were mostly compartmentalised until in the 1960s and 1970s, roughly at the same time as the initiation of CAP, a trend towards integration of policy sectors occurred. However, the agricultural sector is often viewed as being an exception to this integration trend and thus it is often referred to as an "exceptionalist" sector (Daugbjerg & Feindt, 2017; Hendriks & Tops, 1999). A potential downside is that innovation is less likely to occur in an exceptionalist policy sector (Hendriks & Tops, 1999). The reason behind this is that reliance on subsidies reduces the need to innovate. However, because of societal pressure and climate change the agricultural sector needs to shift towards sustainability. The research problems can be categorised in 'ecological' and 'institutional' and will be elaborated upon in the next sub chapters.

1.2.1 Ecological problems

The first important category of problems finds its roots in the Mansholt Plan and its focus on intensification and mechanisation. Growing one crop at a time (also referred to as "monoculture") increases yield and maximises the amount of subsidies that can be earned by farmers. Therefore, it makes sense for monoculture as the preferred farming method. However, growing one crop at a time also means that the chance of having plagues is relatively high. As a reference, forests (where numerous crops/plants grow simultaneously) have a lower chance of having plagues, because different crops (or plants, resp.) attract different animals which results in an ecological balance. Farmers use pesticides to reduce plagues that damage their crops (Blackstock et al., 2010). The result of using pesticides is soil degradation, because pesticides kill more than only the animals that damage crops, it simultaneously makes the soil become dry and poor. Another contributing factor to soil degradation is the use of heavy machinery (Harms et al., 1987). The weight of large machines compresses the soil, which makes it difficult for water to penetrate the soil (e.g. Blackstock et al., Harms et al., 1987). This means that the state of the soil when applying conventional agricultural methods is relatively poor compared to most sustainable agricultural methods.

Moreover, increased flood risk and decreased biodiversity are the result of conventional agriculture, because little greenery can result in wash-off and therefore increased flood risk and poor soil quality results in decreased biodiversity (e.g. Kenyon et al., 2008; Frison, 2020). A third consequence of monoculture is a spatial problem referred to as homogenization of the landscape, which also contributes to decreased biodiversity (Frison et al., 2020). One of the goals of this research is therefore to find out which innovations contribute most to decreasing the ecological footprint of today's agriculture.

1.2.2 Institutional problems

Multiple scholars view the shift towards mechanisation and intensification as "capitalising" agriculture which prevents sustainable agriculture from being implemented on a large scale (e.g. Alons, 2017; Boardman et al., 2003; Boussemart & Parvulescu, 2021; Daugbjerg & Feindt, 2017; Evans et al., 2002; Garvey et al., 2019). This capitalisation is embedded in the policy agenda within agricultural management, both on a national and supranational (European) scale (Boardman et al., 2003). Socio-economic factors result in farmers having little incentive in becoming sustainable (ibid). This means that agricultural planning has to reform in such a way that it becomes viable for farmers to become sustainable (ibid). The current subsidy system is arranged in such a way that increases in productivity are prioritised over environmental costs (Alons, 2017), implying that Environmental Policy Integration (EPI), a process of placing environmental considerations at the heart of the decision-making process in sectoral policies, could be considered to be lacking at the moment (Buizer et al., 2015, Falloon & Betts, 2009). This "failure" is a result of a low priority of environmental interests within agriculture, as well as a closed agricultural policy framework (Alons, 2017; Buizer et al., 2015). It has to be said that environmental discourse within the agricultural policy sector has certainly increased, but it is perceived as difficult to move from a political commitment to the policy outcome in terms of effectiveness (Alons, 2017).

A term that is often used to describe the agricultural policy framework is exceptionalism which refers to a policy sector having a special treatment (e.g. Daugbjerg & Feindt, 2017; Alons, 2017). According to Daugbjerg & Feindt (2017), agricultural policy can be considered the only policy sector to which exceptionalism applies. They say: "What made the agricultural-policy sector attractive was that it could be considered an extreme case of a compartmentalised and 'exceptionalist' policy-making process" (p. 1566). This is due to the fact that the agricultural policy sector is formed by a set of sector-oriented institutions, organised sectoral interest groups, a high amount of government intervention in the market (subsidies, quota and taxes, as mentioned by Boardman et al., 2003) and the potential for redistribution of assets from the whole population to a small group of landowners and producers, implying that farmers and landowners are state-dependent (e.g. Frison, 2020; Boonstra & Van den Brink, 2007). For this research it will be interesting to find out to what extent sustainable innovation can still occur in a highly regulated sector.

1.3 Research aim and questions

This research aims to examine how sustainable innovation is achieved within the Dutch agricultural sector, which is the primary research question (PRQ). In order to answer this question, the first goal is to identify bottlenecks within the current agricultural sector. This is done by providing sufficient theoretical background on the concept of sustainable innovation (2.1), the institutional context of the agricultural sector (2.1 and 2.2) and currently implemented sustainable measures within this institutional context (2.3).

The second goal is to construct a performance index that can measure both innovation performance and environmental performance. In order to develop this index, the elements of environmental- and innovation performance have to be defined (2.4). The performance index is used to analyse and compare four promising sustainable innovations in the Dutch agricultural sector on both innovative capacities given the institutional context and ecological capabilities. The construction of the analysis is more detailedly explained in chapter 3. In order to reach the aforementioned goals and therefore answer the primary research question (PRQ), the following secondary research questions (SRQs) are formulated:

PRQ: *To what extent can sustainable innovation be achieved in the Dutch agricultural sector?*
***SRQ1**: How can sustainable innovation be conceptualised from a theoretical perspective?*
***SRQ2**: Which governance structures are present within the agricultural sector?*
***SRQ3**: To what extent does the current governance approach contribute to sustainable innovation?*
***SRQ4**: Which innovations have the greatest ecological benefits and can be implemented on a national scale?*

2. Theoretical Framework

This chapter presents the concepts and theories that are necessary to answer the first three SRQs. Chapter 2.1 presents theories on the concept of sustainable innovation (SRQ1) and provides indicators for the performance index. In the second chapter governance structures within the agricultural sector are presented and the third chapter examines power relations. These chapters provide the institutional context and therefore answer SRQ2. The final chapter elaborates on different environmental measures that are currently implemented within the agricultural sector (2.4) in order to answer SRQ3. Chapter 2.5 presents the conceptual model that is constructed from the theoretical framework.

2.1 Comparing innovations

2.1.1 Environmental performance

In order to compare sustainable agricultural innovations, two important factors have to be measured: environmental performance and innovation performance. Measuring environmental performance from agricultural innovations is a thoroughly researched subject (e.g. Piorr, 2003; Talukder, 2016; Büchs, 2003). Although the mentioned indicators can differ between theories, there is a common thread that can be observed in which indicators to include in order to effectively measure environmental performance. These indicators are effects on *biodiversity, water management* and *land degradation* (OECD, 2001; Piorr, 2003; Büchs, 2003). Banerjee (1996) suggests that another aspect has to be considered within environmental performance of agricultural methods: *landscape quality*. Incorporation of landscape quality in AES (chapter 2.3.1) explains the widely acknowledged importance of spatial quality within agriculture. This importance is also seen in the presence of multi-functional farmers, as mentioned in chapter 2.1.1. Therefore, it is necessary to include spatial quality next to the earlier mentioned indicators in order to measure environmental performance of sustainable innovations.

Talukder 2016) developed a sustainability performance index that incorporates both environmental performance and innovation performance. Their method of analysis is based on a Multi-Criteria Analysis (more on which in chapter 3.4). However, Talukder (2016) only marginally includes institutional context, which is why innovation theory needs to be further examined. This can be used to develop an index that includes both environmental performance and innovation performance. The latter is explained in the next chapter.

2.1.2 Innovation performance

To measure innovation performance, the widely acclaimed theory *Diffusion of innovation* (Rogers, 2003; from now on abbreviated to DoI) is important for this research because it seeks to explain how, why and at what rate innovation spreads. In order to examine and compare agricultural innovations, its core characteristics have to be defined. DoI identifies five characteristics of innovation: relative advantage, compatibility, complexity, trialability and observability. According to him, these five characteristics determine the success rate of an innovation. *Relative advantage (1)* is the degree to which an idea is perceived as being better than its predecessor. Rogers' theory explains that innovations that have a clear advantage over a previous approach/method/idea are more easily adopted and implemented. *Compatibility (2)* is the extent to which an innovation matches existing values, past experiences and needs of potential customers/adopters. In relation to this research, it means the degree to which agricultural innovation fits within the current policy framework, which is in line with multiple studies that are related to goodness-of-fit (e.g. Van Geet et al., 2021; Mastenbroek & Kaeding, 2006). While goodness-of-fit focuses more on Europeanization, referring to the institutional fit of a European policy for the domestic policy framework (Scott et al., 2008; Makse & Volden, 2011), this same concept can be applied to agricultural policy innovation and its fit for the national policy framework because effectiveness of a domestic policy is related to the policy fit (Mastenbroek & Kaeding, 2006; Van Geet et al., 2021). *Complexity (3)* is the degree to which an innovation is perceived as "difficult to use" (Scott et al., 2008). Rogers adds that when key players perceive an innovation as simple to use, it is more likely to be adopted. In the context of this research, these key players are farmers and decision makers, so if farmers and decision makers perceive an agricultural innovation as easy to use, it is more likely to be implemented on a national scale (Mastenbroek & Kaeding, 2006). *Trialability (4)* is the extent to which an innovation can be experimented with. Since new innovations require investing time and resources, the innovations that can be experimented with before being fully implemented are more likely to be adopted. Lastly, *observability (5)* is the degree to which the results are visible to its adopters. If observable positive outcomes are present that come from implementing the innovation, it is more likely to be successful. In the case of agricultural policy innovations it can be expressed in both visible and result-wise observability (Makse & Volden, 2011). Concluding, this theory about innovation can be useful in gathering information about what currently prevents sustainable innovation from occurring in the agricultural sector. The aforementioned five characteristics of innovations are used as indicators of the Multi-Criteria Analysis (MCA), which is further explained in chapter 3.4.2.

2.2 Governance structures

Traditionally, the Dutch planning system was based on a strong top-down and centralised approach. From the 1970s onwards, this changed towards a more collaborative approach, due to societal pressure because of environmental effects of agriculture and homogenization of the Dutch landscape (Heide et al., 2007). Multiple scholars mention that the governance within the agricultural sector did not, as opposed to other planning sectors, adapt to a collaborative planning approach. Different views in governance theory are presented in the sub chapters below.

2.2.1 Collaborative trends in the agricultural sector

The 1970s showed that within planning, society had a larger say in the direction of policy-making. One of the results is acting upon an ongoing societal pressure on environmental regulation, and that included pressure on conventional agriculture. This societal change (mainly due to population growth or changes in income) and urbanisation made sure that the agricultural sector was forced to adapt (Runhaar et al., 2018). Many farmers chose to invest in cost-saving production methods or processes which generated more production value per hectare (Garvey et al., 2019; Runhaar et al., 2018). An alternative for intensification was a combination of multiple land uses on agricultural soil to generate more income. These "multifunctional farmers" link farming, the rural area and its visitors through initiation of recreational activities such as camping at the farm and Bed & Breakfast or maintenance of nature and landscape, in addition to their agricultural activities (Runhaar et al., 2018).

Boonstra & Van den Brink (2007) say that collaborative planning implies participants should have an equal opportunity to influence objectives within policy-making. However, as they argue, this is not the case within agricultural planning, because democratic power is often in the hands of large agri-businesses with an interest in intensive agriculture. This means that although collaborative planning is somewhat integrated in the agricultural sector, an equal opportunity to influence policy-making between all participants. Moreover, a monofunctional farming style leads to pressure from nature conservationists and face competition from rural residents and tourists who want the same space and this competition is primarily 'won' by stakeholders with an interest in conventional agriculture, showing that collaborative planning in a centralised policy sector can even result in enforcing the position of conventional agriculture (Runhaar et al., 2017).

In the past, the focus on efficient agri-production systems has led to a uniform countryside with many problems: intensification, fragmentation and loss of natural features and biodiversity (Frison, 2020). In order to prevent these problems, monofunctional farmers should realise that they act in a tightly regulated environment. Their production is controlled by strict regulations as derived from societal concerns, often supported by national or supranational legislation (i.e. quota, regulations on animal welfare and environmental-friendly production; Runhaar et al., 2017). This requires a shift in thinking when designing a new production system in which the interpretation of sustainability and participation of various stakeholders are important preconditions.

Concluding, collaborative trends within agriculture are present. However, using collaborative instruments can result in enforcing the existing policy direction towards conventional agriculture and therefore there is less opportunity for sustainable innovation to be promoted in the agricultural sector.

2.2.2 Still a centralised governance approach?

Veldkamp et al. (2009) acknowledge that the current agricultural policy framework is still dominated by a top-down centralised approach, especially when it comes to sustainable development. This view is supported by multiple scholars (e.g. Heide et al., 2007; Meerburg & Blom-Zandstra, 2009). Moreover, Veldkamp et al. (2009) argue that within a centralised policy sector, policies are defined by scientists and policy makers on a (supra)national level. The earlier mentioned quota and regulations that are present in the agricultural sector(Runhaar et al., 2017) imply that policy-making is defined by scientists and policy-makers and therefore I argue that a top-down centralised approach is still present. In order to examine how much room there is for innovation in this sector, the relationship between innovation and centralisation has to be further explored.

According to multiple scholars (e.g. Frison, 2020; Veldkamp et al., 2009; Westerink et al., 2015) the agricultural sector differs vastly from the trend within other policy sectors towards "collaborative" planning because of its centralised approach. The question that emerges is how sustainable development within the agro-sector can still occur in this centralised approach. According to Kay (2003) and Veldkamp (2009), one consequence of a top-down approach is that it limits bottom-up initiatives. Reaching the goal of sustainable agriculture is the responsibility of all participants in the system, including farmers, labourers, policymakers, researchers, retailers and consumers. When bottom-up initiatives are not promoted, I argue that policymakers are failing their responsibility to create an environment in which sustainable innovation is promoted. This same rhetoric is used by Meerburg & Blom-Zandstra (2009), who add that the agricultural sector is in desperate need of policy room for bottom-up initiatives by local stakeholders, because a top-down central approach does not often match the local situation. However, more room for bottom-up initiatives can also lead to emergence of conflicts and tensions in a highly regulated sector and is therefore perceived as difficult (Hendriks & Tops, 1999).

To provide more background on collaboration and communication within spatial planning, the communicative turn in planning has to be discussed. Healey (1996) presents an article which states that planning shifted from empirical and logical knowledge to guide action towards an inter-subjective effort at mutual understanding which enables purposes to be communicatively discovered. To relate her article to Dutch agriculture, a different trend is seen. The current policy framework and purpose of agriculture are viewed as scientific realism, which contrasts the communicative turn in planning. Scientific realism is best described as policy-making with a single fixed goal. Since modern-day agriculture still has a single fixed goal "to produce as much food as possible in an efficient way", it can be classified as scientific realism (Hendriks & Tops, 1999). Moreover, policy instruments like subsidies are predominantly based on the amount of acres that you own which adds to the classification of scientific realism (ibid). Veldkamp et al. (2008) mention that collaboration between stakeholders is one of the key factors in a transition towards sustainable agriculture because innovation requires active participation of key actors. The current top-down centralised approach means that some key actors have little say in the policy direction of agriculture (Meerburg & Blom-Zandstra, 2009).

To conclude, the agro-sector seems to be "stuck" in a loop. CAP makes sure that (supra)national governmental bodies determine the direction of agriculture. This does not mean that sustainable development is not promoted. However, a top-down centralised approach does mean that there is little room for innovation, because not all stakeholders are involved in the planning process. A lack of innovation means less possibility of bottom-up initiatives to be successful, which is against the main planning trend in most other policy sectors. As Hendriks & Tops (1999) note, the linkage between bottom-up initiatives to (supra-) national regulations is often perceived as difficult.

2.2.3 Area-based planning

Area Based Planning (ABP) is a planning method that is based on Habermas' consensus theory (1976) (Boonstra & Van den Brink, 2007) and is designed for incorporating consensus and democratisation into planning. However, its effectiveness within agricultural planning can be questioned. Boonstra & Van den Brink (2007) analysed the effectiveness of ABP through the example of East-Fryslân that illustrates the duality that rural planning has to deal with. According to them, rural governance is based on consensus building through the incorporation of stakeholder management. On the other hand, rural governance is a way of governance 'by procedure' with centrally controlled budgets, which relates to the argument that is made in the previous chapters. To mediate the 'national' administrative constraints and knowledge resources and the 'local' tier of participation and knowledge production turns out as a major challenge for rural governance. When reviewing the problem in this way, one could argue that, in line with the argumentation from chapter 2.2.1, consensus building is difficult in a policy sector which is still largely based on a technical governance approach.

Another problem is that farmers generally have low faith in governmental interventions because they have a problem with the government that relates to the past. On one hand, the government steered farmers towards intensification, and since recent times this intensification has been put to a halt, mostly by environmental agencies and waterboards (Boonstra & Van den Brink, 2007). However, this creates a bias in which farmers are less likely to comply with governmental interventions because they are sceptical about these interventions in advance. In other words, fear plays a large role in the difficult relationship between farmers and the government.

2.2.4 Path-dependency

As argued in chapter 2.2.1, Dutch agricultural planning is not merely shaped by centralised governance. However, when looking at the supranational policy framework (CAP), this can be seen differently. An important concept when reviewing CAP is "path-dependency". According to its initial definition, a system is path dependent if an initial move in a certain policy direction elicits further moves in the same policy direction (Kay, 2003; Frison, 2020). In other words, self-reinforcing or positive feedback is in place. It also implies having constraints on future choice sets, because a certain policy direction is chosen.

One of the most important explanations could be that the agricultural policy sector can be viewed as an "exceptionalist" policy sector. This means that the agricultural policy sector is treated differently than other policy sectors, which is the result of state-dependency. In this case, the presence of quota, guaranteed prices and subsidies explain this state-dependency of agriculture in the Netherlands (Kay, 2003). The financial importance of Dutch agriculture is one of the explanations of the "exceptionalist" position of Dutch agriculture. Another explanation is export orientation in agricultural policies. Frison (2020) explains that food systems have become more and more centred on export agriculture of a few commodities. This reliance on few commodities ensures that monoculture is the favourable agricultural method. The focus on efficiency and mechanisation also contributes to this tendency towards monoculture (Frison, 2020). Currently, most machinery is designed for monoculture, and therefore sustainable alternatives (which often require 'lighter' machinery) are not as often promoted (Frison, 2020; Kay, 2003). This is another example of path-dependency, since a sustainable direction is hindered by the current direction of technology. A policy shift towards promoting sustainable agriculture, away from the *path* of stimulating monoculture, will be difficult because of the focus on export (Kay, 2003). This concentration on export also implies efficiency and performance based innovation (ibid). In my opinion, the dilemma of the government is whether to shift away from export-oriented agriculture (and thus promote smaller-scale sustainable innovation) or to incorporate sustainability within monoculture. The problem is that the first choice requires shifting away from the current policy direction and the second choice limits the amount of sustainable solutions.

2.2.5 (Post-)productivism

Within agricultural planning there is an ongoing debate about the shift within agricultural planning from 'productivist' to 'post-productivist'. Productivist is defined as "*a commitment to an intensive, industrially driven and expansionist agriculture with state-support based primarily on output and increased productivity*" (Lowe et al., 1993, p. 221). Wilson (2001) adds to this that the productivist regime does not only consist of the Ministry of Agriculture and other governmental bodies. These governmental bodies are part of a network of institutions (also containing input suppliers, R&D centres, financial organisations, etc.) that is oriented towards boosting export-based food production via domestic sources. Characteristics of post-productivism are a loss of a centralised governance structure, a changing attitude of the public towards agriculture as 'the villain' and especially interesting 'move away from fundamentalism and exceptionalism (ibid), which relates to the previous chapter on path-dependency (chapter 2.1.4).

To elaborate on the productivist-modernization paradigm, Evans et al. (2002) have critically reflected on the claim that agriculture shifted towards post-productivism. Literature suggests that farmers are moving away from farming systems "(...) where a large proportion of total output is accounted for by a particular product" (Ilberry & Bowler, 1998: p. 71), which implies a shift towards post-productivism. Evans et al. (2002) points out that this claim can be questioned, because farmers are still subject to quota systems and Arable Area Payment Schemes (AAPS) embedded in CAP, which hardens structural and institutional rigidity in farming and thus shows little movement towards post-productivism.

Literature (e.g. Evans et al., 2002; Ilberry & Bowler, 1998; Wilson, 2001; Wilson & Burton, 2015) proposes another characteristic of post-productivism, which is environmental regulation concerning agriculture. Post-productivists argue that agricultural policy is currently focussed on extensification and sustainable farming is promoted through agri-environmental schemes (Wilson & Burton, 2015). If this is true, it could be argued that agriculture has shifted to post-productivism. When looking closer at these policies, they can be described as methods to reduce budgetary demands of agrarian policy while conveniently paying lip service to these extensification goals (Evans, 2002). Since Evans' claims were made in 2002, new policies have developed. Although not much has changed, CAP has added environmental measures in 2014 (see chapter 2.4).

To conclude, collaborative governance trends are seen within the agricultural sector, however these incentives can form a mismatch with the centralised mode of governance. This mismatch results in governmental stimulation of intensive and production-based agriculture and therefore show little incentive to address sustainability issues. The concept of path-dependency describes underlying mechanisms for the policy sector failing to incorporate sustainability in policy formation and creating an environment in which sustainable innovation is less likely to occur. To further examine the institutional context, power structures between the government, agri-business and individual farmers are identified in the next chapter.

2.3 Power structures

Power structures play an important role in the governance direction (e.g. Derkzen & Bock, 2007; Flyvbjerg, 2003). Within the agricultural sector, Derkzen & Bock (2007) mention that democratic power within agricultural planning is mainly viewed as "symbolic". In order to examine this claim, the next chapter will discuss both national power structures through an example of area committees. The second chapter focuses on power structures within CAP and how these structures influence the national institutional context.

2.3.1 National power structures

Within agriculture, the LTO is an organisation that is usually well-represented in municipal boards and committees. Matthijssen et al. (2015) present an article about democratic innovations within agricultural governance through area committees. Their research is a case study of two area committees in Friesland, Netherlands. In rural municipalities, such as the committees that were observed in their research, these committees are well-represented by the LTO. Two areas committees that were observed include 3 out of 10 people that represented an agricultural interest group. The same article also states that the area committees were formed according to a "Dutch tendency to include institutional actors rather than unorganised individuals in decision making processes". This shows a trade-off between pragmatic inclusiveness (the committee as a means of reducing potential conflict) and democratic inclusiveness (the committee as a true representation of the interests and people of the area).

Another interesting insight on these area committees is that, according to Matthijsen et al. (2015), 80% of the area of the case study is possessed by farmers, making them the most powerful interest group. Whilst one could argue that the agricultural interest group must have formal decision making power, this can be doubted because Mathijsen et al. (2015) argue that legal decision-making power remains solely at the municipal council, because the area committee only has an advisory role, meaning that the municipal council has the obligation to take advice from the area committee but are free to decide what to do with the advice. Therefore, formal decision-making power from area committees can be doubted and contribute to the claim from Derkzen & Bock (2007) about symbolic decision-making power by farmers. However, it has to be said that the advice is usually taken into account when making decisions because it simply cannot be ignored. This means that area committees actually have more power than they formally have, although it is still based on symbolic power (ibid).

Symbolic power structures between the area committee and the municipal council are best illustrated through an example. One of the two area committees that were researched by Mathijsen et al. (2019) has been dismantled after municipal elections. The reason for that is not officially known, but the chances are high that the municipality felt threatened by the area committee and thus dismantled it. The fact that the area committee had no ability to effectively challenge its dismantlement shows that even a highly institutionalised area committee is unable to challenge formal power relations. Therefore, the example of an area committee shows that collaborative planning is hard to exercise in a top-down central planning approach. It seems that the signs of collaborative planning within the agricultural sector are emerging, but collaborative planning can only work if the formal decision-making power remains with the (local) government.

Boonstra & Van den Brink (2007) looked at democratisation within rural planning. It involves two cases, one of which is in South-East Fryslân. In order to develop the area more in terms of economic growth, the Land Consolidation Act provided a framework in which farmers could develop their farms with subsidies. In this project, the dominant actors were the Rural Engineering Service of the Ministry of Agriculture and the Central Land Consolidation Commission. Its members were mainly drawn from several ministries and the Farmers' Union. This research points out that this Land Consolidation Act enabled farmers to develop their farms towards intensive agriculture, which decreases promotion of sustainability within the sector. Concluding, the agricultural sector is subject to democratisation and participation from agricultural stakeholders within agricultural policy-making, although both the stakeholders themselves (agri-businesses with an interest in conventional intensive farming) and the amount of actual decision-making power (mainly symbolic power) make sure that this democratisation does not always result in promotion of sustainability within agriculture and can even result in a decrease. Therefore, collaborative planning works best when the formal decision-making power remains with the (local) government.

2.3.2 Power structures within CAP

On power structures within CAP, Kay (2003) mentions that prominent farm interest groups are enjoying political power to influence CAP policy-making decisions. The most important part of their influence is a certain amount of privileged political access they enjoy. Although the absolute power of farm interest groups has declined throughout the years, its influence on decision-making has not necessarily declined because they do not have to compete with other interest groups for attention and financial support (ibid).

However, the actual decision-making power of farmer interest groups has declined throughout most European member states (Wilson & Burton, 2015). The roots of this decline are in the formation of policy networks which are, according to Smith (1993), evidence of the autonomy of state institutions. He states that the policy agenda of the network and the mediation of other views within the network are dominated by state institutions. Moreover, he mentions that through establishing policy networks with interest groups (such as a farmer interest group), state institutions increase the capacity of acting autonomously. Although state institutions generally try to act in agreement with interest groups (because it lowers cost of policy implementation in terms of acquiring information and 'selling' a certain policy direction), the farmer interest groups do not have genuine influence on the decision-making process during a reform situation, which illustrates the 'symbolic' power from stakeholders that is present within the agricultural sector on a national scale as well (see chapter 2.3.1; Derkzen & Bock, 2007).

Concluding, the example of area committees shows that collaborative planning instruments do not always function well within a centralised governance sector. The result is that stakeholders mainly have an 'advisory' role, which illustrates the symbolic power that is discussed by Derkzen & Bock (2007). Within CAP we can see that farm interest groups have a large say in the policy direction. However, these interest groups are usually financially supported by large agri-businesses and therefore steer towards intensive large-scale agriculture and do maringally address sustainability issues. This shows that collaborative instruments in a centralised governance approach can result in power asymmetries.

2.4 Currently implemented environmental measures

As argued in the previous chapters, the policy direction of agriculture does only marginally promote sustainable innovation within the agricultural sector. However, CAP does include environmental measures such as agri-environmental schemes, public-private partnerships and environmental cooperatives (Groeneveld et al., 2019; Rankin et al., 2016; Westerink et al., 2015) which would imply sustainable innovation within this policy sector. The next chapters will examine these environmental measures in terms of effectiveness and contribution to promotion of sustainable innovation.

2.4.1 Agri-environmental schemes

One of the most prominent additions to CAP concerning environmental measures in recent years is the use of Agri Environment Schemes (AES). AES can be described as a voluntary agreement between individual farmers and the government about measures on parcels and/or landscape elements to be taken to the advantage of environment, landscape and/or biodiversity (Buizer et al., 2015). However, environmental processes are rarely influenced by individual farmers, nor are these processes taking place on the level of the individual farmer, which means that local context is rarely incorporated and therefore its effectiveness can be doubted (Groeneveld et al., 2019). Moreover, agri-environment measures (AEM) are rarely aimed at farm-level strategies, while many of the environmental issues originate from changed farming systems (ibid). Another issue is that, since participating in AES is voluntary, it leaves the farmers with a decision whether to participate. AEM can be strictly prescribed, not flexible and difficult to combine with their farming practices and therefore farmers are less likely to participate (Boonstra & Van den Brink, 2007). This means that the impact of AES can be questioned. An alternative to AES is that extensive farming systems can be stimulated rather than taking measures that can be combined with intensive farming. However, this would imply steering away from the existing production-based system which would be difficult to achieve. Measures that can be combined with intensive agriculture are preferable when no radical intervention is desired.

2.4.2 Public-private partnerships

Next to governmental measures like AES there are also private forms of governance that stimulate sustainability within agriculture in the form of public-private partnerships (PPP). An example of PPP that results in promotion of sustainability is cooperative agreements between farmers, nature conservation NGOs and companies who want to address Corporate Social Responsibility programmes (Rankin et al., 2016; Derkzen, 2010). Although the environmental effect of these agreements can be doubted, it shows that private stakeholders can play a role in addressing sustainability issues within the agricultural sector (ibid).

Derkzen & Bock (2007) say that the agricultural sector is subject to a shift towards collaboration between public and private partnerships. However, as they argue, multiple empirical studies show that many of these public-private partnerships provide little access for community or civic representatives, enlarging the chances of financial agreements between powerful private stakeholders who want to keep the production-oriented policy structure intact (ibid). Moreover, when citizens do gain access to policy-making processes, they are in a disadvantaged position because they are subjected to a highly professional and bureaucratic structure. This means that they are seen as 'peripheral insiders', which basically comes down to them sitting at the table but not being able to influence central issues because of lacking institutional support and financial resources (Rankin et al., 2016; Derkzen & Bock, 2007). From this perspective, we can conclude that the information is in hands with professional policy-makers which enables power asymmetries to occur. Powerful stakeholders use these power asymmetries to their advantage, which is in line with chapter 2.3.

2.4.3 Environmental cooperatives

Environmental cooperatives were formed in the 1990s due to growing unease amongst farmers with evolving agri-environment regulations. The critique on these regulations is that they rely "too heavily on scientific input and neglecting local circumstances", which points at a centralised planning approach (Wiskerke et al., 2003). At the time, farmers believed they could tackle the environmental issues themselves without relying on strict regulation. Environmental cooperatives could fulfil this role by organising farmers, coordinating required tasks and negotiating with the national government. According to Westerink et al. (2015) environmental cooperatives are an example of self-governance. Self-governance can be best described as the ability of a person (or group) to exercise within regulation without intervention from external authorities (ibid).

However, as Westerink et al. (2015) and Termeer et al. (2013) point out, the trend towards increased self-governance seems to mismatch with the amount of government involvement in decisions of land managers with AES. This can be seen in the fact that, despite the fact that farmers' participation in AES is voluntary and they can to some extent choose an AES package of their liking, the rules of the scheme are rigid and specific (Termeer et al., 2013, Westerink et al., 2015). Furthermore, when farmers are engaging with AES, they have to intensively report and submit information to the government. A strive for self-governance and the amount of bureaucracy do not match (ibid). It has to be acknowledged that pure self-governance is not possible, it is more about an equilibrium between self-governance and government policy that is desired. The schematic model below shows both a good match of government policy and self-governance (A) and a mismatch (B and C). Because of the strive for self-governance and the amount of bureaucracy, B applies to the agricultural sector.

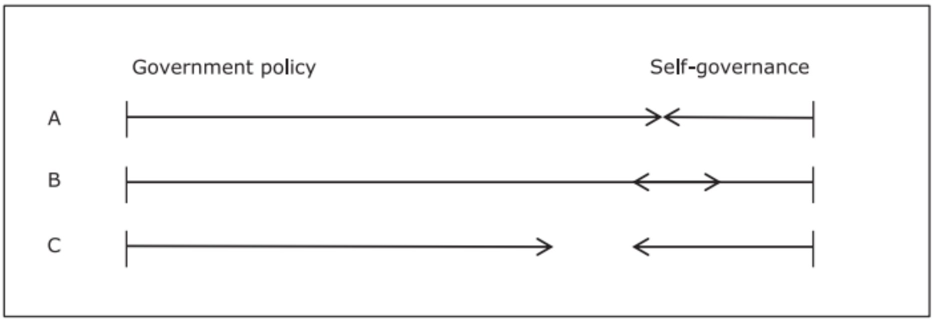

Figure 1: Self-governance vs government policy: match and mismatch (Westerink et al., 2015).

2.4.4 Promotion of local initiatives within CAP

Currently, social innovation and experimentation is happening rapidly at the local level. Examples are community-supported agriculture (such as "Herenboeren", which will be elaborated upon in chapter 3.2), farmers' markets, the creation of local food policy councils and urban food policies (IPES Food, 2019, p.24). Even though these are highly promising initiatives, Pe'er et al. (2019) mention that EU and national policies are often unable to encourage this type of experimentation. To be more specific, local food systems tend to be small-scale, which makes them ineligible for funding from CAP. Whilst supportive EU policies do exist, often the opportunities (for local initiatives resp.) are under-communicated, ineffectively implemented at both national and local scale, or lower in priority than boosting competitiveness in conventional markets (ibid). This is in line with Frison (2020), who explains that this subordination of boosting local initiatives is, amongst other reasons, prescribed to the influence of a limited number of agribusinesses, who's primary interest is supporting conventional industrial agriculture. Despite CAPs reform that is focussed on supporting sustainable agriculture, its subsidy system is still based on the amount of land that is possessed (which is an indicator for industrial agriculture), whilst the promotion of local initiatives and sustainable agriculture entails about 12% of CAPs budget (Peeters et al., 2020; Scown et al., 2020). The new Green Deal promises 30%, but the actual numbers on that are not available yet (Peeters et al., 2020; Scown et al., 2020).

Summarising, currently implemented environmental measures such as AES and PPP are present, but these attempts often fail to address sustainability and sometimes even work counterproductive. A strive for self-governance and a high amount of bureaucracy results in a mismatch between self-governance and government policy. Supranationally, CAP incorporates sustainability, however these measures are often under-communicated, ineffectively implemented at both national and local scale or lower in priority than boosting competitiveness in conventional markets (e.g. Frison, 2020; Scown et al., 2020). Concepts from the theoretical framework are schematically presented in the conceptual model below.

2.5 Conceptual model

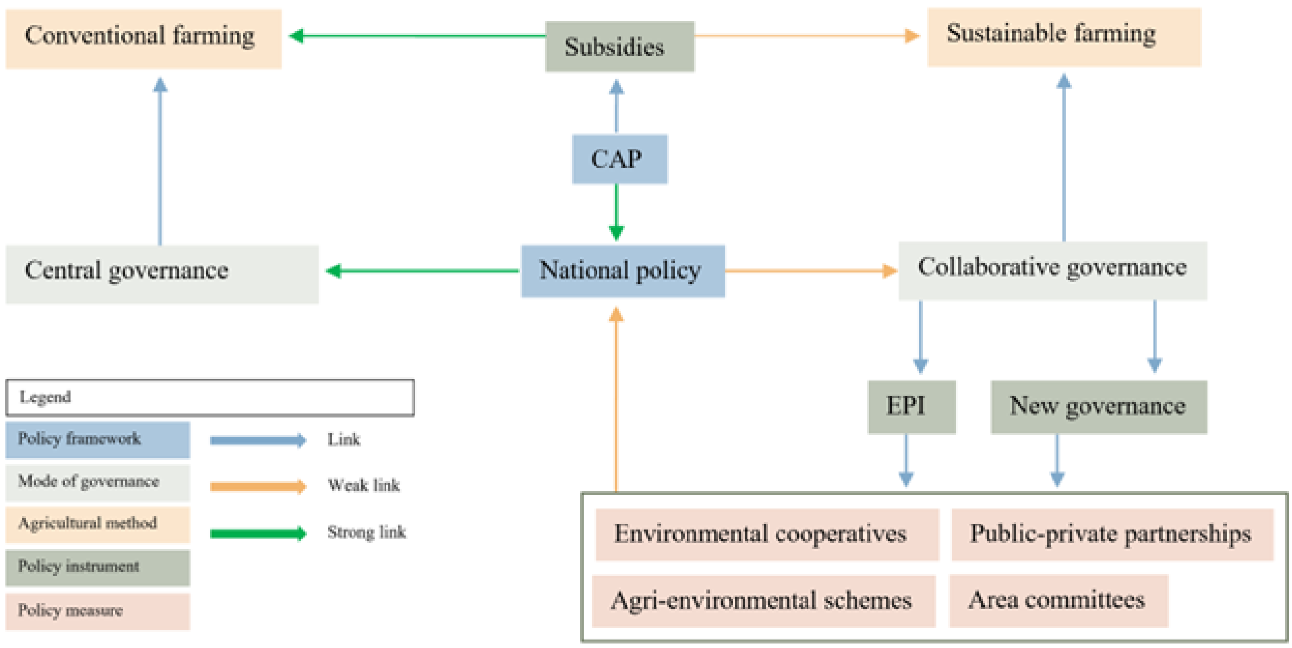

Figure 2: conceptual model, made by author

Chapter 2.2 shows that governance structures from the agricultural sector are mainly formed in the supranational policy framework (CAP, blue), which both influences the national policy direction (also blue) through subsidy distribution based on amount of land, which means that large portions of subsidies go to conventional farming practices. Chapter 2.4 showed that current environmental measures are often failing, and therefore its link to national policy is weak. Both CAP and national policies have policy instruments (grey) to steer towards promotion of desired agricultural methods (yellow) through a desired mode of governance (light gray). Subsidies form an exception because they all come from CAP. Subsidies are divided into promotion of both sustainable farming and conventional farming methods, with the higher amount of subsidies for the latter (80/20 ratio; Heyl et al., 2021). A predominantly centralised (supra)national governance approach makes sure that most subsidies are located to intensive agriculture and therefore its link with central governance is stronger than the link with collaborative governance. Collaborative governance consists of multiple policy measures, subdivided into EPI (which includes the environment more into the sector) and new modes of collaborative governance, which also have a mutual influence on national policy making. Although links between policy measures are identified as well (such as an influence of AES on environmental cooperatives), these links are intentionally left out because of clarity for the scheme.

3. Methodology

3.1 Research Design

The main goal of this research is to investigate to what extent sustainable innovation is possible within the agricultural sector. The theoretical framework provided the institutional context of the agricultural sector (2.2, 2.3 and 2.4) and chapter 2.1 provided background on how to measure sustainable innovation. However, as chapter 2.1 showed, existing literature does not include innovation performance when measuring and comparing agricultural innovations, as the main focus is on environmental performance (e.g. Piorr, 2003; OECD, 2001; Dumanski et al; 1998; Büchs, 2003). This is where Diffusion of Innovation (Rogers, 2003) is important because it provides indicators that measure innovation. The institutional context and background on comparing innovations is presented through literature research and this literature research also forms a foundation for the development of a Sustainable Innovation Performance Index (SIPI) where four promising agricultural sustainable innovations are measured and compared in terms of both ecological and innovation performance within the institutional context that is presented in the theoretical framework. This chapter covers the methodology of this research, which is schematically presented in figure 3.

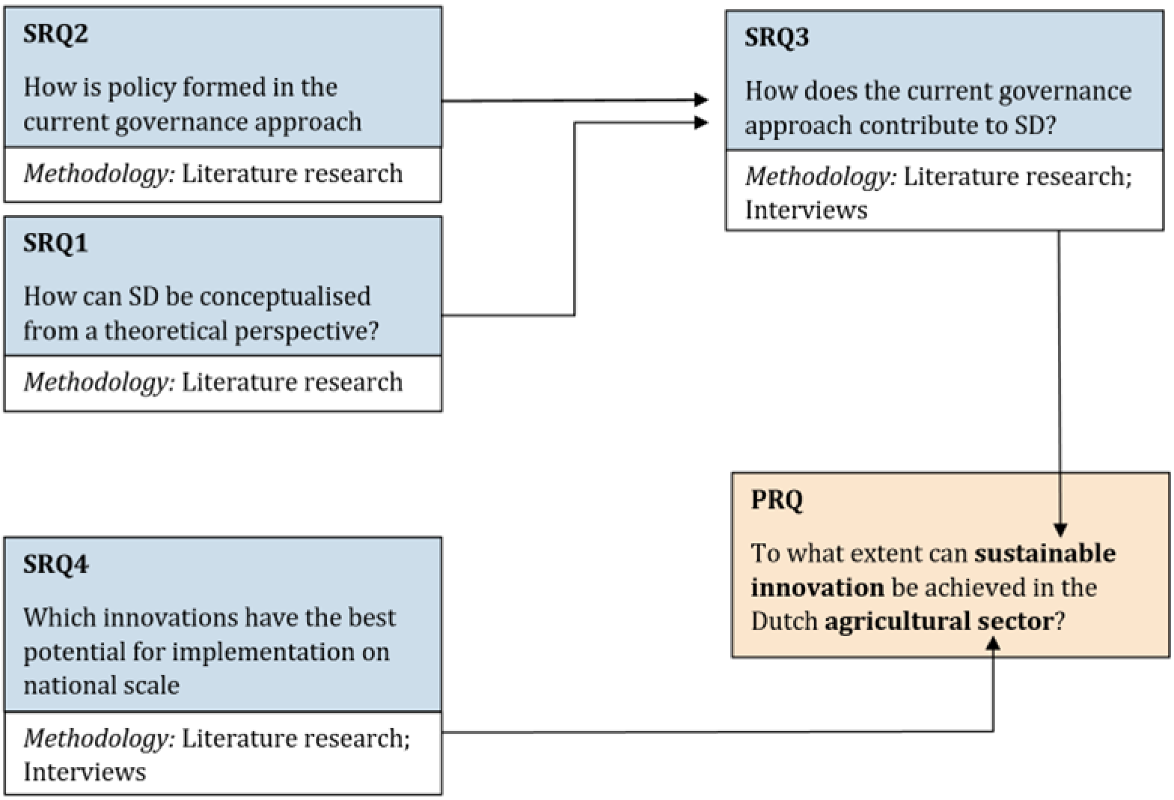

Figure 3: schematic representation of the research questions and their methodology, made by the author.

The chosen method of analysis for SRQ1, SRQ2 and SRQ3 is literature research, because these SRQs are necessary to provide background and context that is necessary to answer the PRQ. In order to answer SRQ4 different data collection is required, because innovations are compared and measured through quantitative data that is not readily available yet (because of differences in implementation phase). Therefore, it is necessary to gather data from experts from the projects themselves and that is why data for this SRQ is gathered through interviews, which is further explained in chapter 3.3.2.. These interviews provide qualitative data that can be used for analysis through the SIPI.

The chosen method of analysis for the SIPI is a Multi Criteria Analysis (MCA). An MCA establishes preferences between options by reference to an explicit set of objectives that the decision making body has identified, and for which it has established measurable criteria to assess the extent to which the objectives have been achieved (Konidari et al., 2007; Communities and Local Government, 2009; Greco et al., 2016). In this case, the objectives are to achieve SD within the framework that is set by decision-making bodies like the EU and national government. This MCA therefore functions as a tool to examine which innovation has the best potential to be implemented on a large scale. Moreover, an MCA has the ability to transform qualitative data (interviews) into a quantitative outcome (benchmark score), which is done by Dumanski et al., 1998. The method of data analysis is further explained in chapter 3.4. The following chapter will elaborate on the cases that are analysed and compared in this research.

3.2 Case selection

For this research, four different sustainable farming practices are analysed and compared with the goal to provide a viable alternative to conventional agriculture and explain the bottlenecks that prevent these innovations from large-scale implementation. This chapter provides background with practical information, supposed benefits and relation to the policy framework. together with reasoning on why these cases are relevant for this research. To provide a wide arrangement of policy options, the cases differ in intervention scale and motives.

3.2.1 Agricycling

The goal of agricycling is to recycle residual flows back into agriculture via fertiliser (Collectief Midden-Groningen, 2021). These residual flows will lead to enhancement of the soil, a better revenue model and ecological profit (ibid). The project started in Fryslân and as part of the "Regio Deal Natuurinclusieve Landbouw" and it was recently initiated in

Groningen as well. The residual flows can consist of reed, roadside and ditch clippings as well as human excretion. Nutrients from this manure reduce the need for fertilisers and enhance soil quality (ibid). Agricycling is considered to be a relevant case because it can be applied to intensive agriculture, forming a contrast to other cases. This application to intensive agriculture is mainly due to its small intervention scale ("simply" switching fertiliser) and therefore it seems to be a viable option to be implemented into (supra)national policy. However, there is no inclusion of agricycling in the CAP/GLB to this date, making it an interesting case for this research.

3.2.2 Community-supported agriculture

Community-supported agriculture (CSA) is a partnership between farmers and a group of consumers in which agricultural products are periodically delivered to this group of consumers by subscription. This subscription consists of a weekly/monthly subscription fee for which the products can be acquired (Lang, 2010). Depending on the type CSA, an investment fee can be charged, meaning the group of consumers is owner of/investor in the farm (Sebastian & Reghin, 2013; Lang, 2010). The Dutch implementation of Herenboeren, which is selected for this research, requires 200 households to make a one-time 2000 euro investment which is needed to build and maintain the farm. The cooperative hires a farmer and collectively decides what is cultivated on the farm. The contribution for acquiring the agricultural products is around 10 euros per week, depending on the season.

A CSA farm is run via nature-driven agriculture, meaning that the soil and natural animal behaviour is central to the project. It is also economically sustainable in the sense that the farmer is paid a monthly salary and members receive products against fair prices. Economic sustainability is further emphasised by the fact that the project does supposedly not rely on any form of CAP subsidies because it depends entirely on resources of its members. However, CAP could play a role in distributing this agricultural method. This case is selected for this research because of the different role of the farmer in an agricultural business. It will be interesting to see how farmers react to this positional change.

3.2.3 Strip Cropping

Strip cropping is part of genetic diversification. Genetic diversification means genetically different crops are grown in the same field and it entails a variety of versions both containing productive and non-productive crops (Xu et al., 2020). Strip cropping is where different productive crops are grown in separate rows. When located in the right way, the crops from different strips can strengthen each other in multiple ways (Mousavi & Eskandari, 2011). According to Xu et al. (2020) strip cropping benefits disease control, climate change resilience and biodiversity. They say intercropping can be viewed as the "new green revolution" because of its potential to raise land productivity by exploiting complementary species and thus contribute to a sustainable intensification of agriculture. This is different as opposed to agroforestry for example (discussed in the next chapter), which is labour-intensive. Xu et al. (2020) also concluded that yield with the width of 6 metre crop bands is similar to that of 12-24 metres, which means that intercropping does not comprise the yield. Crop bands of 6 metres promote the use of lighter machinery, which decreases land compaction (e.g. Blackstock et al., Harms et al., 1987). Intercropping counts as one of the possible farming methods when applying for an eco-subsidy that is presented in the GLB. This means that intercropping is widely considered to be a promising sustainable farming technique. This case is particularly interesting because it contrasts cases with a nature-driven focus.

3.2.4 Agroforestry

As Lundgren (1982) puts it: "Agroforestry is a collective name for land-use systems in which woody perennials are deliberately grown on the same piece of land as agricultural crops and/or animals, either in some form of spatial arrangement or in sequence". This can be done via integrating trees into farming systems or by integrating farming into forests (Raintree & Warner, 1986).

Agroforestry would qualify as sustainable agriculture because the use of trees decreases the need for using pesticides and increasing biodiversity (Raintree & Warner, 1986). This is helpful to combat soil degradation, increase biodiversity and even increase production volume per hectare, the last being the result of a vertically layered crop structure. Lundgren (1982) explains that the incorporation of multiple vertical layers of plants with different heights ensures more production volume. This can be somewhat doubted since not all plants have the same production volume. Since the 2014 CAP reform, around 80% of the total investment and maintenance costs (for the first 5 years) are covered by CAP subsidies, making agroforestry a viable alternative to conventional agriculture (European Union, 2014). CAP makes it possible that the specific requirements for funding (such as the minimum and maximum number of trees) are to be determined by EU member states themselves (ibid), which makes agroforestry a potentially interesting option to be implemented on a large scale. This case is of particular interest to this research because of its nature-driven approach, which differs from other cases with a focus of adoption in conventional farming. It will be interesting to see whether this approach has consequences for its potential for large-scale implementation.

The criteria and differences between all cases are schematically presented in figure 4.

Farming practice (case)	Intervention scale	Motives	Differences
Agroforestry	Large	Nature-driven	High financial cover through subsidies
Strip cropping	Moderate	Production-driven	Can be implemented with existing practice
CSA	Large	Nature-driven	Requires no subsidies
Agricycling	Small	Production-driven	Small intervention

Figure 4: overview of case selection, made by the author.

3.3 Methods of data collection

In order to answer the PRQ, two kinds of data have to be provided: background information for answering the first three SRQs and data to measure and compare environmental performance and innovation performance from the IPs. Because there is no quantitative data available on these Innovation Projects (IPs) that is necessary to compare IPs on their environmental and innovation performance, data is provided with interviews. These interviews can both provide information to conduct the SIPI and provide practical information on the institutional context as an addition to existing literature. Both methods of data collection are explained in the following chapters.

3.3.1 Literature research

The first data collection method is a literature research based on secondary data that is gathered from several academic journals (and policy documents). Its results can be found in chapter 2. The literature research was conducted through a traditional approach, which can be described as a "critical analysis of the relevant, available literature on the topic of interest being studied" (Hart, 2018). The aim of this literature research is to give an overview of the available literature on the chosen topic of interest. As figure 3 shows, the literature review forms the basis for the first three secondary research questions (chapters 2.1 to 2.3), as well as playing a more supportive role in answering SRQ4 because of its foundation for the indicators for the SIPI (chapter 2.1).

3.3.2 Qualitative interviews

Interviews can be a helpful tool when trying to acquire information on a subject that is either ill-described in existing literature or to gain insight into "*a person's subjective experiences, opinions and motivations*" (Busetto et al., 2020). Interviews can be structured in three different ways: standardised, open (for example an autobiographical interview) and semi-structured (ibid). For this research a semi-structured interview was chosen, because the interview is based on a guideline that provides a thematic orientation of the research, which both guides the interview (opposed to an open interview), whilst also giving the opportunity to answer freely, which is not the case in a standardised interview.

Forms of knowledge

One form of a semi-structured interview is an expert interview. In this type of interview, a distinction is made between contextual and operational knowledge. Contextual knowledge is required to provide practical information on governance structures, power relations and current environmental measures that contribute to answer SRQs 1-3. Operational knowledge on the different cases/projects in the form of ecological and innovation performance that is required in order to conduct the SIPI and therefore answer SRQ4.

Interview partners

Semi-structured *expert* interviews require experts to be interviewed. These experts will provide both operational knowledge for the SIPI and contextual data for answering SRQ1 to SRQ3. Figure 5 is a list of the experts that are interviewed and explanatory information about the interviewees and the forms of knowledge that are provided with this method of data collection.

Interviewee	***Position/Description***	***Knowledge about topic***	***Acronym***	***Date***
Interview partner 1	*Spokesperson agroforestry*	*Provide operational & contextual knowledge on agroforestry within the spatial boundaries of this research*	*A*	*06/12/2022*
Interview partner 2	*Spokesperson CSA*	*Provide operational & contextual knowledge on CSA within the spatial boundaries of this research*	*B*	*07/12/2022*
Interview partner 3	*Spokesperson intercropping*	*Provide operational & contextual knowledge on strip cropping within the spatial boundaries of this research*	*C*	*29/11/2022*
Interview partner 4	*Spokesperson agricycling*	*Provide operational & contextual knowledge on Agricycling within the spatial boundaries of this research*	*D*	*02/12/2022*

Figure 5: list of interviewees and their function and contribution to the research. Made by author

Interview guideline

According to Kallio et al. (2016) an interview guide is defined as a list of questions from which conservation is directed towards the research topic during an interview. As opposed to the standardised interview and an open interview, a semi-structured interview guide is considered to be loose, which allows open dialogue during the interview, however some form of structure is given. According to Kallio et al. (2016), good semi-structured interview questions are participant-oriented, clearly worded, single-faceted and open-ended. This implies that the answers can reflect personal feelings and stories, whilst the interview guide can possibly produce data where new concepts emerge. With these new concepts and the concepts that are presented in the conceptual model in mind, the interview guide is constructed (figure 6). The questions are formulated in such a way that the answers to these questions provide sufficient data for both DoI and sustainability indicators as well as leaving room to provide practical information on the institutional context. With the abbreviation "IP", the innovation projects from this study are meant (e.g. agroforestry). The table is divided into two sections, one with questions regarding DoI indicators (yellow) and another section with questions regarding sustainability indicators (green). The questions are classified according to each indicator. An interview transcript can be found in Appendix C.

Indicator	Question, IP = innovation project (e.g. Agroforestry)	Sub-question
Relative Advantage	To what extent does IP influence your work process?	Influence on 1) efficiency 2) quality 3) making your job more easy and 4) more control over your work
Complexity	How did the transition to IP go?	1) Was IP easy to learn? 2) Did the transition go fast? 3) Was it easy to become good at IP?
Compatibility	What are your motives to make the transition towards IP?	1) Were there any problems with law and regulations? 2) how does IP differ from your previous work process?
Trialability	To what extent is it possible to return to your "old" work process after IP is/was implemented?	Does IP have multiple versions to give more possibilities for implementation?

Observability	To what extent can a person see (from the outside) that IP is implemented?	1) To what extent is IP implemented by other farmers/people? 2) Is there interest from other people in IP? If yes, is this just *interest* or also *action*?
Biodiversity	To what extent does IP contribute to biodiversity?	What is IPs contribution to 1) richness and 2) variety of (new) species?
Spatial quality	To what extent does IP contribute to landscape heterogeneity?	1) To what extent does IP contribute to multiple land uses?
Land degradation	To what extent does IP contribute to decreasing land degradation?	What is the contribution to 1) water penetration 2) soil compaction 3) soil life
Water management	To what extent does IP contribute to water management?	What is IPs contribution to 1) water usage (irrigation) and 2) water quality

Figure 6: Interview guide, made by author

3.4 Methods of data analysis

The chosen method of data analysis is the Multi-Criteria Analysis (MCA). A key feature of an MCA is its emphasis on the judgement of the decision making team, in establishing objectives and criteria, estimating relative importance weights and, to some extent, in judging the contribution of each option to each performance criterion (Talukder et al., 2016). This judgement is based on literature research and the output of interviews. A sensitivity analysis is performed in chapter 4.5.1 to measure the influence in outcome if the weights are distributed differently.

A potential downside of MCA is subjectivity (Konidari et al., 2007; Communities and Local Government, 2009). However, if the criteria are chosen based on a solid foundation, subjectivity can be marginalised (ibid). This foundation relies on Rogers' Diffusion of Innovation Theory (chapter 2.4) and existing literature about sustainability parameters of agricultural practices, which is presented in the next chapter.

3.4.1 MCA indicators

The goal of this MCA (abbreviated as SIPI in the specific case of this research) is to measure *innovation* and *environmental performance* through a selected amount of indicators. Both indicators are further explained in the next chapters.

Innovation performance indicators

Existing research about measuring innovation is present in the form of Rogers' Diffusion of Innovation theory (2003). As explained in chapter 2.4, Rogers' theory is based on five innovation characteristics: observability, relative advantage, compatibility, trialability and complexity. Since Rogers' theory is predominantly used in measuring potential market adaptation of consumer product innovations (instead of policy innovations), not all aspects (indicators) are considered to deliver equally contribution to sustainable innovation. As mentioned in other literature where an MCA is conducted (e.g. Bharadwaj & Deka, 2021), different weights are assigned to the MCA indicators. (1) Relative advantage is considered important because advantages over existing agricultural practices are necessary to make the sector more sustainable. Compatibility is also considered to be especially important because the institutional context presented in chapter 2 showed little room for sustainable innovation. Observability receives a fairly low score because it relates to the institutional context.

A list of the five innovation indicators (and their sub-indicators, or "items") is presented in figure 7. The items are based on multiple studies on a wide variety of consumer innovation adoption, such as cryptocurrency, internet banking, online shopping, e-marketing and water-saving irrigation innovations (respectively Bharadwaj & Deka, 2021; Tarhini et al., 2015; Qashou & Saleh, 2018; Warner et al., 2020; Zolait, 2008), which means these items are so broadly used they will fit this research as well because of a similar goal (comparing innovations). However, since this research observes policies instead of consumer products (like most of the aforementioned studies), some of the "items" are changed in their formulation to fit the research subject (for example COMT2 is changed from 'practices' to 'agricultural practices'). The unit of measure is a score of -1 to 2, where -1 means a negative influence, 0 means no influence, 1 means an indirect influence and 2 is a direct influence. The final score for each indicator is calculated by dividing the cumulative score of the items by the amount of items. An example for the calculation of the score for Relative Advantage (RA) would be that the cumulated score of the items is divided by 5 to calculate the total RA score.

Indicator	Items, IP = innovation project (e.g. agroforestry)	Unit of measure	Weight
Relative advantage (RA)		Total score/5	0.3
RA1	IP would enable me to accomplish my work faster	-1 to 2	
RA2	IP would improve the quality of my work	-1 to 2	
RA3	IP would enhance my effectiveness on my job	-1 to 2	
RA4	IP would make my job easier	-1 to 2	
RA5	IP gives me greater control over my work	-1 to 2	
Complexity (CMPX)		Total score/3	0.15
CMPX1	Learning to use IP would be easy for me	-1 to 2	
CMPX2	If I were to use IP, it would be easy to use	-1 to 2	
CMPX3	It would be easy for me to become skillful at using IP	-1 to 2	
Compatibility (COMT)		Total score/3	0.35
COMT1	IP would be compatible with most aspects of the current institutional framework	-1 to 2	
COMT2	IP would fit current agricultural practices	-1 to 2	
COMT3	IP would fit well with the way I like to work	-1 to 2	
Trialability (TR)		Total score/3	0.15
TR1	To what extent can IP be used on a trial basis?	-1 to 2	
TR2	To what extent is it possible to properly try out IP?	-1 to 2	
TR3	To what extent are there more versions of IP available?	-1 to 2	
Observability (OBS)		Total score/5	0.05
OBS1	I will use IP when many farmers use it	-1 to 2	
OBS2	I will use IP when I have seen other farmers use IP	-1 to 2	
OBS3	I will use IP as soon as I get to know about IP	-1 to 2	
OBS4	I will use IP if its effects become visible	-1 to 2	
OBS5	I will use IP when others have a successful experience	-1 to 2	
		Total	1

Figure 7: table of innovation indicators, made by the author.

Environmental performance indicators

Contrary to the innovation indicators, existing research on (agri-)environmental performance indicators (e.g. Dumanski et al., 1998; Büchs, 2003; OECD, 2001; Phillis & Andriantiatsaholiniaina, 2001) is predominantly focused on quantitative indicators such as crop yield, soil quality, water quality and greenhouse gas emissions. These indicators cannot be used in its existing form because the required quantitative data cannot be acquired (for an explanation, see chapter 3.4.3). However, these articles do include important aspects like biodiversity, land degradation, water management. Dumanski (1998) and Piorr et al. (2003) highlight the importance of including spatial quality in the form of landscape heterogeneity. This absence of quantitative data means that Environmental Performance Indicators (EPIs) have to be measured another way. The problem comes down to the following question: how to formulate EPIs without quantitative data? The solution to this problem is presented in a paper by Dumanski et al. (1998) about performance indicators for sustainable agriculture. Their article presents a methodology by using the knowledge of farmers to present the values of the EPIs. The same methodology is used in this research in the form of interviewing project experts to gather this knowledge on biodiversity, spatial quality, land degradation and water management. According to e.g. Heyl et al. (2019), agriculture's largest threats are decreased biodiversity and land degradation and these indicators are therefore weighted the largest. Soil compaction is considered the largest threat in the Netherlands and soil erosion is a global issue, however in the Dutch context it is less relevant and therefore weighted less. Dumanski (2003) and Piorr (2003) their addition of spatial quality to assess environmental performance is accounted for, but homogenisation of the landscape is not considered to be one of the largest threats (Heyl et al., 2019). These indicators also come with limitations which are presented in chapter 3.5. Indicator values are based on information from IP expert interviews.

Indicator	Theme	Abbreviation	Assigned weight	Relevant literature
Species richness	Biodiversity	BI1	0.15	Büchs (2003), Dumanski (1998); OECD (2001), Phillis & Andriantiatsaholiniaina (2001)
Species diversity	Biodiversity	BI2	0.2	Büchs (2003), Dumanski (1998), OECD (2001), Phillis & Andriantiatsaholiniaina (2001)
Landscape heterogeneity	Spatial quality	SQ1	0.15	Dumanski (1998), Piorr et al. (2003),
Multiple land uses	Spatial quality	SQ2	0.1	Dumanski (1998), Piorr et al. (2003),
Soil erosion	Land degradation	LD1	0.1	Büchs (2003), Dumanski (1998), OECD (2001), Phillis & Andriantiatsaholiniaina (2001)
Soil compaction	Land degradation & Water management	LD2	0.2	Büchs (2003), Dumanski (1998), OECD (2001), Phillis & Andriantiatsaholiniaina (2001)
Water quality	Water management	WM1	0.05	Büchs (2003), Dumanski (1998), OECD (2001), Phillis & Andriantiatsaholiniaina (2001)
Water withdrawal	Water management	WM2	0.05	Büchs (2003), Dumanski (1998), OECD (2001), Phillis & Andriantiatsaholiniaina (2001)
			1	

Figure 8: overview of environmental performance indicators, made by the author.

3.4.2 Explanation of the analysis

The MCA (see appendix A for a template) is divided into two parts. The innovation performance part of the MCA is highlighted in blue and the sustainability part is highlighted in green. The overall score (bottom) and names of the different numbers (top) are highlighted in red and yellow respectively. The innovation performance part of the MCA is divided into five indicators. Each indicator consists of sub-indicators (or "items"), which is highlighted by the abbreviation plus a number (for example TR1 is the first sub indicator of trialability). Each of these sub indicators is assigned with a score of -1 to 2. A negative score means that the project has a negative impact on the DoI indicator, 0 means no impact, 1 means little impact and 2 equals a large impact. The scores are assigned in the *score* section of the MCA. Because each parameter has a different impact, weights are assigned, as explained in the previous chapter. The accumulated value of the weights in the DoI part equals 1 (0.3+0.15+0.35+0.15+0.05=1). Because each indicator has a maximum score of 2 and is divided into sub-indicators, a total score for each of the indicators has to be calculated. This is highlighted through the name of the indicator followed by TOT (total). As an example, the overall score of the Relative Advantage indicator is called "RATOT", and has a maximum value of 2, which is the same as the maximum value of the sub-indicators. Therefore, the total scores of the indicators can be calculated by dividing the accumulated scores of each sub-indicator by the amount of sub-indicators: RATOT = (RA1+RA2+RA3+RA4+RA5)/5. This calculation follows the same logic for each indicator.

The sustainability part is divided into eight indicators (see figure 8 for an explanation of the abbreviations). These indicators have a maximum score of 2 as well, with 0 meaning no effect, 1 meaning an indirect effect and 2 meaning a direct effect. The average of these numbers is a positive number (instead of 0) because a positive number is expected from these *sustainable* IPs opposed to a 0 (current practice) and therefore a score of 0 is negative. These scores also have a weight assigned to them (for more information see chapter 2.4.2). The accumulated weights for the DoI and sustainability part result in a value of 2. The overall score is calculated by accumulating all of the weighted scores. This will result in a score that ranges from 0 to 4, which is an odd range. To account for this, the overall score will be divided by 4 to account for the maximum score of 2 and the accumulated weights of 2. This number is then multiplied by 10, because it maximises the score to 10 instead of 1, making it a "school-type grade" which is better for interpretation purposes. The outcome is a score with which IPs can be compared. Individual indicator (as well as individual innovation- and environmental performance) scores can also be compared in order to gain insights in the strengths and weaknesses of each IP.

The scores are colour-coded. In the innovation performance category this colour-coding is based on a range of -1 to 2, where -1 is red, the 50th percentile is yellow and 2 is green. The colour-coding follows the same pattern for the sustainability section, however this section differs in range (from 0 to 2). The overall score also follows this colour-coding pattern, but the range is from 1 to 10 because of the 'school' grade format.

3.5 Research limitations

This research comes with limitations in both data collection and data analysis. The next chapters provide insight into these limitations and reasoning why limitations can be marginalised.

3.5.1 Limitations of data collection

Quantifying concepts such as sustainability and innovation comes with limitations to this research, especially since only a few existing researches transform qualitative data into quantitative data for an MCA (Piorr et al., 2003). An MCA is often used when both qualitative and quantitative data are used in a research, because it can analyse different types of data. There is no quantitative data available on all five innovation projects in the geographical scope of these projects (the Netherlands) and therefore the decision is made to exclude the indicators that are based on existing quantified data, which decreases validity. A solution to this problem would be to gather quantitative data in the field, but this is not possible due to time and budget constraints. However, an argument for using qualitative data is that quantitative measurement of sustainability is still subjective, because it is viewed as a fuzzy concept (e.g. Phillis & Andriantiatsaholiniaina, 2001). A fuzzy concept is a vague concept whose scientific definition and measurement still lack wide acceptance (ibid). This means that, even when gathering quantitative data (which will be time-consuming and difficult to gather), it does not necessarily result in a reliable data set. Moreover, qualitative data also provides background and context, which is important for answering the first three SRQs. Quantitative collection methods such as surveys simply cannot provide this amount of context and therefore, despite its constraints, a qualitative collection method in the form of interviews with IP experts is chosen for this research.

3.5.2 Limitations of data analysis

Even though this research does (next to qualitative data) not include quantitative data as input, an MCA is still the preferred method of data analysis for the SIPI because the data differs in another aspect: unit of measurement (sustainability and innovation). As said before, an MCA is the preferred method of analysis when using different types/forms of data (Greco et al., 2016; Maghrabie et al., 2019; Talukder, 2016; Talukder, 2017). However, not using any quantitative data in an MCA can possibly result in subjectivity (Greco et al., 2016). The largest "threat" is that results can differ in other circumstances (for example when this method of analysis is used in future research). However, the purpose of this research is not to develop a method of data analysis for agricultural innovations, the development of this method of data analysis is simply the result of a lack in standard methodology to analyse the subject of this research. To minimise subjectivity, certain indicators are altered in a second analysis on purpose (see the "Results" chapter to check which indicators have been altered). The purpose is to check whether, for future research, a different value of a certain indicator (which will inevitably happen) results in a significant change in the outcome of the analysis. An insignificant change proves that subjectivity (and thus different values) will not have a large influence on the outcome of the analysis when it is used in future research. The final limitation of this study is that most indicators are, contrary to most other studies where sustainability/innovation indicators are used, are expressed in binary (yes/no) units of measure. The limitation of a binary scale is that its outcome is not specific, and there is even a chance that the project will have a similar score when analysed. A binary scale is still chosen, because a more specific/elaborate scale of measurement (for example a Likert scale) would require multiple respondents in order to have a representative outcome when analysed.

3.5.3 Triangulation

Triangulation is a widely used tool when trying to achieve validity of the research. Its definition, as given by Scriven (1991, pp. 364-365) "*the attempt to get a fix on a phenomenon or measurement (and, derivatively, an interpretation) by approaching it via several independent routes*". These routes are, in this case, conducting interviews with both experts of the IPs to gain contextual data that is necessary for answering SRQ1 - SRQ3 and operational data to answer SRQ4, together with literature research. According to Mundaca & Neij (2009), this triangulation method has the potential downside of requiring a vast amount of data, however this should only be the case when being applied ex-ante. With these potential limitations in mind, triangulation can still be achieved because of the two-folded validation in existing literature and interviews. Moreover, triangulation is applied in choosing the innovation/sustainability indicators (see chapter 3.4.2).

3.6 Ethical considerations

This study aims to give an unbiased representation of how agricultural policy innovations have a chance to be implemented on a national scale in the Netherlands. The positionality of the author is based on a curiosity to see what sustainable changes could be implemented in the Dutch agricultural policy sector. The positionality of the author has no links to any political and/or economic interests, such as the ongoing nitrogen debate (Tweede Kamer, 2022). The author tries to be as neutral as possible and does not aim to promote a mindset or ideology during the interviews nor does he want to provoke controversy in any way.

Interviewees are selected based on their expertise and knowledge of the selected projects, together with their desire to participate in this study. The questions of the interview are selected based on theories and studies from both ecological and innovation performance (see chapters 2.1.1 and 2.2.2 respectively). The aim of this study is to obtain a truthful representation of the agricultural policy sector in the Netherlands and to give a view on the possible policy directions it can take. This study does not opt for radical policy change, it merely tries to grasp what it would take for a small-scale policy innovation to be adopted into the current policy framework.

4. Results

This section consists of the results of the interviews with IP experts which both provide operational data for answering SRQ4 (indicator scores) and contextual data that is useful for answering SRQ1 to SRQ3 (both in chapters 4.1 to 4.4). Ultimately, a comparison between and interpretation of the results is performed. This comparison and interpretation is based on interview data and literature research (chapter 4.5) which results in a ranking of policy options for implementation. The results of the indicator scores can be found in Appendix B.

4.1 Agricycling

Relative advantage

This section has a relatively low score for Agricycling, mainly because the process itself does not greatly influence the work process and/or efficiency of farming. This can be seen as an advantage on one hand, but also as *lacking* a clear advantage for the farmer itself on the other hand, and this is seen in the overall score as well. According to respondent A, both quality of work and making the job easier is influenced (RA2 and RA4 respectively). On quality of work he mentions that artificial fertilisers are saved and organic material is added to the soil. This means extra water storage and sequestration of carbon dioxide in the soil. Moreover, he mentions that energy is saved because of the lack of artificial fertilisers. However, I would argue that these arguments predominantly belong to the sustainability part of the MCA, since this part is focused on the work process and quality of work for the *farmer*, not the *soil.* This means that the score for RA2 is 1 instead of 2, since the effect is indirect but somewhat there. On RA4 respondent A mentions that there is *an indirect effect* because a more resilient soil (because of Agricycling) does result in less need for fertilisers. However, respondent A himself mentions this as an indirect effect, resulting in an indicator score of 1. The other RA indicators are 0, because Agricycling has no effect on them. This is mostly because Agricycling is not a large change to business operations, and therefore does not have a clear advantage over regular business operations.

Complexity

The transition towards Agricycling was not easy, especially because of regulation authority restrictions. In the case of this project, this was mostly due to restrictions on recycling/waste management regulations, not on agricultural regulation. Moreover, the financial construction (public private partnerships) and the authorities (or actually companies) that research the effectiveness of Agricycling cause trouble during implementation. This is mostly down to the large agricultural companies' interest in protecting conventional agriculture, or as respondent A puts it: *their research questions differ from the questions from the agricultural sector.* Since Agricycling is not a large change to business operations, it is relatively easy to use and easy to become skillful at, which explains the high scores on those respective indicators.

Compatibility

respondent A mentions that Agricycling is not a large business intervention and therefore scores relatively high on COMT2 and COMT32. He adds to this by saying Agricycling can be used in most types of arable farms, which only exclude intensive livestock farms. Apart from arable farming it can also be used with grassland, but this is currently not the case because of regulatory restrictions. These regulatory restrictions are, according to respondent A, only there because of the *pioneering nature* of the Agricycling concept. One could argue that this cannot be validated and therefore might not be true, however regulatory restrictions due to the *pioneering nature* of a project is an argument that is heard across all IPs of this research, which makes it a valid argument. respondent A points out that current waste regulations are predominantly focussed on *processing* instead of *recycling* waste. This makes it hard for Agricycling to receive its necessary permits. A useful addition to this statement is that once these permits are received, there are no more restrictions for individual farmers to come. However, the score for COMT1 is not maximum because there are still regulatory restrictions in place. COMT2 and COMT3 do have maximum scores, because Agricycling can be used with most farming methods and do not interfere with their daily practices. respondent A points out that *accessibility* is one of the key features of Agricycling and this can be seen in its respective indicator score.

Trialability

According to respondent A, one of the benefits of Agricycling is "*that you (as a farmer, resp.) can stop with it today if you want to*". He adds: "*The only thing is that you buy compost cloths and thermometers yourself, so if you quit after a year it is considered to be a divestment. We did that (a self-investment, resp.) on purpose*" (min 33:04). This means that Agricycling receives the maximum score of 2 on the trialability section of the analysis.

Observability

According to respondent A, there is a large interest from farmers in the Netherlands. However, this interest started slowly. Only when (some) municipalities monetised the use of agricycling, interest grew like a snowball effect. This is why OBS1 is rated negatively: it is considered to have a negative impact on the overall score if farmers predominantly use the project when a lot of other farmers use it. The other indicators are maximum rated, because respondent A mentions that Agricycling has little impact on the current way of business, and therefore the *bump* is small to use Agricycling.

Biodiversity

According to respondent A, enriching the soil will attract more animals in the long run, which means Agricycling has an *indirect* impact on biodiversity. Although one could argue that micro-organisms in the soil count as biodiversity, this indicator is focussed on biodiversity *above* the ground (soil life is incorporated into LD1 and LD2). The *indirect* impact of Agricycling on biodiversity *above* the ground results in a score of 1 for both indicators.

Spatial Quality

According to respondent A, Agricycling has an impact on landscape variety (SQ2), since the project is steered towards a cooperation between both arable and livestock farming. For example by using excretion from livestock farms and recycling this into the soil of an arable farm. However, I would argue that this is an indirect effect which cannot be seen from *the outside*. Another argument from respondent A is that optimal use of residual flows means that the farmers' fields have to be designed for it, which means landscape diversity. He adds that, as opposed to intercropping, it *stimulates* landscape diversity. This also points towards an indirect effect, which results in a score of 1 on SQ2. SQ1 is awarded with 0, since Agricycling does not have an effect on physical landscape heterogeneity.

Land Degradation

Respondent A highlights combating land degradation as his *pet peeve* (min 55:55 in the recording). Water penetration for example has everything to do with calcium and magnesium in the soil, which can be added through Agricycling. These added minerals result in better water penetration, which means less compaction and less erosion. Moreover, the PSE value (which basically means the connection between parts) is formed through the way in which the soil is *fed*. If the soil has a low PSE value and is driven upon with heavy machinery, the soil is destroyed. Agricycling helps with raising the PSE value. Even though Agricycling does not necessarily influence the way that the soil is farmed (for example with heavy machinery), it is still a highly effective tool when combating land degradation.

Water Management

According to respondent A, Agricycling does not influence water usage, resulting in a score of 0 on WM2. However, he mentions that Agricycling has a direct impact on water quality because adding organic matter to the soil makes sure that the soil can retain water better which increases water filtering capacity by the soil. He also mentions that a hummus layer is created, which is needed for additional filtering capacity and therefore to improve water quality. This results in the maximum score of 2 for WM1.

4.2 Community-supported agriculture

Relative Advantage

CSA scores negative on RA1 and RA4 because respondent B mentioned that farmers have to be more all-round to participate in CSA. This makes sense because a community farm contains all types of agricultural products: livestock (for meat and dairy), fruit, vegetables (both in greenhouses and on the field), and so on. This means that the farmer needs to have a lot of all-round knowledge. This means that Herenboeren has a strict selection of farmers that are considered to be suitable for the job. Moreover, respondent B mentioned that farmers themselves are also *pioneers* in the sense that they have a lot to find out for themselves. According to respondent B there is not "one single profile" for farmers, however there needs to be an affiliation with organic and nature-driven agriculture, which means that a lot of farmers are not suitable for the job.

On quality of products respondent B mentioned that "*farmers get up and go to bed with it*" (min 4:43 of the recording). Herenboeren has two employees that focus on guaranteeing quality of the products. This results in a maximum score of 2 on RA2. The score on RA5 is 1, since there is a twofold explanation on *control.* On one hand, the farmer has control over their agricultural products and processes because they do not rely on factors like crop yield. On the other hand, one could argue that farmers have less control over their work, since the cooperation consists of multiple members which all have a say in which products are produced. However, respondent B adds to this that the farmer is still considered to be an expert by its cooperation members, which means that the opinion and expertise of the farmer are seriously recognised. When the farmer considers a certain crop as non-desirable, this is accepted by the cooperation members.

Complexity

Respondent B mentions that Herenboeren elaborate on an existing agricultural method (organic-dynamic agriculture), which means that most of the farming techniques already exist. This results in a maximum score of 2 for CMPX1. According to respondent B, CSA can be viewed as a pioneering business model that uses existing techniques. She thinks that CSA is not easy to learn for farmers, but "*that is the case with many new concepts*" (min 13:34 of the recording). Farmers have to be intrinsically motivated in order to be successful. Respondent B did see farmers quit. Ultimately, this results in a negative score for CMPX2.

On the other hand, respondent B mentioned that farmers are (contrary to most farmers) on salaried employment, which means that they no longer have an *entrepreneurial role*. This can make some aspects of farming less complex, which results in a score of 1 for CMPX3.

Compatibility

Respondent B mentioned that the *pioneering* aspect of the project often results in legislative issues. For example, in minute 26:15-26:30 of the recording respondent B says "*emissions is an important factor for us, because we have livestock on the farms. However, it is small-scale and nature-focused livestock. This makes it even more difficult to receive the right permits, because we do not have a large pig farm but we do have pigs".* This means that, in line with other IPs, regulatory issues are present because of the *pioneering* nature of the project. However, since this IP contains multiple farming methods, its position within the policy framework is more fuzzy and therefore regulatory issues are more serious compared to some other IPs.

Another regulatory issue, in this case regarding permits, is that it is perceived difficult to find the right location for a CSA farm. I asked an extra question (min 47:46 of the recording) about what is currently prohibiting large-scale implementation of CSA. Respondent B answers that finding the right piece of land with the right permits is the greatest obstacle for large-scale implementation. Another issue is finding the right lease construction. She mentioned that sometimes when a right piece of land is found, only a short (three years maximum) lease can be obtained. This is too short to have an environmental impact on the land. According to respondent B, a minimum lease of 16 years is desirable for successful implementation. The combination of the fuzzy position within the policy framework and issues regarding permits result in a score of 0 on COMT1 and COMT2.

On COMT3 respondent B mentioned that on one hand farmers are more inclined to work at a CSA farm because of salaried employment, which means that the farmer is no longer the entrepreneur. On the other hand, salaried payroll also means that the farmer is no longer the only decision maker because he or she is part of a cooperation that also has other members. This changes the position of the farmer in the "company", which some farmers consider undesirable. However, farmers that currently do not own land for themselves are allowed to be CSA farmers, which means that although CSA will not be the rightly matched business model for every farmer, it adds new opportunities to the professional market. This results in a score of 1 on COMT3.

Trialability

Respondent B mentioned that a piece of land that a CSA farm is built upon is perceived as small for most (intensive) farmers, which means that returning to the previous farming method will harm the biodiversity that is created. Moreover, respondent B mentions that a single piece of land is somewhat useless for intensive farming.

She also mentions that Herenboeren aspires to take on multiple forms, however this is only possible with external funding. Currently, discussions are ongoing about external financing. Respondent B adds that when this funding is acquired, multiple forms/versions of CSA can be worked out, which will be favourable for trialability and therefore for large-scale implementation. These indirect positive aspects of trialability result in a score of 1 for all TR indicators.

Observability

Respondent B mentioned that there is outside interest in the project, however this does not regularly result in taking action. According to respondent B, social connectedness is one of the three pillars within Herenboeren (next to nature-driven production and an economically supported system). This means that it is expected of a CSA farmer that he or she builds a social network. According to respondent B, next to interested citizens, a lot of interested farmers stop by as well.

However, respondent B adds that the open/democratic character of a CSA farm means that it is not compelling to every farmer. She says that farmers are (rightfully) proud of their family history and what they have achieved. This means that farmers are not always inclined to switch (to salaried payroll for example). Moreover, one can question whether salaried payroll is always the right choice, since a farm is completely overtaken. An acquisition is a big step for a lot of farmers and it is a risk for Herenboeren as well, because too much influence from farmers can lead to communication problems between farmers and the cooperation. The fact that there is a lot of interest, although there are still bumps for farmers to take the leap towards CSA results in a score of 1 for OBS1, OBS2, OBS4 and OBS5. OBS3 receives a score of 0 because most farmers will know about CSA and finding a farmer that is willing to participate is perceived to be somewhat difficult.

Biodiversity

Creating biodiversity is one of the most important goals of CSA. However, it is perceived as difficult to measure biodiversity, which is why Herenboeren contracted someone that does bio-monitoring. Respondent B mentioned that because of its nature-driven farming techniques, CSA has an undisputed effect on biodiversity. She also mentioned that multiple crops are grown and flowers and trees are planted to attract fauna. She says that by attracting insects there will automatically be an increase in animals that are higher up the food chain. The attraction of insects results in a score of 2 on BI2, whilst its indirect attraction of animals higher up the food chain results in a score of 1 for BI1.

Spatial Quality

The influence of CSA on spatial quality is relatively high, because a CSA farm contains a variety of cultivation methods. According to respondent B, fruits and vegetables (both on fields and in greenhouses) and livestock are cultivated, with an additional presence of windbreaks and flowers for the aforementioned attraction of insects. This makes sure that there is a great heterogeneity in the landscape. In the interview, I asked whether this heterogeneity in the landscape is a premise, on which respondent B answered that land use variety is part of the Herenboeren concept.

Another aspect of spatial quality is presented during my question on external funding. Respondent B answered that external funding is sometimes acquired when the farm has an educational use as well. This means that signs are placed on the farm to attract nearby visitors and educate them in the process. This is considered to be a different land use as well, which (together with the other aforementioned factors) results in a score of 2 for SQ1 and SQ2.

Land Degradation

Soil compaction is an aspect that Herenboeren incorporates in their cultivation plan and farm layout, which includes the layout of where tractors can drive and the assembly and layout of (walking) paths. This is part of the *nature-driven* farming method that Herenboeren is based upon. This results in a score of 2 for LD2. LD1 receives a score of 1, because the nature-driven farming method benefits the soil and does have an impact on soil erosion, however this impact is considered to be indirect.

Water Management

Respondent B mentions that water management can be somewhat of a struggle for CSA, since CSA farms are constructed on many types of land, which can result in discrepancies in effect on water management. Moreover, livestock farming (although its small-scale and biologic livestock farming) does have a negative impact on water quality. However, since CSA benefits the soil and therefore the water quality, WM1 receives a score of 1. WM2 also receives a score of 1, because of less soil compaction which indirectly contributes to less water withdrawal. Since the effect is indirect, WM2 receives a score of 1.

4.3 Strip Cropping

Relative Advantage

Respondent C mentioned that most modern-day agricultural machinery is designed for large-scale production. Because most machinery is not designed for less homogene, uniform and smaller scale agriculture, labour intensity is automatically higher. 20th century agriculture is formed by technology (machinery, fertilisers, et cetera), which has negative impacts, but also positive impacts in the sense that we (as a society) do not have hunger anymore and produce a lot. Respondent C mentioned that this does not have to change, which is an important aspect that is taken into account at the "Boerderij van de Toekomst" (literal translation is Farm of the Future, from now on abbreviated to BvdT). BvdT is an agro-ecological development farm in Flevoland. Crop diversification is one of the agricultural innovations that is developed at BvdT. Crop diversification is divided into mixed cropping and strip cropping. The difference is that in "mixed cropping" (as the name suggests) different crops are mixed randomly within the field. Strip cropping divides different crops into strips within the same field. According to respondent C its key difference is that in strip cropping diseases spread more easily but it is better for biodiversity. This is the case because mixed crops are still harvested at the same time (as is the case with monoculture) which means less shelter and food for animals. Strip cropping does not have this problem, but diseases therefore spread more easily because a crop that is vulnerable for a certain disease is still in the same strip with the same crop. The bottom line here is that both versions have different problems in terms of effectiveness. To overcome this problem, BvdT offers these multiple "versions" of crop diversification and therefore each farmer has a tailor-made solution.

Another problem is that some aspects of strip cropping do not match with current technology. Respondent D mentioned an example of fertiliser machinery that is too wide (48 metres, respectively) for the *strips*. This means that farmers have to invest in smaller machinery (and drive through the field more often) or a robot has to be developed. Certain crop treatments require more labour and for those treatments BvdT is currently developing automated machinery to overcome this problem.

Ultimately, the fact that both versions of crop diversification have their own problems in terms of effectiveness, but still multiple versions are possible results in a score of 1 for RA2 and RA3. The fact that the automated machinery is not yet developed and/or the farmer has to invest in "smaller" machinery results in a score of 0 for RA1 and RA4. RA5 receives a score of 2 because BvdT is working on multiple versions of the project which enhances the amount of control that a farmer has over his or her work.

Complexity

According to respondent C, the transition towards strip cropping was relatively easy, mainly due to the fact that development of this IP on BvdT means prototypes were developed prior to implementation. However, as mentioned in the previous section, there is a duality in the "choice" between disease prevention and biodiversity. This makes the implementation of strip cropping complex in itself. A similar "choice" is seen in the width of the strips, which has consequences for the complexity of implementation. Respondent C mentioned that implementation is not difficult, however a wider strip (which requires no investment in new machinery) means less ecological benefits. This results in a score of 1 for CMPX2, because there still is a (marginally) positive effect, even with wider strips. CMPX1 receives a score of 2, because respondent C mentioned no difficulties with the transition towards IP. This is in contrast to the other IPs that are researched. CMPX3 receives a score of 2 as well. The fact that this IP was developed and fine tuned on BvdT is a possible explanation for the easy adaptation by farmers (and thus, according to respondent C. The variety of strip width adds to this by creating choices and therefore including conventional farmers to participate in the project.

Compatibility

Respondent C mentioned multiple motives to switch to strip cropping. Resilience against both diseases and the climate (a dominant motive from organic farmers), decreased availability of fertilisers, increased societal pressure and/or effectiveness on biodiversity are common motives. The earlier mentioned variety of available variations of strip cropping (strip width, etc.) is the reason why, albeit not together, each of these motives can be satisfied. On adaptability respondent C further mentions that strip cropping can be implemented together with conventional farming methods as well. However, as is the case with including most IPs with conventional methods, its effectiveness decreases. Nonetheless, adaptability increases willingness to participate by a greater variety of farmers resulting in a score of 2 for COMT2 and COMT3.

Respondent C mentioned two regulatory constraints. The first constraint concerns the RVO, the organisation that divides EU subsidies. At the initial stage of this IP, RVO did not know how to handle strip cropping because it was not yet incorporated in its system. This resulted in farmers having difficulties registering their "strip-cropped" field. Respondent C mentioned that currently registration is possible but it requires more administrative work than a conventional field because each *strip* has to be registered separately. Respondent C added that this extra administrative work is mainly due to the IP being in its initial stage.

The second constraint concerns fertiliser use. Some fertilisers require a certain distance to another crop. Respondent C gave an example where the minimal distance between potatoes and another crop is ten metres. This is simply not possible with strip cropping, since strips are located next to each other for ecological benefits. Since the first constraint currently only requires a little extra administrative work and the second constraint only eliminates a small amount of possible crops, this IP scores a 1 on COMT1.

Trialability

As mentioned previously, there is a great variety of 'versions' and alterations possible to attract as many farmers as possible. Varying strip width and the amount of fields that are designed according to the principle is possible, which ensures the maximum score of 2 on TR3. On the amount of fields respondent C gives the example that when a farmer grows four different varieties of crops, it is possible to rotate two crops (as is usual in conventional agriculture) whilst performing strip cropping with the remaining two crops. The farmer can choose whether to expand later and compare yields of the two fields, which is beneficial for TR1 and TR2 as well. This can be the case when farmers have to apply chemical fertilisers that require a certain distance to another crop (as the 'potato' example in the COMT section illustrates).

Moreover, different objectives can be met because farmers can vary with mixed cropping and strip cropping which have different benefits (as explained in the RA section). When a farmer's objective is to use less chemical fertilisers, mixed cropping can be applied. Respondent C explained that another benefit of mixed cropping is mutual strengthening between crops. He illustrated this by giving the example where one crop uses nitrogen and the other crop binds nitrogen. This also adds to the maximum score on TR3, whilst also benefiting TR1 and TR2 because both variants can be reversed to conventional agriculture if the farmer wants to. Per contra, respondent C mentioned that reversing to conventional agriculture can be problematic when farmers have invested in 'smaller' machinery. He adds to this that farmers with 24 metre strips can reverse without issues. The only potential issue is that every switch from multiple crops to a single crop can result in this new crop having the wrong pre-crop. This problem will be automatically solved within a few years. Ultimately, the fact that the presented issues are minor whilst variation highly contributes to trialability result in a score of 2 for TR1 and TR2.

Observability

Both interest and opposition are present. The critique is mostly about what respondent D called "The Belief System", in which people are against change and link agricultural practices to conventional monoculture. Another form of criticism is expressed in the fear of government intervention and therefore obligatory implementation. However, this form of critique expresses any kind of change, in my opinion. This 'light' critique is contrasted by extensive interest for a lot of farmers because of its versatility. Respondent C does mention dominant adopting groups in organic and small-scale farmers.

The project is currently adopted by a handful of large-scale farmers. This number will increase when regulatory and technological constraints are solved (see COMT and RA sections, respectively). Because of the hindrances for large scale farmers to adopt this farming technique, OBS2 and OBS3 receive a score of 1. Versatility and extensive interest by organic and small-scale farmers result in the maximum score for OBS1, OBS4 and OBS5.

Biodiversity

The effect on biodiversity has to be nuanced. Respondent C mentions that, in general, there is a positive effect of genetic crop diversity on soil fertility, yield and biodiversity. He specifically used the words "in general", because it depends on the context in which the project is applied. This context consists of location, execution and motivation. Respondent C mentioned that harvesting every crop at the same time can create discontinuity in the availability of food. He adds to this by saying that some implementations can even create a biological trap, because creating a suitable breeding place for animals and destroying it afterwards results in a negative impact. However, correct and context-specific implementation equals a positive correlation and thus a score of 2 for BI1 and BI2.

Spatial Quality

There is no significant impact on landscape heterogeneity. Visual differences to conventional agriculture include more consistent coverage and greater crop variety, which result in a score of 1 for SQ1. Implementation does not result in the availability of extra land uses. Respondent C mentioned that BvdT attracts visitors and can potentially be associated with an added land use in the form of recreation, however this is only in the specific context of BvdT and therefore does not apply to other locations. This results in a score of 0 for SQ2.

Land Degradation

On SQ1 respondent C mentioned that soil erosion is not much of an issue in the Netherlands in general. On the other hand, strip cropping can be an important instrument for combating the global issue of soil erosion. Respondent C says that erosion is the most important land degradation factor globally, and therefore receives a score of 2 for SQ1.

On SQ2 respondent C mentioned that strip cropping combines the care for soil, and adding organic material to the soil is a part of that. However, strip cropping is not inextricably linked with adding organic material. He says that implementing strip cropping promotes instruments for combating land compaction and this indirect link results in a score of 1 for SQ2.

Water Management

Water quality is, as respondent C mentions, mostly affected by organic matter in the soil. Agricultural practices about addition of organic material and strip cropping go well together because permanent vegetation means that organic fertilisers can be grown and added to the soil to add organic matter. This organic matter improves filtering capabilities when water penetrates the soil. However, extra organic matter and strip cropping are not inextricably linked, which results in a score of 1 on WM1

Strip cropping has a direct effect in decreasing run-off because longer periods of vegetation, which keeps the water from direct run-off to surface water. Another benefit is that less use of chemical fertilisers equals less pollution from these chemicals to surface water. Respondent D illustrates this by saying that monoculture results in equal water consumption and water retaining capabilities. Diversifying crops means that rigidity to water stress and usage is added, whilst also creating barrieres. These barriers make sure that water infiltrates into the soil rather than running off to surface water. This direct impact on water retaining capabilities equals less water withdrawal and results in a score of 2 on WM2.

4.4 Agroforestry

Relative Advantage

One of the key differences between conventional agriculture and agroforestry is that conventional agricultural fields are *horizontal* and agroforestry is *vertical* and is therefore built in vertical layers (trees, bushes, small plants, etc.). The advantages are that product volume per hectare is higher compared to conventional agriculture. However, the agroforest in Glimmen focuses on products that have special health benefits and nutritional value. As respondent D puts it, these products usually take a longer time to be economically profitable, however it benefits quality and so its yield will be visible in the long run. This means that it is hard to compare agroforestry yield to conventional agricultural yield.

Another focus of this agroforest is education. As respondent D puts it: by promoting a certain lifestyle/development (knowledge sharing), it can be seen as another way of scaling up. However, this cannot be (as the previous argument) be monetized in the traditional way. These two arguments result in a score of 2 for RA2, since the quality of the products directly benefits from this farming method. On RA3 respondent D gives a two-way answer: on one hand the *vertical* farming method can make sure that yield goes up, while on the other hand most products take a longer time to be economically profitable. She said that the effectiveness of agroforestry on yield is yet to be discovered, which results in a score of 0 on RA3. On RA1 and RA4 respondent D mentions that an agroforest is more labour intensive compared to conventional agriculture, but it also depends on the "version" of agroforestry is applied. The project in Glimmen focuses on education and landscape value, which means its business model is vastly different from other agroforests. Respondent D mentions that other agroforests (especially in the Southern parts of the Netherlands) have a focus on productivity, which means that products are grown in "traditional" rows where tractors and other machinery can drive through and thus create higher product yield. More information on this subject is presented in the Trialability section.

The last addition on efficiency that respondent D mentions is that agroforestry creates conditions for the soil to do most of the work. If we compare it to traditional farming, where the farmer fertilises, waters and ploughs, an agroforest does (most of this) by itself. Most labour goes into the design (which is harder than a traditional field), coherency between natural elements and biodiversity, selection of crops and harvesting times. As respondent D puts it: this requires more ecological and "design" knowledge that a traditional farmer has to possess. However, when the design is made, nature takes care of the elements that farmers have to invest time and money in.

With all these arguments in mind, one can still conclude that harvesting an agroforest is considered to be more difficult and time consuming than a conventional farming field, which results in a score for RA1 and RA4 of -1. RA5 receives a score of 1 because of the design element, which gives greater control over the work. However, this is considered an indirect effect because the selection of products is partly based on the location of the agroforest, which would imply less control over the work.

Complexity

On CMPX1 respondent D mentioned that there were little regulatory issues. She mentioned that this was the case because of the added landscape value and educational value of their project, which means that multiple financial aids could be used during the investment phase. Respondent C did mention regulatory issues, however they were relatively small. The most profound regulatory issue is regarding receiving construction permits. Because of its educational focus, the organisation is constructing an education centre for the agroforest. The municipality wanted the organisation to come up with a ten-year business plan, however they found that hard to formulate. For the sake of receiving the permit they formulated a business plan that was somewhat different from their original plan. Apart from this issue, respondent C mentioned that (especially) the provincial government was thinking along well. Concluding, CMPX1 receives a score of 2.

On CMPX2 and CMPX3, respondent D mentioned that, as said in the RA section of this interview, agroforestry is mostly about coherency between natural elements. This means that a great understanding of nature is required to be successful. However, as she also mentioned, less farming techniques are required, since nature does most of the farming (apart from harvesting). The founders of this agroforest did not have any agricultural background and still managed to create a successful agroforest, which shows that even with no agricultural background you could still be successful if you have a connection with nature. This indirect positive effect results in a score of 1 on CMPX2 and CMPX3.

Compatibility

On COMT1 respondent D mentioned that, as said in the previous section, there are little regulatory issues related to the policy framework. In my opinion, this is mainly because this agroforest has multiple land uses (recreation, education, production), which means that multiple governmental sectors have an interest in this agroforest. In addition, respondent D mentioned that the water treatment company of Groningen is a partner of this agroforest because of its water purification capabilities, which strengthens my opinion. Respondent D mentioned that building construction was not incorporated into the municipal destination plan, but because the business plan was so good, they granted the construction permit anyway. These arguments result in a score of 2 for COMT1. On COMT2 and COMT3 respondent D mentioned that it is not likely that an abundance of traditional farmers will switch to the variant of agroforestry that is implemented in Glimmen. According to respondent D this is due to the fact that this agroforest is not designed for production and more for educational purposes. This implies two things. The first one is that almost every traditional farming aspect is overhauled, which means that farmers cannot farm in the way that they are used to and therefore are less inclined to switch, and the second being that a massive switch to agroforestry means less production which could cause problems. Alternatively, respondent D mentioned that 1) parts of agroforestry could be applied to conventional farming methods and/or 2) traditional farming can coexist with agroforestry serving different purposes (production and education, respectively). This ultimately results in a score of 0 for COMT2, because it is not considered to be a one and one substitution for traditional farming and a score of -1 for COMT3 because farmers cannot farm the way that they are used to.

Trialability

Respondent D mentioned that production capacity is optimal after 7-10 years because trees take longer to grow than traditional crops. During the first years after setup, mostly annual crops are grown to gain some yield, but yield is optimal after a longer period of time. Optimal production value relatively far in the future means that it is hard to properly try out this IP, resulting in a score of 0 for TR2. This future optimal production value also means that converting back to a conventional field is highly undesirable, which is even more so because of the scenic value of (most) agroforests. This results in a score of 0 for TR1 as well. The possibility of a production-based agroforest, which means that multiple versions of agroforestry are possible, result in a score of 2 for TR3. Respondent D even mentions that incorporating certain elements of agroforestry into traditional agriculture is possible (for example rows of trees next to the field to ensure healthy soil), which strengthens the argument.

Observability

Because of the educational nature of this agroforest, people from around the region of Groningen have become more interested in the concept. She mentioned multiple occasions on which people have started their own agroforest. The recreational use of the farm also attracts visitors (mainly bikers, because the farm is located next to a biking route). This is encouraged by the fact that, at specified times, the farm is open for visitors. The farm attracts multiple types of visitors: bikers, people who are interested in a healthy lifestyle and also company employees/customers are welcome at the farm. Because of its educational purpose, attracting visitors is an important source of income. This results in a score of 2 for

OBS3 and OBS5. Because, as respondent D mentioned, agroforestry is not considered to be a viable alternative to production-based agriculture, OBS1 scores -1. On OBS2 and OBS4, respondent D mentioned that there is interest in incorporating (parts of) agroforestry in traditional farms, however this is currently still "interest" and not "action" because its production effects are yet to be confirmed.

Biodiversity

Creating biodiversity is one of the key features of agroforestry. Creating multiple biotopes on a single piece of land adds tremendous value to biodiversity. To give an example: Agricycling adds organic matter to the soil, which creates soil life. This attracts other animals as well (indirectly). However, in regular fields (where Agricycling is mostly applied), there is little shelter, food and water available for most larger animals and smaller animals can be predated on more easily. Due to its earlier mentioned *verticality*, animals in an agroforest do not have these limitations. Moreover, an agroforest represents the true natural habitat for any type of animal which makes them more comfortable. An agroforest also has benefits for diversity and richness, because of incorporating native and foreign plants (both for harvesting and creating conditions for healthy soil). This results in a score of 2 for both Biodiversity indicators.

Spatial Quality

As said in previous sections, the agroforest in Glimmen serves multiple purposes. Respondent D mentioned education, recreation, production (although little), scenic, and a picking garden. Not to even mention the plans that lay ahead (fishing spot, bird watchtower and community kitchen). However, there are also agroforests which are more production-based and therefore add less spatial quality. Overall, the multifunctionality of agroforestry results in a score of 2 for both SQ indicators.

Land Degradation

On land degradation, respondent D mentioned that by adding organic matter to the soil, soil compaction is drastically reduced. Moreover, this agroforest uses no heavy machinery. On LD2 respondent D mentioned that by adding organic matter to the soil, erosion is also drastically reduced. This is strengthened by the earlier mentioned *verticality* of an agroforest, because it breaks wind and rain and thus reduces soil erosion even more. This results in a score of 2 on LD1 and LD2.

Water Management

As mentioned in the COMT section, the water company is a partner of this agroforest, and for a good reason. During construction of this agroforest, all irrigation tubing was removed.

Looking back, this was not the best idea because during the first years of the forest, mostly annual crops were grown. Those crops need water. However, they still managed and this year no additional water was withdrawn. Respondent D also mentioned an example of the agroforest from Wouter van Eck (in Ketelbroek), where in a dry season the (conventional) nearby field was completely dry and irrigated with clean drinking water, while his agroforest was still flourishing. This illustrates the tremendous water management related benefits, which results in a score of 2 for both WM indicators.

4.5 Comparing and interpreting results

In this section, the indicator scores are compared between the projects. Figure 8 presents the indicator scores, their respective weights, an overall score per category and an overall score for each IP (as explained in chapter 3.4). This section is divided into three sub chapters. Firstly, the innovation performances from each IP are compared and reflected upon to answer SRQ3. Chapter 4.5.2 is about comparing and interpreting environmental performances to answer SRQ4. Chapter 4.5.3 compares final scores and gives overall recommendations.

Indicator	Weight	Score			
		Agricycling	CSA	Strip cropping	Agroforestry
Relative advantage	0.3	0.4	0.6	0.8	0.2
Complexity	0.15	1.3	0.6	1.7	1.3
Compatibility	0.35	1.6	0.3	1.7	0.3
Trialability	0.15	2	0.6	2	0.6
Observability	0.05	1.4	0.8	1.6	1
Innovation performance		**6.4**	**2.7**	**7.3**	**2.6**
Biodiversity	0.35	1	1.5	1.5	2
Spatial Quality	0.25	0.5	2	0.5	2
Land Degradation	0.3	2	1.5	1.5	2
Water Management	0.1	1	1	1.5	2
Environmental performance		**5.8**	**8.3**	**6.3**	**10**
Overall score		**6.1**	**5.5**	**6.8**	**6.3**

Figure 9: Overview of MCA results, made by the author.

4.5.1 Sensitivity Analysis

In order to account for the subjectivity and sensitivity of the weights that are presented in chapter 3.4.2, a sensitivity analysis is performed and the results are presented in a similar format as figure 9, although however the weights are changed in order to measure the differences in overall outcome.

Indicator	Weight	Old weight	Score			
			Agricycling	CSA	Strip Cropping	Agroforestry
Relative advantage	0.15	0.3	0.4	0.6	0.8	0.2
Complexity	0.35	0.15	1.3	0.7	1.7	1.3
Compatibility	0.15	0.35	1.7	0.3	1.7	0.3
Trialability	0.3	0.15	2	0.7	2	0.7
Observability	0.05	0.05	1.4	0.8	1.6	1
Innovation performance			**7.2**	**3.1**	**8.2**	**4**
Biodiversity	0.35	0.35	1	1.5	1.5	2
Spatial Quality	0.35	0.25	0.5	2	0.5	2
Land Degradation	0.2	0.3	2	1.5	1.5	2
Water Management	0.1	0.1	1	1	1.5	2
Environmental performance			**5**	**8.3**	**6**	**10**
Overall score			**6.1**	**5.7**	**7.1**	**7**

Figure 9: sensitivity analysis, made by the author.

As we can see in this analysis, in the innovation performance part relative advantage and compatibility's high weights are switched for complexity and trialability. On the environmental performance side spatial quality and land degradation have switched in the amount of weight. This ultimately does not result in a tremendous amount of change when ranking policy options. Although individual innovation and environmental performance differ somewhat, this result can be neglected. The next chapters will elaborate on the innovation performance and environmental performance

4.5.2 Innovation performance

Indicator	Weight	Score			
		Agricycling	CSA	Strip cropping	Agroforestry
Relative advantage	0.3	0.4	0.6	0.8	0.2
Complexity	0.15	1.3	0.7	1.7	1.3
Compatibility	0.35	1.7	0.3	1.7	0.3
Trialability	0.15	2	0.7	2	0.7
Observability	0.05	1.4	0.8	1.6	1
Innovation performance		**6.4**	**2.7**	**7.3**	**2.6**

Figure 10: Innovation performance indicators for all IPs.

When comparing innovation indicators we can see that Agricycling and strip cropping score relatively high (6.4 and 7.3 respectively). Both IPs are not complex and compatible with the current policy framework and the way farmers like to work. This can be explained by the fact that both IPs are applicable in conventional farming methods and do not require a lot of change to implement. Both methods are not considered to be complex as well. For strip cropping this is due to the fact that this method can be tailor-made for each farmer and does not require a lot of newly acquired knowledge to be successfully implemented. This is the same for Agricycling, where initial setup is done by the organisation itself. After that, the farmer can return to his own farming method. The main difference between the two IPs is in relative advantage. Strip cropping scores higher on this indicator because its effects on biodiversity and disease control exceed the effect of Agricycling on soil properties.

CSA and agroforestry score low on the innovation indicators, which is mainly due to compatibility and relative advantage issues (the highest-weighted indicators). Agroforestry scores low due to the amount of change that is required to the mindset of the farmer (a switch from production-driven to nature-driven farming). As explained in chapter 4.3, agroforestry prioritises environmental performance over production performance, which is reflected in its particularly low scores on relative advantage and compatibility. This priority also explains its low score on trialability, because most crops that ensure vertical production (particularly trees) take longer to be ready for harvest and therefore reversing to conventional agriculture is a divestment. However, agroforestry scores high on TR3 because elements like crop diversification can be used in other (conventional) agricultural methods and can therefore be an important method for promoting sustainability within conventional agriculture. An interestingly high score, and key difference from CSA, is that agroforestry is not considered to be complex (1.3 to 0.6 respectively). This is mainly due to the fact that non-farmers can also start an agroforest whilst CSA requires specialised farmers.

4.5.3 Environmental performance

Indicator	Weight	Score			
		Agricycling	CSA	Strip cropping	Agroforestry
Biodiversity	0.35	1	1.5	1.5	2
Spatial Quality	0.25	0.5	2	0.5	2
Land Degradation	0.3	2	1.5	1.5	2
Water Management	0.1	1	1	1.5	2
Environmental performance		**5.8**	**8.3**	**6.3**	**10**

Figure 11: Environmental performance indicators for all IPs.

When comparing environmental performance, results differ vastly from innovation performance. Where strip cropping and Agricycling had the highest innovation performance score, they scored lower on the environmental performance section. For Agricycling this is mainly due to its lack in spatial quality addition and improvement in biodiversity. Agricycling is a relatively small intervention and mostly combats land degradation (which is seen by the green colour), with soil compaction in particular.

An interesting fact is that respondent D mentioned that strip cropping enables other organic farming methods to be implemented simultaneously (for example barriers with trees and adding organic fertilisers such as 'Agricycling'). When those elements are incorporated into the farm design as well, it would rate even higher on environmental performance. Since Agricycling adds organic matter to the soil, water filtering capacities rise (and thus water quality), species richness improves and soil compaction decreases. Both strip cropping and strip cropping's versatility make sure that simultaneous application is possible. Figure 12 shows revised performance indicator scores if Agriycling is implemented with strip cropping.

Indicator	Weight	Score		
		CSA	Strip cropping+Agricycling	Agroforestry
Biodiversity	0.35	1.5	2	2
Spatial Quality	0.25	2	0.5	2
Land Degradation	0.3	1.5	2	2
Water Management	0.1	1	2	2
Environmental performance		**8.3**	**8.3**	**10**

Figure 12: Revised performance indicator scores if Agricycling is incorporated with strip cropping

Strip cropping offers versatility and, when applied with soil-restoring techniques, shows promising results in terms of climate resilience for crops, soil-restoring capabilities and applicability for large-scale implementation.

Agroforestry and CSA score relatively high on environmental performance (10 and 8.3 respectively). With agroforestry this high score is explained by its nature-driven focus. This results, as opposed to innovation performance, in the maximum score for environmental performance. CSA also receives a fairly high score, which is mainly due to its effects on biodiversity and spatial quality. Spatial quality is an aspect that is seen in the public attention that CSA receives, because respondent B mentioned that attracting cooperation members is not perceived as difficult. This can be particularly explained by its contribution to spatial quality. Incorporating 'outsiders' into nature-driven farming practices adds an extra land use (education) and therefore increases spatial quality. Education is an aspect that agroforestry incorporates as well. Agroforestry adds an extra dimension to this by focusing on landscape development, which makes it suitable for recreational purposes as well.

4.5.4 Comparing final scores

Item	Score			
	Agricycling	CSA	Strip cropping	Agroforestry
Innovation performance	**6.4**	**2.7**	**7.3**	**2.6**
Environmental performance	**5.8**	**8.3**	**6.3**	**10**
Overall score	**6.1**	**5.5**	**6.8**	**6.3**

Figure 13: Overall (indicator) scores for all IPs

When comparing final scores we can see that strip cropping receives the highest score. This score is the result of versatility in implementation, application in combination with conventional agriculture and positive impact on biodiversity, soil compaction and water management. The only downside of strip cropping is the lack of innovation in suitable machinery (and thus the need for automated innovation) and no addition of organic matter. However, strip cropping still offers opportunity for mutual effects with soil-enhancing farming methods (see figure 11) and it is still possible to implement with less suitable machinery despite decreasing benefits. CSA is considered to be the least favourable agricultural method, which is mainly due to its high complexity (because of the need for specialised farmers) and low compatibility and trialability due to its lack in versatility. CSA is considered to be a great alternative to conventional agriculture, however it serves specific needs and is therefore not applicable for large-scale implementation.

I consider the similarity in overall scores from Agricycling and agroforestry to be interesting since their focus differs vastly, as can be seen in their corresponding innovation- and environmental performance scores. Where agricycling is a relatively small intervention (with limited ecological benefits) that is applicable to production-driven agriculture and therefore applicable for large-scale implementation, agroforestry is a large intervention, highly nature-driven and therefore less applicable for large-scale implementation. Despite its differences, this analysis considers both projects to be equally valuable.

Ultimately, **strip cropping** is considered to be the best alternative to conventional agriculture. Where Agricyling serves a specific purpose in terms of environmental performance, it can be considered too less of an impact to 'green' the sector. Strip cropping's versatility makes it applicable for most farmers. Its versatility also allows other sustainable methods to be implemented simultaneously and reach its full ecological potential. Therefore, the **combination of strip cropping and Agricycling** is considered to be the best alternative for conventional agriculture. On the other hand, the educational capabilities of agroforestry and CSA can play a role in educating the public. Agroforestry can use its educational capabilities to educate farmers using verticality in their business model and CSA can educate local communities on the importance of sustainable food production.

5. Conclusion and discussion

This chapter concludes this research and therefore answers the PRQ (chapter 5.1). Afterwards, the methods and results are reflected upon in the discussion (chapter 5.2).

5.1 Conclusion

Literature research shows that centralised governance is applied that promotes intensive and production-based agriculture and subsequently marginally supports environmental problems such as biodiversity decrease, land degradation and landscape homogenisation (e.g. Alons, 2017; Boussemart & Parvulescu, 2021; Frison, 2020; Talukder, 2016). If used differently, this centralised mode of governance can be used to change subsidy distribution towards "green" subsidies that promote sustainable innovation. Although CAP does address sustainability through environmental measures such as environmental cooperatives, PPP and AES, these measures are not always effective and sometimes even work counterproductive. This counterproductivity is especially the case with PPP because it allows conventional agri-businesses to steer the government towards production-based agriculture. AES can be strictly prescribed, non-flexible and difficult to combine with current farming practices. By incorporating sustainable farmers into PPP and reducing power of large agri-businesses, large-scale implementation of sustainable farming practices is encouraged. Based on the contextual data from the literature research and IP expert interviews, I argue that depending on production-based agriculture is unavoidable, although the possibility for sustainable production-based agriculture is there in the form of centrally controlled "green" subsidies which could promote sustainability within the current top-down governance approach.

Results from the SIPI show that **strip cropping** is considered to be the best policy option to be incorporated into national policy because of its versatility, compatibility and ecological benefits. The only downside to strip cropping is that conventional methods mostly rely on large machinery, which (when applied with large machinery) compromises its ecological benefits. This means that the future of strip cropping partially depends on innovation in automated machinery, which is not readily available yet. However, strip cropping's versatility makes sure that this method can be applied with currently used machinery in conventional agriculture and therefore ready for large-scale implementation. Versatility is also expressed in encouraging other sustainable agricultural methods to be applied simultaneously, which improves environmental performance. Because of this versatility from both agricultural methods, I argue that a **combination of strip cropping and Agricycling** is the best method to promote sustainability in the agricultural sector. Adding organic material to the soil (which Agricycling does) is a sustainable aspect that is not specifically improved by strip cropping alone and therefore requires soil-enhancing methods like Agricycling for their mutual potential to be reached.

Where Agricycling and strip cropping have a production-based focus, data from the SIPI shows that agroforestry and CSA have a strong nature-driven focus ("going against the system") which means they are not suitable for large scale implementation because production demands cannot be met. However, these IPs can serve a different purpose on a smaller scale. Strip cropping and Agricycling have a more production-driven focus and are therefore more suitable for large-scale implementation. CSA is an interesting business model that gives alternative options to both consumers and producers, but its business model differs too much from conventional agriculture to replace it, mainly because production demands cannot be met on a large scale. This model is best used for local food production and using its educational purposes for educating the public on sustainable food production.

Agroforestry also differs from conventional agriculture because of its nature-driven instead of production-driven approach. Although it may not replace conventional agriculture entirely, it can play a vital role in educating the public on nature- and food systems and fulfilling a recreational role. This educational role can also be used to educate farmers on sustainability and incorporate natural elements into their (production-driven) practices. Moreover, agroforests can be "productive" recreational forests because of their contribution to landscape quality.

To answer the PRQ, sustainable innovation in agriculture can best be promoted through incorporating a combination of strip cropping and Agricycling. Agroforestry can serve the purpose of educating society on the importance of sustainability in food production and creating "productive" recreational areas and CSA makes sure that the needs of citizens with an interest in sustainable food consumption are met on a local scale. Therefore, all four IPs can contribute to promoting sustainability within the agricultural sector. The government can encourage sustainable practices via revised subsidy distribution, which fits the top-down governance approach. Like all respondents said, "we can not do it alone".

5.2 Discussion

This research contributes to agroecology via the construction of a sustainability and innovation performance index. Where existing research mainly focuses on environmental performance, this index incorporates innovation as well via DoI indicators. This index could be a starting point for further research. Developing a rigid sustainable innovation performance index with the inclusion of production value is desired to increase predictability (Duit & Galaz, 2008). Unfortunately this was not possible for this research due to time constraints, whilst it is an aspect that cannot be overlooked when implementing projects on a national scale. I found it particularly difficult to incorporate this since not every IP is in the same implementation phase. Moreover, I would suggest finetuning the DoI indicators since OBS and TR are almost identical. Because these indicators were used in multiple researches the choice was made to incorporate them, although alterations to the TR indicator have been made during the interviews by changing TR3 to the possibility of multiple versions from an IP. This was added because multiple versions result in more versatility. For future research, the DoI indicators can be altered to improve rigidity to the analysis.

As a final remark, I would like to address that future research should incorporate sustainability more in agri-business development. Aspects like "spatial quality" and "soil properties" are usually overlooked when analysing agricultural business models. I hope that this research delivered a contribution by highlighting the importance of including innovation performance in a monitoring index for new initiatives.

6. Reference list

Allmendinger, P. (2017) Planning Theory. *Palgrave*, Third Edition.

Alons, G. (2017) Environmental policy integration in the EU's common agricultural policy: greening or greenwashing?. *Journal of European Public Policy*, 24(11), pp. 1604-1622.

Bharadwaj, S., & Deka, S. (2021) Behavioural intention towards investment in cryptocurrency: an integration of Rogers' diffusion of innovation theory and the technological acceptance model. *Forum Scientiae Oeconomia*, 9(4), pp. 137-159.

Blackstock, K.L., Ingram, J., Burton, R., Brown, K.M., & Slee, B. (2010) Understanding and influencing behaviour change by farmers to improve water quality. *Science of The Total Environment*, 408(23), p. 5631-5638.

Boardman, J., Poesen, J., & Evans, R. (2003) Socio-economic factors in soil erosion and conservation. *Environmental Science & Policy*, 6(1), pp. 1-6.

Boonstra, W. J., & Van den Brink, A. (2007) Controlled Decontrolling: Involution and Democratisation in Dutch Rural Planning. *Planning Theory & Practice*, 8(4), pp. 473-488.

Boussemart, J., & Parvulescu, R. (2021) Agricultural productivity gains and their distribution for the main EU members. *Revue d'économie politique,* Vol. 131, pp. 137-172.

Büchs, W. (2003) Biodiversity and agri-environmental indicators - general scopes and skills with spatial reference to the habitat level. *Agriculture Ecosystems & Environment,* Vol. 98, pp. 35-78.

Buizer, M., Arts, B., & Westerink, J. (2015) Landscape governance as policy integration 'from below': A case of displaced and contained political conflict in the Netherlands. *Environment and Planning C: Politics and Space*, 34(3), pp. 448-462.

Busetto, L., Wick, W., & Gumbinger, C. (2020) How to use and assess qualitative research methods. *Neurological Research and practice*, 2(1), pp 1-10.

Collectief Midden-Groningen (2021) Project Kringloopcoöperatie Groninger Kleischil. Retrieved on October 23rd via https://collectiefmiddengroningen.nl/informatie/projecten/kringloopcooperatie-groninger-kleischil/

Communities and Local Government (2009) Multi-criteria analysis: a manual. Retrieved on November 11th via http://eprints.lse.ac.uk/12761/1/Multi-criteria_Analysis.pdf

Daugbjerg, C., & Feindt, P. H. (2017) Post-exceptionalism in public policy: transforming food and agricultural policy. *Journal of European Public Policy,* Vol. 24(11), pp. 1565-1584.

Derkzen, P. (2010) Rural partnerships in Europe—A differentiated view from a country perspective: The Netherlands and Wales. *European Urban and Regional Studies*, 17(1), pp. 17-30.

Derkzen, P., & Bock, B. B. (2007) The construction of professional identity: symbolic power in rural partnerships in The Netherlands. *Sociologia Ruralis*, 47(3), pp. 189-204.

Duit, A., & Galaz, V. (2008) Governance and complexity—emerging issues for governance theory. *Governance*, 21(3), pp. 311-335.

Dumanski, J., Gameda, S., & Pieri, C. (1998) Indicators of Land Quality and Sustainable Land Management. *Environmentally and Socially Sustainable Development.* ISBN: 0-8213-4208-8.

Evans, N., Morris, C., & Winter, M. (2002) Conceptualizing agriculture: a critique of post-productivism as the new orthodoxy. *Progress in Human Geography,* 26(3), pp. 313-332.

European Union (2014) Common Agricultural Policy. *Official Journal of the European Union.*

Falloon, P., & Betts, R. (2009) Climate impacts on European agriculture and water management in the context of adaptation and mitigation – The importance of an integrated approach. *Science of The Total Environment*, 408(23), pp. 5667-5687.

Greco, S., Figueira, J., & Ehrgott, M. (2016) *Multiple criteria decision analysis* (Vol. 37). New York: Springer.

Flyvbjerg, B. (2003) 'Rationality and power'. In Campbell, S. and S. Fainstein (eds.) *Readings in Planning Theory*, second edition, Oxford (UK): Blackwell, pp. 318-29.

Frison, E. A. (2020) Path Dependence and Carbon Lock-In in the Agriculture Sector. *IPES Food*.

Garvey, J., Sirr, G., O'Shea, D., & O'Brien, F. (2019) Risk and Planning in Agriculture: How Planning of Dairy Farms in Ireland Is Affected by Farmers' Regulatory Focus. *Risk Analysis*, Vol. 39, pp. 1491-1502.

Groeneveld, A. N., Peerlings, J. H. M., Bakker, M. M., Polman, N. B. P., & Heijman, W. J. M. (2019) Effects on participation and biodiversity of reforming the implementation of agri-environmental schemes in the Netherlands. *Ecological Complexity*, Vol. 40, 100726.

Habermas, J. (1976) "What Is Universal Pragmatics?", 1st published, "Was heißt Universalpragmatik?", Sprachpragmatik und Philosophie, Karl-Otto Apel (ed.), Suhrkamp Verlag, Frankfurt am Main. Reprinted, pp. 1–68 in Jürgen Habermas, Communication and the Evolution of Society. *Beacon Press: Boston, Massachusetts.*

Harms, W. B., Stortelder, A. H. F., & Vos, W. (1987) Effects of Intensification of Agriculture on Nature and Landscape in the Netherlands. *Land Transformation in Agriculture*, pp. 357-379.

Hart, C. (2018) Doing a literature review: Releasing the research imagination.

Healey, P. (1996) The communicative turn in planning theory and its implications for spatial strategy formation. *Environment & Planning B: Planning and Design*, Vol. 23, pp. 217-234.

Hendriks, F., & Tops, P. (1999) Between democracy and efficiency: trends in local government reform in the Netherlands and Germany. *Public administration*, 77(1), pp. 133-153.

Heyl, K., Döring, T., Garske, B., Stubenrauch, J., & Ekardt, F. (2021) The Common Agricultural Policy beyond 2020: A critical review in light of global environmental goals. *Review of European, Comparative & International Environmental Law*, 30(1), pp. 95-106.

Ilbery, B., & Bowler, I. (1998) From agricultural productivism to post-productivism, pp. 57-84. *Addison Wesley Longman Ltd*.

IPES Food (2019) Towards a common food policy for the European Union. Retrieved on December 23rd via https://www.ipes-food.org/_img/upload/files/CFP_FullReport.pdf

Kay, A. (2003) Path dependency and the CAP. *Journal of European public policy*, 10(3), pp. 405-420.

Kenyon, W., Hill, G., & Shannon, P. (2008) Scoping the role of agriculture in sustainable flood management. *Land Use Policy*, 25(3), pp. 351-360.

Klootwijk, C.W. (2016) Dutch dairy farms after milk quota abolition: Economic and environmental consequences of a new manure policy. *Journal of Dairy Science*, 99(10), pp. 8384-8396.

Lang, K. B. (2010) The changing face of community-supported agriculture. *Culture & Agriculture*, 32(1), pp. 17-26.

Lowe, P., Buller, H., & Ward, N. (2002) Setting the next agenda? British and French approaches to the second pillar of the common agricultural policy. *Journal of Rural Studies* Vol. 18, pp. 1–17.

Lundgren, B., & Raintree, T. B. (1982) Agroforestry. Reference number: EDB-84-054757.

Maghrabie, H. F., Beauregard, Y., & Schiffauerova, A. (2019) Grey-based Multi-Criteria Decision Analysis approach: Addressing uncertainty at complex decision problems. *Technological forecasting and social change*, Vol. 146, pp. 366-379.

Makse, T., & Volden, C. (2011) The role of policy attributes in the diffusion of innovations. *The Journal of Politics*, 73(1), pp. 108-124.

Mansholt, S. (1970) The Mansholt Plan. *Studies: An Irish Quarterly Review*, 59(236), pp. 404-418.

Mastenbroek, E., & Kaeding, M. (2006) Europeanization beyond the goodness of fit: Domestic politics in the forefront. *Comparative European Politics*, 4(4), pp. 331-354.

Matthijssen, T. J. M., Behagel, & J. H., Buijs, A. E. (2015) How democratic innovations realise democratic goods. Two case studies of area committees in the Netherlands. *Journal of Environmental Planning and Management*, 58(6), 997-1014.

Meerburg, B., & Blom-Zandstra, M. (2009) The changing role of agriculture in Dutch society. *The Journal of Agricultural Science, 147*(5), pp. 511-521.

Mousavi, S. R., & Eskandari, H. (2011) A general overview on intercropping and its advantages in sustainable agriculture. *Journal of Applied Environmental and Biological Sciences*, 1(11), pp. 482-486.

Mundaca, L., & Neij, L. (2009) A multi-criteria evaluation framework for tradable white certificate schemes. *Energy Policy*, 37(11), pp. 4557-4573.

OECD (2001) Environmental Indicators for Agriculture. Retrieved on November 11th via https://www.oecd.org/greengrowth/sustainable-agriculture/1916629.pdf

Pe'er, G., Bonn, A., & Bruelheide, H. (2019) Action needed for the EU Common Agricultural Policy to address sustainability challenges. *People and Nature*. Vol. 2, pp. 305-316.

Peeters, A., Lefebvre, O., Balogh, L., Barberi, P., Batello, C., Bellon, S., ... & Wezel, A. (2020) A Green Deal for implementing agroecological systems: reforming the common agricultural policy of the European Union.

Phillis, Y., & Andriantiatsaholiniaina, L. (2001 Sustainability: an ill-defined concept and its assessment using fuzzy logic. *Ecological Economics,* 37(3), pp. 435-456.

Piorr, H. P. (2003) Environmental policy, agri-environmental indicators and landscape indicators. Agriculture. *Ecosystems & Environment*, 98(1-3), pp. 17-33.

Qashou, A., & Saleh, Y. (2018) E-marketing implementation in small and medium-sized restaurants in Palestine. *Arab Economic and Business Journal*, 13(2), pp. 93-110.

Raintree, J. B., & Warner, K. (1986) Agroforestry pathways for the intensification of shifting cultivation. *Agroforestry systems*, 4(1), 39-54.

Rankin, M., Nogales, E. G., Santacoloma, P., Mhlanga, N., & Rizzo, C. (2016) Public–private partnerships for agribusiness development. *Food and Agriculture Organization of the United Nations.* ISBN 978-92-5-109252-1

Rogers, E. M. (2003) *Diffusion of Innovation, 5th Edition.* Simon and Schuster. ISBN: 978-0-7432-5823-4.

Runhaar, H. A., Melman, T. C., Boonstra, F. G., Erisman, J. W., Horlings, L. G., De Snoo, G. R., ... & Arts, B. J. M. (2017) Promoting nature conservation by Dutch farmers: a governance perspective. *International Journal of Agricultural Sustainability*, 15(3), pp. 264-281.

Runhaar, H., Polman, N., & Dijkshoorn-Dekker, M. (2018) Self-initiated nature conservation by farmers: an analysis of Dutch farming. *International Journal of Agricultural Sustainability*, 16(6), pp. 486-497.

Scown, M. W., Brady, M. V., & Nicholas, K. A. (2020) Billions in misspent EU agricultural subsidies could support the sustainable development goals. *One Earth*, 3(2), pp. 237-250.

Sebastian, A. G., & Reghin, I. B. (2013) Community supported agriculture (CSA). *Annals Constantin Brâncu*, pp. 11-16.

Scott, S. D., Plotnikoff, R. C., Karunamuni, N., Bize, R., & Rodgers, W. (2008) Factors influencing the adoption of an innovation: An examination of the uptake of the Canadian Heart Health Kit (HHK). *Implementation Science*, 3(1), pp. 1-8.

Scriven, M. (1991) *Evaluation thesaurus (4th ed.).* Sage Publications, Inc.

Smith, M. J. (1993) Pressure, power and policy: State autonomy and policy networks in Britain and the United States. *New York: Harvester Wheatsheaf.*

Talukder, B. (2016) Multi-Criteria Decision Analysis (MCDA) for Agricultural Sustainability Assessment.

Talukder, B., Blay-Palmer, A., Hipel, K. W., & VanLoon, G. W. (2017) Elimination method of multi-criteria decision analysis (MCDA): A simple methodological approach for assessing agricultural sustainability. *Sustainability*, 9(2), 287.

Tarhini, A., Arachchilage, N. A. G., & Abbasi, M. S. (2015) A critical review of theories and models of technology adoption and acceptance in information system research. *International Journal of Technology Diffusion (IJTD)*, 6(4), pp. 58-77.

Termeer, C. J., Stuiver, M., Gerritsen, A., & Huntjens, P. (2013) Integrating self-governance in heavily regulated policy fields: insights from a Dutch Farmers' Cooperative. *Journal of Environmental Policy & Planning*, 15(2), pp. 285-302.

Tweede Kamer (2022) Debat over het stikstofbeleid. Retrieved on November 25th via https://www.tweedekamer.nl/kamerstukken/plenaire_verslagen/kamer_in_het_kort/debat-over-het-stikstofbeleid

van Geet, M. T., Verweij, S., Busscher, & T., Arts, J. (2021) The importance of policy design fit for effectiveness: a qualitative comparative analysis of policy integration in regional transport planning. *Policy Sciences,* 54(3), pp. 629-662.

Veldkamp, A., Van Altvorst, A. C., & Eweg, R. (2009) Triggering transitions towards sustainable development of the Dutch agricultural sector: TransForum's approach. *Agron. Sustain. Dev.,* Vol. 29, pp. 87-96.

Warner, L. A., Lamm, A. J., & Silvert, C. (2020) Diffusion of water-saving irrigation innovations in Florida's urban residential landscapes. *Urban Forestry & Urban Greening*, Vol. 47, 126540.

Westerink, J., Melman, D. C., & Schrijver, R. A. (2015) Scale and self-governance in agri-environment schemes: experiences with two alternative approaches in the Netherlands. *Journal of Environmental Planning and Management*, 58(8), pp. 1490-1508.

Wilson, G. (2001) From Productivism to Post-Productivism... and Back again? Exploring the (Un)changed Natural and Mental Landscapes of European Agriculture, Transactions of the Institute of British Geographers, 26(1), pp. 77-102.

Wilson, G.A., & Burton, R.J. (2015) 'Neo-productivist' agriculture: Spatio-temporal versus structuralist perspectives. *Journal of Rural Studies*, Vol. 38, pp.52-64.

Wiskerke, J. S. C., Bock, B. B., Stuiver, M., & Renting, H. (2003) Environmental co-operatives as a new mode of rural governance. *Wageningen Journal of Life Sciences,* 51(1-2), pp. 9-25.

Xu, Z., Li, C., Zhang, C., Yu, Y., van der Werf, W., & Zhang, F. (2020) Intercropping maize and soybean increases efficiency of land and fertilizer nitrogen use; A meta-analysis. *Field Crops Research*, 246, 107661.

Yin, R.K. (2003) Case Study Research Design: Design and Methods. Sage Publications, Thousand Oaks, London.

Zolait, A. H. S. (2008) Incorporating the Innovation Attributes Introduced by Rogers' Theory into Theory of Reasoned Action: An Examination of Internet Banking Adoption in Yemen. *Computer and Information Science*, 1(1), pp. 36-51.

7. List of Appendices

Appendix A: MCA Template

Every indicator has a score of 1 for the sake of this example.

Item	Score	Weight	Weighted Score
RA1	1		
RA2	1		
RA3	1		
RA4	1		
RA5	1		
RATOT	1	0.3	0.3
CMPX1	1		
CMPX2	1		
CMPX3	1		
CMPXTOT	1	0.15	0.15
COMT1	1		
COMT2	1		
COMT3	1		
COMTTOT	1	0.35	0.35
TR1	1		
TR2	1		
TR3	1		
TRTOT	1	0.15	0.15
OBS1	1		
OBS2	1		
OBS3	1		
OBS4	1		
OBS5	1		
OBSTOT	1	0.05	0.05
BI1	1	0.15	0.15
BI2	1	0.2	0.2
SQ1	1	0.15	0.15
SQ2	1	0.1	0.1
LD1	1	0.1	0.1
LD2	1	0.2	0.2
WM1	1	0.05	0.05
WM2	1	0.05	0.05
		Overall score	5.0

Appendix B: MCA summary of results

Project		Agricycling		CSA		Strip cropping		Agroforestry	
Item	Weight	Score	Weighted	Score	Weighted	Score	Weighted	Score	Weighted
RA1		0		-1		-1		-1	
RA2		1		2		2		2	
RA3		0		2		1		0	
RA4		1		-1		0		-1	
RA5		0		1		2		1	
RATOT	**0.3**	**0.4**	**0.12**	**0.6**	**0.18**	**0.8**	**0.24**	**0.2**	**0.06**
CMPX1		0		2		1		2	
CMPX2		2		-1		2		1	
CMPX3		2		1		2		1	
CMPXTOT	**0.15**	**1.3**	**0.2**	**0.7**	**0.1**	**1.7**	**0.3**	**1.3**	**0.20**
COMT1		1		-1		1		2	
COMT2		2		1		2		0	
COMT3		2		1		2		-1	
COMTTOT	**0.35**	**1.7**	**0.6**	**0.3**	**0.1**	**1.7**	**0.6**	**0.3**	**0.12**
TR1		2		0		2		0	
TR2		2		1		2		0	
TR3		2		1		2		2	
TRTOT	**0.15**	**2.0**	**0.3**	**0.7**	**0.1**	**2**	**0.3**	**0.7**	**0.10**
OBS1		-1		1		2		-1	
OBS2		2		1		1		1	
OBS3		2		0		1		2	
OBS4		2		1		2		1	
OBS5		2		1		2		2	
OBSTOT	**0.05**	**1.4**	**0.1**	**0.8**	**0.0**	**1.6**	**0.08**	**1**	**0.05**
BI1	0.15	1	0.15	1	0.15	1	0.15	2	0.3
BI2	0.2	1	0.2	2	0.4	2	0.4	2	0.4
SQ1	0.15	0	0	2	0.3	1	0.15	2	0.3
SQ2	0.1	1	0.1	2	0.2	0	0	2	0.2
LD1	0.1	2	0.2	1	0.1	2	0.2	2	0.2
LD2	0.2	2	0.4	2	0.4	1	0.2	2	0.4
WM1	0.05	2	0.1	1	0.05	1	0.05	2	0.1
WM2	0.05	0	0	1	0.05	2	0.1	2	0.1
Overall score		**6.1**		**5.5**		**6.8**		**6.3**	

Appendix C: Interview transcript, example of strip cropping

Questions in blue are additional questions that came up during the interview. Yellow represents a different topic that is relevant in an answer of the respondent, and red highlights an example. When information is potentially suitable for a quote, the corresponding timestamp in the recording is displayed.

Relative Advantage

In hoeverre denkt u dat strokenteelt het werk van boeren beïnvloedt op basis van kwaliteit en makkelijk maken van werk?

Landbouw heeft zich ontwikkeld tot grootschalig en veel van hetzelfde. Hier hebben we de machines ook op ingericht. Als je dingen door elkaar gooit (minder groot/homogeen/uniform) dan kunnen de huidige machines dat niet aan. Kost meer werk. Dus in die zin is dingen door elkaar gooien is huidige tech niet op toegespitst en dus kost het meer werk.

How can this be fixed?

Nieuwe tech ontwikkelen. Landbouw in 20e eeuw is gevormd door technologie (machines/gewasbescherming etc), die heeft allerlei negatieve impacts, maar positief is dat we geen honger hebben en veel produceren. Dat kunnen we wat ons betreft ook houden, en dat doen we ook op BvdT, onderdeel is strokenteelt en gewasdiversiteit. Waarom? Andere vorm van gewasdiversiteit is voedselbossen en je kunt ook kijken naar Agroforestry (rijen bomen icm eenjarigen). Ons gaat het over toepassing van genetische diversiteit, op welke manier dan ook. Waarom? Omdat we a) nadelen van grote oppervlakten van hetzelfde kennen (gevoelig voor ziekte en plagen en weinig weerbaar tegen extremen) en b) lage biodiversiteit. Wil je de huidige landbouw daar minder gevoelig voor maken, dan moet je gewasdiversiteit toepassen (genetisch). Kan op verschillende manieren. Waarom dan strokenteelt? Dat is een manier die gemakkelijk met de huidige technologie kan worden opgepakt.

Ook binnen het huidige beleid?

Ook dat, zitten wel haken en ogen aan maar ja in principe wel. Belemmeringen zijn details. Alleen voor een deel past de tech niet, als je een spuit met bestrijdingsmiddelen hebt, dan is die te breed voor de stroken en moet je er dus vaker doorheen rijden (Land degradation), of je moet een robot ontwikkelen. Sws moet je wel minder B.M gebruiken maar tegelijkertijd is de capaciteit te klein. Dus bezig met robots. Voor een aantal gewasbehandelingen kost het meer arbeid en daar zijn we bezig om technologie voor te ontwikkelen. Dus automatische machines

Moeilijker/makkelijk maken van werk

Brede machine voor grootschalige landbouw heb je in geïnvesteerd en kost ook heel veel en je rijdt relatief weinig (4x per jaar) dus je moet heel veel rooien wil je dat terugverdienen. In de industrie schaf je een machine aan die dag en nacht draait, in de landbouw zeker niet dus is andere manier van investeren. Voor een aantal handelingen maakt het niet uit (ploegen bijvoorbeeld) maar voor een aantal handelingen maken kleinere stroken wel uit (harvesting/gewasbescherming). Daar moet je dus nieuwe machines voor aanschaffen. Strokenteelt beinvloedt dat: gewasbescherming/kunstmest strooien

Complexity

Hoe verliep de transitie (van normaal boeren) naar strokenteelt?

Was het makkelijk om de nieuwe vorm van boeren te leren?

Wat je nu ziet (eigenlijk moet je het breder zien want we moeten af van monocultuur) is meer genetische diversiteit. Strokenteelt is hier 1 van, je kunt ook brede stroken doen. 24 meter brede stroken is vrij makkelijk te implementeren. Maar hierbij geldt wel: hoe breder de stroken, hoe minder de voordelen. Los van technologie. Wat je ziet is dat vooral biologische bedrijven dit oppakken, omdat voor hen de voordelen het grootst zijn vanwege de weerbaarheid tegen ziekte en plagen (zij hebben daar meer last van want geen chemische gewasbescherming). Daarom zie je dat vooral zij dit oppakken (op verschillende manieren).

Hoe zit het met niet-biologisch?

Er zijn gangbare boeren die het proberen met gangbare stroken, er zijn ook boeren die het proberen met brede stroken (machine breedte). Dus per bedrijf zie je dat ze een andere vorm toepassen (Trialability).

Ging de transitie snel? Was het makkelijk om goed te worden in de nieuwe vorm van boeren?

Eerst op onze eigen proefbedrijven ontwikkelen, en tegelijkertijd werken we met boeren groepen die het ook uitproberen.

Compatibility

Wat zijn mogelijke motieven om over te stappen naar strokenteelt?

Weerbaarheid (vooral biologische boeren), afnemende beschikbaarheid bestrijdingsmiddelen, toegenomen maatschappelijke druk op gebruik bestrijdingsmiddelen, en voor een aantal boeren de positieve effecten op biodiversiteit. We hebben een gangbare boer die gek is van vogels. GD heeft positief effect daarop dus wil dat. Andere boer zag dat strokenteelt positief effect had op productieverlies van aardappelziekte. Grote oppervlakte ging die ziekte er snel doorheen, en kleinere oppervlakken niet.

Is het vaak intrinsieke of extrinsieke motivatie?

Die dingen komen samen. Context van waarin boeren opereren verandert (klimaatverandering, maatschappelijke druk), als de omstandigheden zo zijn dat je niet kunt boeren op normale manier dan moet je naar oplossingen zoeken. Dus is een combinatie en een perspectief naar de toekomst. Als er geen perspectief is dan moet je wel veranderen als boer.

Wat waren de knelpunten (in relatie tot wet- en regelgeving) tijdens de transitie?

Dat was de RVO, die over de uitkeringen van EU subsidies gaat, en RVO wist niet hoe ze met strokenteelt moesten omgaan, dat zat nog niet in hun systeem. Nu nog steeds zie je dat het meer werk kost om strokenteelt te registreren dan monocultuur. Maar nu krijg je in ieder geval wel je RVO subsidie. Het maakt niet uit in je subsidie hoe je je gewassen indeelt, behalve als je ze echt helemaal gaat mengen (voedselbos). Het nadeel is dat elke strook apart aangemeld moet worden. Dus kost iets meer administratie, maar dat is vooral omdat het nog in de kinderschoenen staat.

Andere belemmering is regelgeving omtrent gewasbeschermingsmiddelen, is dat je bij sommige GB een bepaalde afstand moet behouden tot een ander gewas. Bijvoorbeeld bij Aardappelen moet je bij spuiten 10 meter afstand houden tot ander gewas, en dat kan bij strokenteelt niet. Is allemaal wel oplosbaar. Dus op allerlei manieren zitten toepassing gewasdiversiteit bestaande structuren in de weg. Regelgeving, bestaande technologie. Wat meeste in de weg zit is het “Belief System” (hoe hoort het). Bij iedereen is een gewas een groot oppervlak van hetzelfde. In reclames etc grotende wuivende graanvelden. Dus believe system van landbouw is monocultuur (boeren, samenleving), dat is ook moeilijk te doorbreken.

Trialability

In hoeverre is er een mogelijkheid om terug te keren naar de "reguliere" landbouwvorm na implementatie van strokenteelt?

Je kunt weer terugschakelen maar je hebt dan wel een probleempje met vruchtwisseling (lost zich binnen paar jaar op). Als je van meerdere crops naar 1 crop gaat dan kan het zijn dat op sommige stukken het gewas een verkeerde voorvrucht krijgt. Maar dat lost zich binnen een paar jaar weer op. Behalve als je als boer in smalle machines hebt geïnvesteerd, dan wordt het lastig. Maar als je als boer met 24 meter brede stroken werkt dan kan het 1 op 1.

Zijn er ook meerdere versies mogelijk van strokenteelt (om grootschalige implementatie makkelijker te maken) ?

Je kunt het ook op 1 perceel toepassen en later uitbreiden (of niet). Je kunt ook starten met 2 gewassen, als je 4 gewassen in totaal hebt kun je ook 2 gewassen roteren en 2 gewassen in combinatie doen (dus in stroken). Dus je kunt er verschillende stappen in zetten. Bijvoorbeeld een boer die met het spuiten (omdat andere gewas daar 10 meter vanaf moet staan) doe ik het niet, maar met mijn granen en mijn tarwe doe ik het wel. Dus beetje afhankelijk van het type gewas.

Je hebt ook nog verschillende versies als in: mengteelt (alles door elkaar) en strokenteelt (alles in stroken). Daar binnen ook nog variatie: stroken zo smal als je wil (rij om rij), of binnen een rij gaan mengen. Dan moet je het wel in 1 keer tegelijkertijd kunnen oogsten. Echter: De truc van strokenteelt is dat je voor de dieren altijd wat te eten hebt, dus dat betekent dat mengteelt (waarbij je alles tegelijkertijd moet oogsten) alsnog een grote verstoring is. Voordeel van mengteelt is dat (tov strokenteelt) ziekten en plagen er nog minder snel doorheen gaan. Daarnaast kunnen planten elkaar beter helpen (dus bijvoorbeeld de 1 bindt stikstof en de ander gebruikt stikstof van die ene). Vooral dat je minder bestrijding nodig hebt omdat ziektes minder goed kunnen verspreiden. De voordelen hangen af van hoe intensief je mengt en hoeveel gewassen je mengt.

Observability

In hoeverre kan iemand (van de buitenkant) zien dat strokenteelt aanwezig/geïmplementeerd is?

Je kunt vanuit de lucht zien als er strokenteelt wordt toegepast. Mensen vinden het wel aantrekkelijk in het landschap, maar ja het kan niet (believe system).

In hoeverre wordt het concept overgenomen door andere boeren? Is er veel interesse?

Er is veel interesse maar er is ook tegenstand. Boeren zeggen: jullie zijn gek, dat kan niet, kost veel te veel werk. EN jullie zijn met dingen bezig en straks wordt het overgenomen door de overheid en moeten we het verplicht doen. Er is ook belangstelling. In gesprek waarom we dit doen snappen mensen wel de achterliggende doelen, en ze zien ook wel dat hele boel dingen op hun af komen waarbij ze niet verder kunnen gaan op de manier waarop ze dat deden.

In welke fase zit het project nu? 2259

Er zijn een paar boeren die het grootschalig overnemen, 50 tal op kleinere schaal (niet alleen nederland maar ook grote percelen koolzaad tarwe in saksen duitsland). Dus ja er is belangstelling en stapsgewijs wordt het ook in de praktijk overgenomen en het zal meer overgenomen worden als we de knelpunten en de regelgeving beperkingen en aanloopkosten op te lossen (technologie).

Zo ja, is dit alleen interesse of ook actie? 2350

Bij kleinschaliger bedrijven en bij biologische bedrijven en bij bedrijven waarbij een jonge boer (vaak origineel van buiten de landbouw) op een bedrijf komt. Voor nieuwe intreders, kleinschalige en biologische boeren zie je vaak al wel dat het ook toegepast wordt. Daarnaast zie je ook dat boeren het op 1 perceel toepassen, en op andere percelen gewoon nog grootschalige landbouw toepassen.

Vragen duurzaamheid

Biodiversiteit

In hoeverre draagt strokenteelt bij aan een verbeterde biodiversiteit in zowel hoeveelheid als variëteit?

Lastige vraag aan een wetenschapper. Altijd wat genuanceerd. In zn algemeenheid weten we (grote analyse over gedaan, meneer Benouard) Meet Analyse gedaan over effecten van genetische diversiteit en gewasdiversiteit. Hij ziet dat in zn algemeenheid een positief effect heeft op bodemkwaliteit, opbrengst en biodiversiteit. Ik zeg wel "in zijn algemeenheid" omdat het erg afhankelijk is van lokale situatie, uitvoering en context waarin je het doet. Dus het is niet zo dat het een "one size fits all" is, het moet altijd contextspecifiek ontwikkeld en ingevoerd worden. Als je kijkt naar de mechanismen die er achter zitten (afname biodiversiteit) dan is het heel logisch dat gewasdiversiteit werkt. Alleen toon maar eens wetenschappelijk aan dat het zo is. Dan kom je een beetje in een spagaat terecht.

Gewasdiversiteit helpt, maar als je toch in de winter alles tegelijk omploegt, creëer je alsnog een hele grote discontinuïteit voor veel organismen en dan raak je alles weer kwijt. Dan heb je misschien in de zomer wel wat voordeel, maar netto is het dan 0. Het kan zelfs negatief werken omdat je een ecological trap creëert. Dat betekent dat je tijdelijk heel veel dieren naar je toetrekt, en als je dan de hele omgeving in een keer sloopt dan komen die dieren in een val terecht. Dan doe je meer schade dan als je sowieso al geen goede grond hebt (een soort muizenval). Dus stel je voor je hebt een gewas dat vogels aantrekt. Als je dan vervolgens oogst (en dus de nesten kapot maakt) kom je per saldo negatief uit.

Maar als je bij strokenteelt zorgt dat er altijd ergens groen is, dan werkt het wel. En het werkt nog beter als je het combineert met meerjarige akkerranden met bloeiende planten. Gaat nog beter als je hier en daar ook een struik of boom hebt staan. Zo zie je ook dat strokenteelt in bepaalde contexten beter werkt dan andere. Een ander voorbeeld is hunger gaps. Dat is: je kunt heel aantrekkelijk zijn voor insecten/vogels, maar als er dan op bepaalde moment helemaal niks is (dat gebeurt in flevopolder), dat iedereen dan tegelijk gaat ploegen dan krijg je een hunger gap. Er is een bepaalde periode helemaal niks te vreten. En dan zit er het hele jaar niks. Dus dan kun je wel allemaal dingen doen met gewasdiversiteit, maar als je die hunger gap creëert heb je er niks aan/werkt het negatief. Het is dus ook zaak om de mechanismen om de context te begrijpen.

In zn algemeenheid is genetische diversiteit een belangrijk instrument voor bevordering biodiversiteit, maar (net zoals andere instrumenten) is het contextafhankelijk/onderdeel van een groter geheel.

Vanuit eigen onderzoek (en andere landen zoals China), we weten dat gewasdiversiteit een grote impact heeft op ziekteverspreiding en dat is volslagen logisch (zeker in een tijd van social distancing). Barrieres, niet veel individuen die ergens gevoelig voor zijn helpen tegen ziekteverspreiding. Als je er dingen tussen zet gaat het minder snel.

Ruimtelijke kwaliteit

In hoeverre draagt strokenteelt bij aan landschaps heterogeniteit and variatie in landgebruik?

De variatie van landgebruik niet. Behalve dat je soms in strokenteelt meerjarige gewassen opneemt en ook strokenteelt makkelijk kunt combineren met meerjarige niet-productieve elementen. De technologie die je hier voor ontwikkelt om kleinschalig te kunnen werken past ook bij allerlei andere toepassingen van landschapsdiversiteit.

Voorbeeld: als je met een kleine robotspuit zou kunnen werken dan is het geen probleem meer als je elke 25 meter een haag hebt staan (kun je makkelijk tussendoor). Maar wordt wel een probleem als je een grote spuitmachine hebt van 48 meter. Dus de ontwikkeling die met strokenteelt samengaat waarbij je ook technologie ontwikkelt die niet meer afhankelijk is van de schaalgrootte, dan is het eigenlijk een spin-off. Dus in die zin maakt de toepassing en visie van strokenteelt landschap variëteit veel meer mogelijk.

Het moet niet te aantrekkelijk worden, want in lelystad kregen we zoveel bezoekers dat de vogels niet meer kwamen.

Land degradatie

In hoeverre draagt strokenteelt bij aan het verminderen van landdegradatie in impact op 1) water penetratie in de grond 2) compactie en 3) bodemleven?

Draagt bij, want in z'n algemeenheid gewasdiversiteit. We hebben in Nederland nauwelijks te maken met landdegradatie, en als we dat hebben dan heeft het te maken met zeespiegelstijging, verzilting en met de toepassing van zware machines. Heeft er wel mee te maken doordat je lichtere machines hebt en “controlled traffic” (exact op hetzelfde plekje rijden) heb je minder last van bodemverdichting. Dat is door zware machines best een probleem. Mondiaal is strokenteelt een heel effectief wapen tegen erosie. Erosie is in de akkerbouw 1 van de belangrijkste landdegradatie-effecten.

Strokenteelt combineert de zorg voor bodem, en bodem bedekt houden past er ook goed bij, maar het is niet onlosmakelijk er aan verbonden. Bijvoorbeeld strokenteelt betekent lichtere machines. Maar lichtere machines betekent geen strokenteelt. Het werkt het wel in de hand, maar het is niet een 1 op 1 effect.
Bodemverdichting kun je ook vermijden in een monocultuur met dezelfde technieken (dus lichtere machines) alleen dat doe je niet zo snel doordat ze minder opleveren en je dan vaker moet rijden.

Water Management

In hoeverre beïnvloedt strokenteelt water management in zowel bijdrage aan 1) watergebruik (irrigatie) als 2) waterkwaliteit?

Waterpenetratie: indirect effect van strokenteelt, wel direct van controlled traffic. Vooral het niet meer ploegen en minder zware mechanisatie maakt dat grond minder gevoelig voor waterstress en waterinfiltratie is. Dit heeft te maken met organische stofgehalte. Dit wordt niet rechtstreeks beïnvloedt door strokenteelt, alleen het toevoegen van organische stof is makkelijker met strokenteelt of dat het past goed bij strokenteelt. Het principe van strokenteelt is alles groen houden, ook in de winter, en dat kan ook. Daarmee kun je meer groenbemesters telen en daarmee voeg je meer biomassa toe aan de bodem.
Rechtstreeks zorgt het voor minder afspoeling en minder emissies. Doordat je minder GB gebruikt heb je minder drift naar opp water van GB en heb je minder afspoeling van GB en je hebt ook minder afspoeling van nutriënten. Dus niet zo zeer uitspoeling van nutriënten, maar uit/afspoeling van GB wel want die gebruikt je minder.

Voorbeeld: als je groot oppervlak van alles hetzelfde hebt, dan zal een overschot aan nutriënten/pesticiden met teveel water heel makkelijk de plant af gaan maar als je verschillende planten hebt gaat die afspoeling minder snel want dat wordt tegengehouden. Ene was is half kaal andere gewas is nog in bloei. Dus het kan water tegenhouden (want heeft zelf water nodig) en dus spoelt het niet massaal weg. En je krijgt barrières dus het spoelt niet af naar oppervlaktewater maar trekt de grond in.