What about perennial grains?

– structures towards a sustainable grain production in Sweden

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Abstract

This thesis aims to create an understanding of how structures affect grain producers' work with sustainability, and to investigate if perennial grains can be part of the future grain production in Sweden. The agricultural sector is facing a dilemma, both to ensure that ecosystem services are kept intact but also to keep up the global food supply for the growing population. Today's efficient industrial agriculture has contributed to increased emissions and the sector needs a sustainability transition. The food and agriculture industry has a strongly institutionalised structure, which means that fundamental changes take a particularly long time. Swedish grain producers are affected by structures from different levels within the sector which affect their possibility to act sustainable within their business. The current cultivation systems with annual grains requires a lot of tillage which contributes to a lot of emissions. Perennial grains are used in other countries but not yet integrated into the Swedish agricultural sector. The ongoing research development of perennial grains in Sweden is to adapt the crop to the Nordic climate and to develop a perennial grain that can be compared with the current yield and profitability of annual grains.

The data collection in this thesis has been conducted through semi-structured interviews with six grain producers in Skaraborg, Västra Götaland. The theoretical framework in the thesis consists of *structuration theory* and *sustainability transitions*. The concept duality within structuration theory with structures and actions are applied on the different MLP-levels within sustainability transitions to analyse how the selected grain producers are affected by structures from the different levels and how their individual agency is affected.

The results reveal that the institutionalised structures affect the grain producers' attitude towards sustainability within their business through both change inertia and the fear of lowered profitability. Joint structural changes within politics, research and development, consumers, and the grain producers themselves; are needed before the respondent perceives an opportunity to act more sustainably within their day-to-day operations. Most of the respondents consider perennial grains to be more interesting if they had better characteristics such as higher profitability, higher yield, and a higher market demand. The attitude towards perennial grains is positive but the perceived risk of low profitability inhibits implementation. By analysing the grain producers' own context with selected theoretical framework: This study shows that a supporting system is needed that enables increased profitability for sustainable initiatives and sustainability through all levels. Researchers and retailers are important actors in creating resources and structures that make it easy for grain producers to act sustainably. The grain producers themselves need to take risks when they are in situations where they have a choice to act sustainably.

Keywords: Sustainability, sustainability transitions, sustainable agriculture, perennial grains, structures, grain production, attitude, structuration theory

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Abbreviations

COVID-19	Coronavirus Disease
MLP	Multi-level perspective
SLU	Swedish University of Agricultural Sciences

1. Introduction

The world's population is growing, and sustainable, sufficient food production is therefore needed (Brown et al. 2011; Maskey 2001; Taeuber 1967). Foley et al. (2005) describes that the agricultural sector is facing a dilemma, both to ensure that ecosystem services are kept intact, but also to keep up the global food supply for the growing population. Slätmo et al. (2017) state that current consumption and production of food leads to a negative environmental impact. Global warming affects agriculture differently worldwide: Examples of negative effects are extreme weather conditions and challenges in cultivation that affect food-producing companies (Cline 2007; Wheeler et al. 2000). The total greenhouse gas emissions from the agricultural sector were approximately 7 million tonnes of carbon dioxide equivalents in 2019, which was almost 14 per cent of Sweden's total emissions (Naturvårdsverket 2020). Sweden's 13-14 per cent is a low number compared to the global emissions from the agriculture sector, which is 20-30 per cent (Ericson 2018). Even though Ander (2018) claims that Sweden is a pioneering country in climate, there is still much to improve. To continue producing agricultural products, a reduced climate impact and adaptation to climate change is required (SJV 2012).

The development of agriculture began in the 18th century and has developed into today's efficient agriculture (Myrdal 1999). Much happened in Sweden's agricultural development during the 1950s when electricity brought about major structural changes, such as many physical tasks changed from manual to mechanical. The food and agriculture industry have a strong institutionalized structure, which means that fundamental changes take a particularly long time (Farla et al. 2012; Zhang et al. 2011). Today's efficient industrial agriculture has contributed to increased emissions and the sector needs a sustainability transition (Crews et al. 2018; Buttel 2006). Researchers have tried to 'fix' it by testing a wide range of solutions (Crews et al. 2018). Examples of such solutions are precision farming, electric farming machines and digitalisation (Rise 2021). Despite these attempts to find solutions and innovations, which have required enormous financial and human resources, the environmental challenges remain (ibid.). Because many sustainability issues concerning the agricultural industry are urgent, we must find effective ways to change the current unsustainable production methods (Buttel 2006). Effective ways that actually work.

Despite the emphasis on environmental sustainability in this thesis, social and economic are seen as equally important, and sustainability is considered to arise when the three interact (Elkington 1998). As the agricultural sector contributes to increased emissions, it can also be seen as an opportunity to decrease emissions and increase sustainability (Ander 2018). A major part of the greenhouse gas emissions from agriculture comes from production, and it depends largely on what is produced (SJV 2012). In addition to the climate issue, grain producers in Sweden operate in a market with constant change regarding consumer demand, societal changes, and political regulations (Hajdu et al. 2020). Due to changes in the business environment, agricultural companies and research institutes have developed more sustainable business models and innovations in their production to maintain competitiveness (Ulvenblad et al. 2017). The Swedish grain producers affect the agricultural sector by influencing what is produced and consumed (SJV 2012; Röös 2017).

In 2016, the influential region Västra Götaland in Sweden consisted of 19 per cent of the total number of agricultural companies (SJV 2020). Skaraborg, which is located in the eastern part of Västra Götaland, contributes to the country's food and feed production through its large share of grain producers (Lorentzson et al. 2016; Skaraborg 2021). In Västra Götaland and Sweden overall, current cultivation systems are based on annual grains and monocultures, which can be developed into a polyculture system with perennial grains to produce food and feed for animals (Crews et al. 2018; Fokus Forskning 2017; Zhang et al. 2011).

Perennial grains in a polyculture cultivation system grow for several years without need of annual ploughing or chemical weed control because of the large root system (The Land institute 2020; Crews et al. 2018; Hayes et al. 2017; Zhang et al. 2011). The large root system prevents weeds and creates an ongoing ecosystem that pulls carbon dioxide out of the air (Sprunger et al. 2019). Therefore, compared with monocultures, polycultures with perennial grains contribute with numerous benefits based on climate aspects and the need for less tillage and working hours (Crews et al. 2018; Fokus Forskning 2017; Zhang et al. 2011). By growing perennial grains, soil erosion is reduced, nutrient leakage is minimized, emissions from machines are reduced, and the need for pesticides is reduced (ibid.).

An example of such grain is the wheatgrass Kernza, which is in commercialization in Kansas, US where over hundred grain producers use the grain within their farming systems (The Land Institute 2020). The kernel is used for pasta and bread and the straw is used for animal feed (ibid.). The Swedish University of Agriculture Sciences, together with others, are now testing whether it would work in Sweden or not. Challenges regarding the establishment of perennial grains in Sweden are

overwintering in the Nordic climate and farmers' attitude towards a transition from monocultural systems to polycultural systems (Axfoundation 2020; Fokus; Lantmännen 2020; Forskning 2017). The Land Institute (2020) highlights the need for further research on social and economic aspects to understand the grain producers' needs within a transition to polyculture systems.

1.1. Theoretical problem

Structuration theory implies that there are existing structures to which people react upon, and through perceived challenges and opportunities from structures, individuals perform actions (Chiasson & Saunders 2005; Giddens 1984). Socio-technical systems are built upon different structures and one example of such a system is the agricultural sector that grain producers are a part of (Van den Bergh et al. 2011; Trist 1981). However, how grain producers react upon these structures are still unclear (Darnhofer 2015). To understand how structures can affect the grain producers in their work towards sustainability and if perennial grains can be included in their productions; the structuration theory proves sufficient to apply.

In addition, Berthet et al. (2018) argue that research needs to promote more open, participatory approaches to innovations and renew agriculture's traditional organization with its established structures. For this, we want to uncover how grain producers react upon these structures to see possibilities for a transition. McCauley and Stephens (2012) describe that research on sustainability transitions contributes to the understanding of how systems-wide transformation towards more sustainable practices occur.

1.2. Empirical problem

Annual grains are sensitive to the effects of climate change, such as floods or drought, which creates a need for new systems, structures, and grains to use (Hayes et al. 2017). The modern established agricultural system used in more than two-thirds of the global arable land consists of monocultural systems with annual grains (Zhang et al. 2011). Annual grains imply a need for yearly clearing of vegetation and tillage that leads to soil erosion and other forms of degradation of the ecosystem (Crews et al. 2018; Zhang et al. 2011). Further consequences of monoculture cultivation systems are water pollution, greenhouse gas emissions and soil degradation (ibid.).

This thesis will focus on how structures affect grain producers and their attitude towards sustainability and their individual agency regarding production of

perennial grains. Röös (2017) claims that there are difficulties in measuring social structures within the agricultural sector and food production. Because of the difficulties of measuring, these aspects are not measured often, resulting in less attention, and understanding (ibid.). Zhang et al. (2011) describe that the agricultural sector, research, and political decisions need to act now due to established structures requiring a long time before a change occurs. Within the work towards sustainability in the agriculture sector, the social structure, such as the attitude of grain producers is important for the development since their actions affect the entire industry (ibid.).

1.3. Aim and research questions

This thesis aims to create an understanding of how structures affect grain producers' work with sustainability and to investigate if perennial grains can be part of the future grain production in Sweden. In this thesis, we perform a multiple case study of Swedish grain producers in Skaraborg, Västra Götaland. To fulfil the aim of the study, we pose the following research questions:

- How do structures affect the grain producers' work towards sustainability in their business?
- What is the grain producers' attitude towards perennial grains?

1.4. Thesis outline

Figure 1 illustrates an overview of how the thesis is structured. Chapter one is an introduction with focus on the study's problem, aim, and research questions. Chapter two contains a description of the theoretical framework, including the study's theories, *sustainability transitions*, and *structuration theory.* The chapter ends with a theoretical synthesis. Chapter three describes the methodology of the thesis regarding research design, literature search, multiple case study, data analysis and ethical consideration. Chapter four contains an empirical analysis based on the selected theoretical framework connected to the empirical data. Chapter five includes the discussion of the study. Finally, the thesis ends with chapter six including a conclusion of the findings and contributions and further research.

Figure 1. Thesis report outline

2. Theoretical framework

The scope of this thesis is to focus on sustainability and the attitude to perennial grains within grain producers, analysed through structuration theory and sustainability transitions. The theories are used to analyse how structures affect the grain producers' business and possibilities to grow perennial grains. Since the focus is usually on processes of radical change at the level of a country in sustainability transition studies, the theoretical delimitation in this study is that the focus is on a smaller spatial level (Darnhofer 2015).

2.1. Structuration theory

Structuration theory stems from social theory and the need to understand human actions in relation to social institutions (Giddens 1984). In this thesis, Giddens definition of structure is used:

> "Rules and resources, recursively implicated in the reproduction of social systems. Structure exists only as memory traces, the organic basis of human knowledgeability, and as instantiated in action." (Giddens 1984, p. 377).

Jack and Kholeif (2007) describe the epistemological basis of structural theory as the view of knowledge as socially constructed where people are seen as knowledgeable agents. Over the years, structuration theory has been formed and developed in various areas, including being linked to entrepreneurship and organisational research (Chiasson & Saunders 2005). Giddens (1984) describes that structures are created through human action which in turn makes structures disappear without human action. Structures can therefore be seen as rules and resources that govern human action. Actions are reactions of perceived opportunities and challenges from structures (Giddens 1984). The relationship between actors and structure are defined by agency (Giddens 1979). Moreover, agency can be described as the agent's capacity to interpret and mobilize different rules. Furthermore, by linking actions to social systems, an understanding can be created of how decisions are made in relation to the outside world (Stones 2005).

The concept duality is used within structuration theory to describe how action and structure together create each other, which can also be linked to the development over time and space (Giddens 2013; Layder 1994). Figure 2 illustrates how human action creates structure, which in turn creates human action (Rose & Scheepers 2001). Then, over time and space these human actions are changed and developed. By analysing structure and action, an understanding of the creation and reproduction of social systems can be created (ibid.).

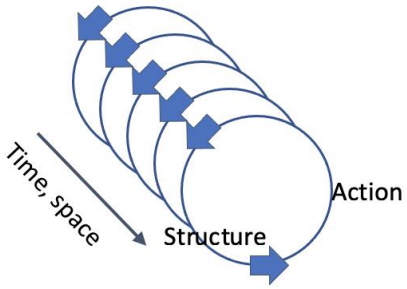

Figure 2. Illustration of duality of structure reproduced through time and space (Based on Rose & Scheepers 2001 p. 224; own modification)

Giddens (1984) highlights the two concepts' agents and reflexivity as important parts within duality. Poole and McPhee (2005) describe three different dimensions that affect action: norms, power and meaning. The three dimensions are also mentioned as the modalities of action which are part of every interaction. Poole and McPhee (2005) highlight that norms connected to social behaviours, such as how situations are usually handled, influence new actions. They also mention that power between actors, for example between a manager and an employee, affects how action takes place. Meaning is described as linked to how a situation is interpreted, different interpretations create different actions (ibid.). According to Poole and McPhee (2005), norms, power, and meaning are inverted but can also be distinguished.

Three types of consciousness have been discussed and highlighted as important during individual decisions within structuration theory and the concept of duality: practical, discursive, and unconscious (Layder 1994; Giddens 1984; Poole & McPhee 2005). Practical consciousness is connected to knowledge and memories, which occur during common routines and do not require reflection before the action (Layder 1994). The second type of consciousness, discursive consciousness, occurs during new situations when the individual needs to reflect and consider different options (Giddens 1984). Layder (1994) describes the discursive consciousness as the opportunity for individuals to make a difference. Poole & McPhee (2005) discuss the third type of consciousness, the unconscious, that occurs when something threatening or odd happens. In that kind of situation, the actor works to

find meaning for it (ibid.). If finding meaning is not possible, the actor works to maintain existing routines.

2.2. Sustainability transitions

Sustainability transitions are multi-dimensional, long-term, and fundamental transformations of large socio-technical systems towards more sustainable consumption and production (Farla et al. 2012; Markard et al. 2012). Sectors such as water supply, energy supply, agriculture and manufacturing are examples of socio-technical systems (Van den Bergh et al. 2011). These kinds of systems consist of networks of actors and institutions, knowledge, and material artefacts (Geels 2004; Weber 2003). According to Smith et al. (2005), guidance and governance often play a particular role in sustainability transitions. To question the existing system is also important for transformation to happen (McAdam 2003). The agricultural sector has a strong institutionalized structure, which means that fundamental changes take a particularly long time and therefore a motivation to change is of importance for a transition to happen (Farla et al. 2012; Stauber 2007).

Different approaches of studying socio-technical transitions have emerged throughout the years (Lachman 2013). Geels (2002) presents the more prominent approach in this branch of research, the multi-level perspective (MLP). The MLP model highlights innovation as the starting point for socio-technical transitions (Van den Bergh et al. 2011). The model is divided into three levels illustrated in Figure 2. The first analytical level is niches, the site of individual agency and radical change (Geels 2011). Individual agency is both constrained by and forming the structure of the higher levels. The second analytical level is the patchwork of regimes, the place of established methods and associated rules that stabilize existing systems like mainstream grain marketing and supply channels (ibid.). The third level is the landscape level, with structures such as knowledge, regulatory and cultural systems (ibid.). Interaction and development at these three levels results in non-linear processes, which the MLP model sees transitions as (Darnhofer 2015). The MLP emphasizes that processes at the niche, regime and landscape level need to be aligned for a transition to be successful (ibid.). In transition processes, power is not concentrated within specific actors or at a particular level like niche or regime but dispersed across interrelated agents at numerous levels (Avelino et al. 2016).

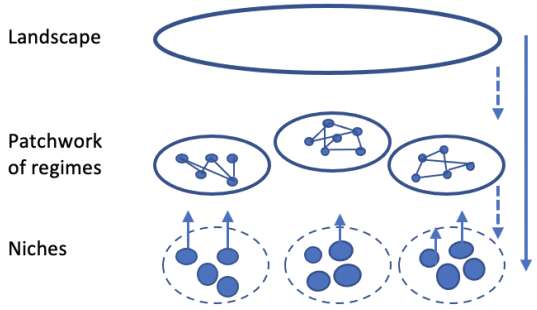

Figure 3. Illustration of Multiple levels as a nested hierarchy (Based on Geels 2002 p. 1261; own modification).

Niches are created by actors at the local level. For example, entrepreneurs developing a new market, through the invention of new technology or initiatives that give rise to changes that are outside the existing system, which is the socio-technical regime (Darnhofer 2015; Geels 2004). In food systems, alternative food networks and production methods like organic farming and urban farming can be seen as niches (Darnhofer 2015; Geels & Schot 2007). Due to pressure from the patchwork of regimes and socio-technical landscape, innovations often have difficulties developing to a point where they contribute to societal change, despite the societal importance of niches and novelties they foster. An example of such pressure could be decisions made based on short-term profitability making. Social norms and preferences could also make it difficult for innovations to develop (Alló & Loureiro 2014). Elzen et al. (2004) claim that niches are crucial for transitions because they create a start for systematic change.

The patchwork of regimes in figure 3 is the dominant socio-technical regimes within a system. In food systems, the socio-technical regime often refers to intensive, modern, conventional agriculture and the institutions that maintain the system (El Bilali 2019). The patchwork of regimes forms the backbone of socio-technical systems and can be seen as complex compositions of norms, standards, and rules that guide action, which in turn recreate the regime's structure (Geels 2011; Geels & Schot 2007). Infrastructure and buildings are material manifestations of the regime which also contribute to the structural reproduction and rigidity (Geels 2004). This structural complexity creates stability and thus inertia to change (ibid.). Even though novelties may constitute a valid alternative, it could be difficult for them to take off when structures build up around specific technologies that help protect these technologies (Geels & Schot 2007). One example of that is infrastructure that is built around personal transportation. A regime is composed of several sub-regimes such as user preferences, market, policy, and science, which have their own dynamics but interpenetrate and co-evolve with each other. The

concept of a patchwork of regimes aims to capture the meta-coordination between these different sub-regimes (Geels 2004).

The landscape level consists of external forces that affect the patchwork of regimes, such as economic crises, major political decisions, wars, climate change or other events that shape the context in which the system operates (Markard et al. 2012; Geels & Schot 2007). Compared to the other levels, this level is made up of more deeply rooted structures such as demographic trends, political ideologies, informal institutions, traditions, and customs (Geels & Schot 2007). Even though the landscape level can affect and put pressure on the niche level and patchwork of regimes, the processes at the level cannot be influenced by niche or regime actors in the short term (shown by the arrows in figure 3) (Geels & Schot 2010). The basis for restructuring in the patchwork of regimes is affected by changes in the landscape which creates pressure on the present regime (Darnhofer 2015). According to Geels and Schot (2007) a disruption in the patchwork of regimes creates an opportunity that allows niches to break into the regime. It is important to pay attention to the interactions between regimes when analysing emerging transitions (Darnhofer 2015). Indeed, the growth of niches often requires interaction between two or more regimes, an example of that is the case of biofuels, which is an interaction between the agriculture regimes and energy regimes (ibid.).

2.3. Structuration theory through Sustainability transition

Opportunities and challenges create human action that in turn creates structures, which over time and space changes and develops (Rose & Scheepers 2001). A sustainability transition means fundamental change within socio-technical systems, such as the agricultural sector (Markard et al. 2012; Van den Bergh et al. 2011). Within the agriculture sector, existing structures affect the decision-making among grain producers (Chiasson & Saunders 2005). Geels' MLP shows that there is structure at different levels, *landscape*, *patchwork of regimes* and *niches* (Geels 2002). In this thesis the unit of analysis is the grain producers and how the MLP levels with its structures affect their actions. Giddens' structuration theory is used to find out about the individual agency among the grain producers, as actors in the agricultural sector (Giddens 1984). By applying structuration theory with the concept duality through the MLP-levels, it is possible to analyse how the grain producers are affected by structures in their actions towards sustainability and production of perennial grains (see figure 4).

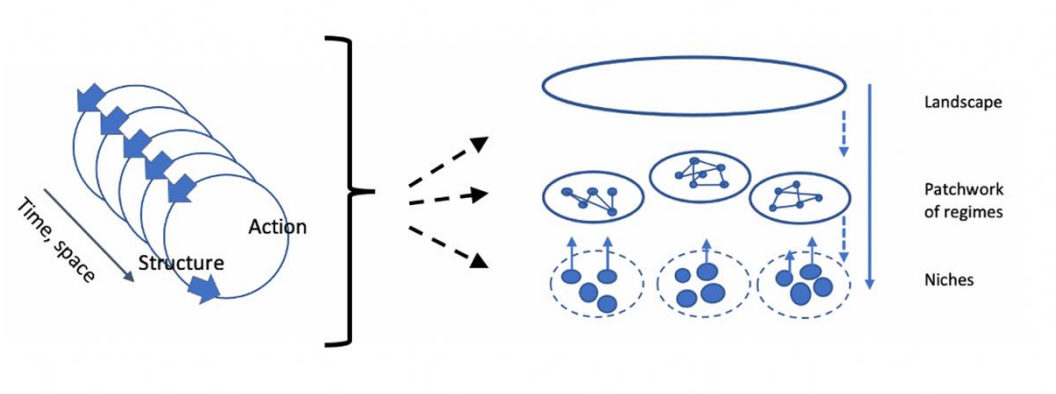

Figure 4. Illustration of structuration theory with duality seen through sustainability transition connected to the different MLP-levels, own illustration

3. Methodology

In order to fulfil the aim to create an understanding of how structures affect grain producers' work with sustainability and to investigate if perennial grains can be part of the future grain production in Sweden, a qualitative method creates opportunities for interpretation and understanding (Bryman & Bell 2017; Yin 1994). A qualitative method can be used to conduct sense-making in a thesis (Van den Hoonaard & Van den Hoonaard 2008). Selected questions and aims are answered through an inductive research process where theories and explanations are created based on observations and collected data (Bryman & Bell 2017). This deep diving makes it possible to link their actions to the theory and then to see the connections between the practice and the theory (Yin 1994).

The ontological approach in this thesis is a constructivism paradigm, which is part of the interpretative epistemology approach (Bryman & Bell 2017; Yin 1994). In this study, the researchers perceive the world as constructed by individuals who interact within their own social reality. Depending on the researcher's view of reality and the chosen ontological and epistemological approach, the outcome of the thesis is affected (Alvesson & Sköldberg 2017). For this, results from qualitative research are an interpretation of data and not a presentation of reality. A paradigm explains the chosen way of looking at the nature of the world and what place individuals have in that context (Mackenzie & Knipe 2006; Guba & Lincoln 1994). Within the constructivist paradigm, individuals make decisions based on their own social context (Guba & Lincoln 1994). Bryman and Bell (2017) describe constructivism as a paradigm within a world that is constantly changing. With this view of research, Guba and Lincoln (1994) describe the need to understand that all situations can be interpreted differently and that the results of a study are also affected. The resilience of each individual's own reality also creates the precondition for giving personal depth to the research linked to reality.

Forchuk and Roberts (1993) argues that all research must be read with a critical eye. Qualitative research is usually criticized for being too subjective (Bryman & Bell 2017). Within the interpretative epistemology with the constructivist paradigm is it not possible to act objectively, based on the arguments that the researcher's subjective assumptions of what is meaningful and important affects the result

(ibid.). The researcher's reflection of the interpretation can give value and provide quality to the research. Reflection is about the researcher's awareness of how they interpret the data. In other words, the results of this thesis are a representation of the researcher's subjective opinion of what is important and their interpretation of data. The result of interviews and analysis is intrinsically influenced by the researcher's skills, prejudices, and feelings (Bryman & Bell 2017).

Since the results of this thesis are based on interpretations, some commitments have been made to create credibility, which is a common quality criterion within the constructivism paradigm (Bryman & Bell 2017; Guba & Lincoln 1994). This also leaves some room for critically reflecting on the limitations that may affect the study's results (Lincoln 1995). Interpretations always affect the content of a study, the researcher's background and knowledge affect the interpretation when analysing the result (Bryman & Bell 2017). Hence, different people interpret the material in different ways, which have an impact on the result. In this study, the researchers are aware that the result was affected by how the collected material was interpreted and that these interpretations were affected by who they are. The researchers themselves grew up on farms, are women, are agronomy students, and in the 20-30 age group.

Triangulation has been done to increase the research's credibility (Noble & Heale 2019). In this study, triangulation was done when two researchers interpreted and analysed the result to reduce the risk that one individual's understanding colours the result. To further increase the dependability, the researchers have deliberately interviewed a varied sampling, respondents who have contributed with different perspectives (Bryman & Bell 2017; Guba & Lincoln 1994). Dependability is also about making the interpretation process as transparent as possible (ibid.). In this study, this has been done by carefully documenting the analysis process.

3.1. Literature search

In this study, secondary information from websites and published reports and books will complement primary sources with semi-structured interviews. When using secondary sources, both findings of the thesis and the thesis itself gets greater credibility with validation (Bryman & Bell 2017; Mays & Pope 2000). Therefore, collected data from books and articles that are peer-reviewed are collected from the database of the Swedish University of Agriculture Science (SLU). To find relevant information, the following keywords were used in different constellations in the mentioned database: *sustainability, sustainability transitions, sustainable agriculture, perennial grains, structures, grain production, attitude,* and *structuration theory.*

3.2. Multiple case study

A multiple case study is utilized to understand how structures affect grain producers in one area and their actions towards sustainability, and if it is possible to grow perennial grains. The multiple case study is an extension of the case study approach (Bryman & Bell 2017). The case study methodology is a tool in qualitative research for studying a phenomenon that happens in a bounded context with a precise unit of analysis (Baxter & Jack 2008). The unit of analysis in this thesis is the grain producers' and how structures affect their actions towards sustainability and production of perennial grains. Even though the emphasis is on the individual case, the multiple case study allows the researcher to compare the results against each other (ibid.). The comparison allows the researcher to decide on what is unique and common in the various examined cases.

The goal of comparing is to give a deeper understanding of the studied subject and not to generalize (Baxter & Jack 2008). Further, the comparison can promote theoretical reflection on the results and contribute to further research (Bryman & Bell 2017; Yin 1994). The generalization to other environments, usually a small representation, is a common critique within qualitative studies (Bryman & Bell 2017; Gomm et al. 2000). Qualitative case studies should be generalized to theory and not constitute a known population. This in-depth case study creates opportunities for insight into how they act regarding sustainability as grain producers in Sweden.

3.2.1. Sampling the region of Skaraborg

The empirical delimitation of the study is the producer perspective and the region Skaraborg, Västra Götaland in southwest of Sweden (see Figure 5). Therefore, no other perspectives will be considered. The selection of respondents is grain producers operating within Skaraborg. The area was chosen because it influences Swedish food production with a large proportion of grain producers. Skaraborg is a former region in Västra Götaland consisting of 15 municipalities (Skaraborg 2021). In Västra Götaland, 22 per cent of the area consists of agricultural land, which is 17 per cent of Sweden's agricultural land in total (ibid.). In Skaraborg, the soil conditions and cultivation opportunities are similar in the region. Therefore, the area is a fair unit to analyse (SJV 2013). By interviewing grain producers from the same geographical location, it provides relevance when analysing the attitude towards sustainability and perennial grains.

Figure 5. Region of Skaraborg, Västra Götaland in Sweden.

3.2.2. Sampling the respondents

A good informant to interview is a person who enables us to ask analytical questions within their expertise, while they in turn can tell us a lot about the chosen topic (Yin 1994). To find suitable respondents within Skaraborg, two approaches have been used: personal contacts and agricultural communities found on Facebook.com. A Facebook post with a description of the thesis and the question of interest in participating in an interview was written in the groups "Spannmålsbönderna" ("The grain producers") and "Ruralista! Grönt är det nya svarta" ("Ruralista! Green is the new black") (see Appendix 1). "Spannmålsbönderna" has 16,000 members and "Ruralista! Grönt är det nya svarta" has 2,000 members. By asking the personal contacts and writing in the Facebook posts about acquaintances that could be more suitable to contact as respondents, the opportunity was created to find suitable respondents (Bryman & Bell 2017). When the researchers contacted grain producers who did not want to participate, they were asked about other suitable people to interview for the study. Thus, suitable respondents were contacted that wanted to participate.

All respondents are anonymous and have therefore been assigned fictitious names. Two women, Anna and Sofia, and four men, Joel, Gustaf, Gösta and Lars. Joel, Anna, Gustaf and Gösta were found through acquaintances for recommendation on grain producers to contact. Lars was found through "Spannmålsbönderna" and Sofia through "Ruralista! Grönt är det nya svarta". By having the opportunity to reach out to many people, the conditions are created to find suitable respondents as well as respondents with different gender and backgrounds around the chosen subject for the thesis (Bryman & Bell 2017). The selection of respondents includes choosing grain producers with different experience and knowledge, different

gender, ages, and different production orientation in addition to grain cultivation due to discover, compare and analyse different structures (Yin 1994). After interviewing six respondents, additional data collection did not provide significant additional insight, theoretical saturation was achieved and no more interviews were conducted (Stake 2006; Guest et al. 2006; Glaser & Strauss, 1967).

The researchers were critically reflexive in the selection of respondents, people of different gender were interviewed to get a reality-based picture of the result since the industry consists of both men and women. By contacting acquaintances and posting in the Facebook group "Spannmålsbönderna", the researchers only got in contact with one female respondent. To include more women in the study, the researchers also posted in "Ruralista! Grönt är det nya svarta" with only female members. It resulted in one more woman, which increased the diversification of the result as a woman in a male-dominated industry could contribute with different perspectives compared to a man (Sachs 2018).

Gustaf is between 20-30 years, Joel, Anna, and Sofia are in the age range between 30-40 years, Lars is between 40-50 years and Gösta is between 60-70 years (see Table 1). Joel is operation manager, Lars and Gösta are owners, and Anna, Gustaf and Sofia are part owners. Joel, Lars and Gösta have a university education, Anna and Sofia have vocational education and Gustaf has an education from agricultural high school. The size of the farms varies from 5 to 600 hectares of land. As shown in Table 1, two of the farms have a conventional orientation, two of the farms have an organic orientation and two have a combination of organic and conventional. Joel and Gustaf have grain production as main production. Anna and Sofia have cattle production and Gösta has milk production as main production, but all are producing grains. Lars has grain and eggs as main production.

Table 1. Description of respondents

Respondent	Gender	Age range	Hectares	Education	Main production
Joel	Male	30-40	500-600	Agriculture and Rural management	Conventional grain production
Anna	Female	30-40	0-100	Agro technology	Organic cattle production
Gustaf	Male	20-30	400-500	Agricultural high school	Conventional and organic grain production
Lars	Male	40-50	500-600	Agronomist	Organic grain production, organic egg production
Gösta	Male	60-70	300-400	Agriculture and Rural management	Organic milk production, conventional grain production
Sofia	Female	30-40	100-200	Agro technology	Conventional cattle production

In addition to the main production on each farm, Gustaf, Lars, and Sofia operate in other business categories. Examples of other categories are forestry, seed cleaning, self-picking of strawberries and contracting business. Figure 6 illustrates in which phase of the life cycle the respondents think their business is in. Anna, Gustaf, and Sofia describe their state of the business as a growth phase, Joel and Gösta describe their state as a maturation phase and Lars describe that he is in an introduction phase.

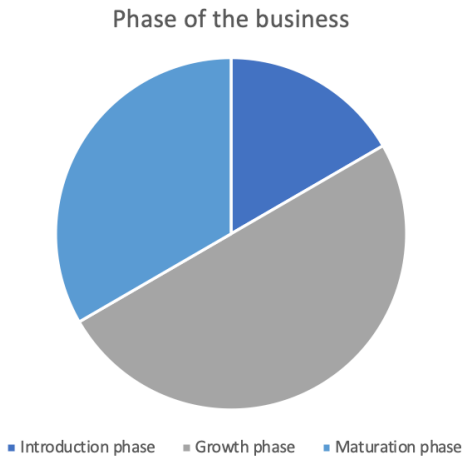

Figure 6. The distribution of the phase of the respondents' businesses

3.2.3. Interviews

Since information can be collected differently, this affects how the informants provide information and how the information can be analysed (Yin 1994). Semi-structured interviews were utilized to gather the empirical data in this study. The selected type of interviews was effective since the thesis aimed to answer the research questions in each respondent's specific context. To be able to reach the desired depth of the studied phenomenon semi-structured interview format was suitable, the risk with utilising structured and unstructured interviews is that this research could be too standardized or incorrect (Zhang & Wildemuth 2009; Yin 1994).

Semi-structured interviews employ a relatively detailed interview guide useful when the researcher possesses sufficient objective knowledge about a phenomenon but lacks subjective knowledge (McIntoch & Morse 2015; Merton & Kendall 1946). The interview guide creates a structure and can be seen as an analytical framework with open-ended questions, which the participants are free to respond to as they wish (McIntoch & Morse 2015). This is an advantage with this approach, the interview can therefore be perceived more as a structured conversation than a questioning (Bryman & Bell 2017; Yin 1994). This constitutes the semi-structured aspect of the method, the framework, and the flexibility of the responses (McIntoch & Morse 2015).

In this study, the interview guide was created based on the theoretical framework and research questions of the thesis (see Appendix 2). Since the questions were predetermined, the interviews were still experienced both serious and professional (Bryman & Bell 2017; Yin 1994). The same predetermined open questions were asked in the same order to all respondents, making the collected data comparable (McIntoch & Morse 2015).

In this study, the interview guide is structured around three themes, first background, then sustainability and implementations, and finally, perennial grains. Since it is difficult to ask someone about structures that affect them, these themes were selected to indirectly find out about how structures affect them. The background questions were meant to be the foundation of the analysis, such as information about the respondent and its business. These answers allowed for drawing conclusions based on similarities and differences between the respondents. Questions about sustainability and implementations were formulated so that the respondent would talk about their perception of sustainability, possible sustainability work and preferences for implementation. The final questions about perennial grains focused on the respondent's perceived opportunities and

challenges about implementing perennial grains in their business and in Sweden as well as important actors for a sustainable agriculture sector in the future.

To test the questions before the real interviews, a pilot version of the interview guide was tested on the author's family members. The family members were grain producers and met the criteria of experience of grain production. The pilot version gave the author's a first impression of the effectiveness and quality of the interview guide and allowed for reformulation and development of the questions and themes (Maryam 2016).

Being a farmer often requires a lot of time being invested into the job. Therefore, the goal was to keep the interviews around 30 minutes long to make it possible for the grain producers to take part (SJV 2002). The interviews in this thesis were conducted with computers via Zoom and by telephone. The respondents chose whether the interview was to be conducted by telephone or screen so that they would feel that the interview was flexible and therefore made it easy to participate. Two respondents felt that Zoom was suitable and four considered telephone interviews most convenient. Face-to-face interviews are to be preferred since it provides the researcher with an extra dimension of context (Bryman & Bell 2017). As critical reflexivity in this case, it would have been better if the researchers decided to have all interviews over screen instead of letting the respondent choose. This because the interviews over screen were perceived as more rewarding as it was possible to interpret each other's body language.

This thesis was written during distance education because of the coronavirus disease (COVID-19). Therefore, conducting interviews face-to-face was not an option due to the pandemic. It is arguable if any important contextual impact could affect the results due to the short amount of time dedicated to conducting the interviews. Due to the lack of personal interaction, Vogl (2013) claims that interviews by telephone are often avoided. However, Sturges and Hanrahan (2004) compares telephone interviews with face-to-face interviews and argues that there are no significant differences in the quality of data. Thus, telephone interviews can be a successful tool when gathering data in qualitative research (ibid.).

In this study, the conducted interviews were relatively short, and the open-ended questions limited the researchers influence on the respondent and provided an unbiased data gathering. As ethical assurances in this study, various approaches were adopted. Authors have a great responsibility of ethical assurance and are required to report ethical considerations of their research (Connelly 2014; Munhall 1988). Fisher and Anushko (2008) highlights the importance for researchers to not harm the respondent's confidentiality or the respondent itself. Before the

interviews, the respondents were informed that the participation is voluntary, that they have the right to terminate their participation whenever they want and that they will be kept anonymous. It is important that the respondents are well aware of what the thesis entails, provided with important information to participate and give their consent to participate (Bryman & Bell 2017; Munhall 1988). The respondents were also asked to approve a recorded interview so that the interviewers could stay focused and not be distracted by taking notes as well as minimizing the researchers' influence on the analysis because they could listen to and see the respondents' expressions. To have anonymous respondents with fictitious names is to protect their personal information. It could make it easier to collect honest empirical information which increases the quality criteria trustworthiness (Bryman & Bell 2017).

After each interview, the collected data was controlled, and a respondent validation was sent to the respondents to increase the confirmability and credibility through ensuring that the observations were consistent with what was intended to be conveyed (Yin 2009). With the respondent validation, the respondents get the opportunity to change or remove the collected empirics before it will be used in the thesis, which minimizes the risk of misunderstandings and misinterpretations between the researchers and respondents.

3.3. Data analysis

The unit of analysis in this thesis is the grain producers' and how structures affect their actions towards sustainability and production of perennial grains. In qualitative research, patterns within phenomena are investigated in different ways where coding and linking to theory in some way lie as a basis (Bryman & Bell 2017; Yin 1994). To structure and analyse the collected empirical data in this study, thematic coding and content analysis have been used.

In this study, the analysis of data is based on constructionism and the perception of an interpretable reality (Bryman & Bell 2017; Yin 1994). As Van den Hoonaard and Van den Hoonaard (2008) describe, there are different features that can be used in qualitative research, before, during and after collecting data. To create a clear structure and to organize the collected empirical data, the respondent's answers are linked to a thematic coding system (Bryman & Bell 2017; Robson 2011). Through an inductive analysis process, themes have been created through the respondents' interviews adapted to the research questions (Skjott Linneberg & Korsgaard 2019). The empirical data has been structured according to the selected themes: *sustainability*, *implementations*, and *perennial grains*. Thematic coding fits well in a qualitative thesis by creating connections and structure from the large amount of

information of the semi-structured interviews (Bryman & Bell 2017; Braun & Clarke 2006).

Qualitative content analysis has been used to analyse the data and to interpret its meaning after the thematic coding (Bryman & Bell 2017; Elo et al. 2014). Through the phases preparation, organization and presentation of results, the thematic coding was linked to theory and created new themes for the analysis where the two theories were individually analysed together with sustainability, implementations, and perennial grains to finally analyse the two theories together. To interpret the empirical data during the analysis, interpretations were created by looking for meaning by questioning the answers from the interviews (Morse 2008). By questioning and wondering, for example *"what did they mean here"* and *"what can this be linked to"*, the empirical data was interpreted and linked to the different theoretical themes and presented in the empirical analysis (ibid.). Questioning and interpreting the data are according to Morse (2008) used to facilitate the analysis and the structure of themes, which in qualitative studies often are abstract and difficult to find. In this thesis with semi-structured interviews, content analysis created a clear structure linked to theory based on the large amount of collected data. By using a well-proven analysis method, other researchers can use the same approach in other contexts, which creates the possibility of transferability (Bryman & Bell 2017; Guba & Lincoln 1994). Despite the possibility of transferability, it is important to keep in mind that the analysis has been done through interpretations based on the researchers' ability within the framework of a specific method, which may mean that the results may differ depending on who is interpreting (ibid.).

Since the researchers and respondents are from Sweden, the interviews were conducted in Swedish and translated into English. To be able to adapt the collected material to the study, the empirical data have been translated carefully to not negatively affect the quality through misinterpretations (Van den Hoonaard & Van den Hoonaard 2008).

4. Empirical analysis

Through an empirical analysis, the collected material from the semi-structured interviews has been analysed through the selected theoretical framework. Structuration theory with a focus on how agency, as structure and human action through duality affect each other, has been analysed based on the three levels in the MLP model within sustainability transition. All actions and interactions are based on knowledge and reflexivity which includes underlying motives with norms, power and meaning (Poole & McPhee 2005; Giddens 1984). As shown in Table 2, this chapter is structured according to structures affecting the grain producers in the different levels; niche, patchwork of regimes, and landscape with a focus on implementations, sustainability, and perennial grains to gain an understanding of structures they operate within.

Table 2. Compilation of structures affecting the grain producers from the different MLP-levels

	Landscape level	**Patchwork of regime level**	**Niche level**
Structures affecting the grain producers	Climate change Political decisions Governmental support Research and development	The use of fossil fuels Lack of time i.e. lack of structures Male-coded values Colleagues and nearby farms Anonymous products and low consumer knowledge	Colleagues and nearby farms Their own reality and specific context

4.1. How structures at the landscape level affect the grain producers

Niches The landscape level consists of external forces and structures that affect agriculture and shape the context in which the system operates (Markard et al. 2012; Geels & Schot 2007). Several structures are affecting the grain producers within the landscape level in their work towards sustainability.

Climate change is one example of structures within the landscape level that affect the grain producers in their journey towards sustainability (see Table 2). All respondents mentioned the climate as important to consider within grain production. Gösta described his present work to reduce environmental impact as growing organically and adapting agriculture to the requirements that exist around sustainability. These requirements have been created through pressure and structures from the landscape level through Arla in this case. He expressed that the work is being done to reduce energy consumption, to replace current diesel with a lower number of fossil-based alternatives because diesel needs to be replaced to meet Arla's requirements.

Decisions made by the government come from the landscape level and affect the rest of the society at the patchwork of regimes and at niche level (Darnhofer 2015; Geels & Schot 2007). Political decisions were mentioned by all the respondents as an important factor for the development of sustainability in the agricultural sector (see Table 2). Gösta and Anna mentioned the importance of policy and that it both affects the environment in general and affects how grain producers can work with reduced environmental impact. Anna also experiences a challenge in achieving a profitable business without the need for governmental support (see table 2), which is something the landscape level can affect through politics (Geels & Schot 2010). Experiences such as these show structures where grain producers face challenges and opportunities in being able to act with sustainable initiatives (Giddens 1984).

Regarding how the respondents are affected by research and development, four of them perceived it as a positive process regarding sustainability (see Table 2). As well as the landscape can put pressure and contribute towards a sustainability transition, it can also prevent niches that could contribute to a sustainability transition (Geels & Schot 2010). Gösta experienced a need for more research on innovations that can contribute to more sustainable development for the environment. He said:

> "In this capitalist system, the focus is on what is considered most profitable, which is a global political problem"

Several of the respondents expressed that other focus in the research can create better opportunities to work more sustainably in the daily work on the farm. Anna and Sofia also experienced that research takes place in the wrong areas, that important areas are not prioritized. It is also experienced by Anna and Sofia that a gap has been created between how research institutes take place in the agricultural sector compared to how it looks like in reality. Anna describes that:

> "Research is done on product development and on research on innovations for large farms, which is not really what ordinary farms need"

Lars perceived research and development as bad and described that all advice and the last 50 years of agricultural development are the opposite of regenerative thinking. Lars believes that within the next 5 to 10 years worldwide, great successes and development will be possible in the agricultural sector when people understand that nitrous oxide emissions are nothing but poor soil health. The different experiences around research and development show that different knowledge and reflexivity are influenced by major actors in the agricultural sector (Giddens 1984).

Decisions and structures from the landscape level sets the frame for how decisions can be made on a farm level by the grain producers. Current structures depend on past events and are a basis for what actions will be taken by the grain producers in the future (Giddens 2013; Layder 1994). This can be connected to the structuration concept duality based on the correlation between structure and action over time and space (Rose & Scheepers 2001). Even though the landscape level can affect and put pressure on the niche level and the patchwork of regimes through the mentioned examples above, the processes at the landscape level cannot be influenced by niche or patchwork of regime actors in the short term (Geels & Schot 2010). For agriculture to undergo a development towards sustainability, many factors come into play because of the strongly institutionalized structure (Farla et al. 2012).

4.2. How structures at the patchwork of regime level affect the grain producers

The grain producers experience challenges within the strive for sustainability in their daily work that affect the possibility of individual agency (Giddens 1979). Depending on structures that come from the patchwork of regime level, the grain producers react to the structures through action and new structures are created through duality (Layder 1994; Giddens 1984). Four of the grain producers mentioned transports and the use of fossil fuels as a challenge within the work towards less environmental impact (see Table 2). Both the number of transports involved in the sector and the dependence on fossil fuels are based on established

structures in which farmers operate (Geels 2011; Geels & Schot 2007). The cattle farmer Anna considers the discussion about achieving agriculture without fossil resources as contractionary. Gustaf described that:

> "One challenge is to reduce processing in the organic fields, considering that they [the organic fields] require too much driving. I also want to reduce the amount of transport, for example when buying fertilizer."

Sofia expressed that the industry is fundamentally male-coded and that this results in a development that is shaped by male values. She experiences that farmers, just like all people, are shaped by each other and that there are clear norms and prestige (Poole & McPhee 2005), for example, she describes that:

> "It is okay to spend a lot of money on new machines but not to accept a lower yield, even if the result on the last line[in the accounts] would be just as good"

Sofia believes that norms that are linked to prestige and how one identifies in relation to them can hinder new thinking. Male norms are structures in the patchwork of regimes that create stability and inertia to change, which inhibits individual freedom of action among grain producers (Geels 2011; Geels 2004; Giddens 1979).

Sofia also mentioned time as a challenge when working towards sustainability within her grain production. She said that depending on the situation, sustainability decisions are prioritized differently; being in phase with the business makes it possible to plan for more sustainable initiatives. Not having time for sustainability speaks for the lack of structure for it. These challenges within the day-to-day actions are affected by structures, which affect how the grain producers adapt and choose to act in the future (Giddens 1984). When these challenges are experienced, situations are created where the actor needs to reflect and use existing knowledge before new decisions are made (Layder 1994; Giddens 1984). The grain producers use discursive consciousness when they act within challenging situations such as mentioned situations with male coded values and lack of time i.e., lack of structures for it (see Table 2). By experiencing discursive consciousness, they create initiative for change and adapt new behaviours (Layder 1994).

Four of the respondents mentioned consumers as important actors that affect the sustainability of the industry, which also affects the conditions of sustainable grain production. The respondents experience challenges regarding the low demand for more sustainable products, that consumers do not have enough knowledge about

the production of food. Joel mentioned that it is difficult as a grain producer to affect the consumers when products are sold through other brands, thus you get anonymous products (see Table 2), which does not show what an individual producer has done for sustainability work. This creates difficulties in being both profitable and sustainable and it is an example of how structures in the patchwork of regimes within the agricultural sector inhibit individual agency and therefore a transition (Geels 2004). Joel also claims that agriculture has itself to blame for consumers' lack of knowledge of the agricultural industry. Behind decisions, knowledge plays a major role (Layder 1994), which several of the respondents believe that consumers need more of to contribute to a change within sustainability.

4.3. How structures at nice level affect the grain producers

The niche level is the site of individual agency and radical change but due pressure from the patchwork of regimes and landscape, innovations at niche level often have difficulties developing to a point where they contribute to societal change (Geels 2011). Individual agency is both constrained by and through duality forming the structure of the higher levels, therefore the grain producers were asked about priorities for implementations and perennial grains since it is a niche and not yet developed (Layder 1994; Giddens 1984).

Regarding external influence on decisions, all respondents mentioned that they are influenced and inspired by nearby farms and colleagues in the sector regarding implementations within their grain production (see Table 2). All respondents perceived other farmers as a positive factor for the development of their businesses, farmers are generally seen as colleagues and not competitors. Lars experienced a huge impact of external actors in the sector. Anna experienced an indirect impact and Gustaf, Joel, Gösta and Sofia expressed that they felt affected. The farmers' experience of influence of other actors shows that they all react to different structures in the industry that creates opportunities and challenges in their individual actions (Giddens 1984).

During implementations, the grain producers make decisions that do not take place daily or routinely in the business. During daily routines as the respondent has with annual grains, practical consciousness is used where the decisions are based on knowledge and memories and do not require reflection before action (Layder 1994). When an individual does not make routine decisions, discursive consciousness is used (ibid). Discursive consciousness gives the opportunity for individuals to make a difference (Layder 1994). In this way, the grain producers

create actions on a niche level that create new structures (Rose & Scheepers 2001; Giddens 1984). All respondents except Anna have made implementations in their organisations. Some implementations have changed the operations in general, such as Lars who has started with regenerative agriculture, as Joel which has started with precision cultivation and built a grain dryer and Gustaf who has converted conventional cultivation to organic cultivation. The motives for the implementations have been different, but mainly to increase efficiency, profitability, and sustainability. Joel said:

> "In the event of changes, priority is given to efficiency but also to profitability and sustainability. We want to be sustainable, but in a sustainability decision, finances are a priority"

In the event of a possible transition from the current system that the grain producers have with annual grain production to perennial grains would mean an implementation of a niche. All six of the respondents had heard of perennial grains before but it varied in how much they knew about it. All had a positive attitude towards implementing it in their business which is important and indicates that there is an opportunity for a change to happen (Stauber 2007). Anna, Sofia, Gustaf and Gösta expressed lack of knowledge and Joel expressed perceived knowledge about perennial grains. Lars is about to join a project with the perennial grain Kernza, which initiates an ongoing process towards an implementation with perennial production (Darnhofer 2015; Geels & Schot 2007).

To understand the structure and the future interest in perennial grains, opportunities and challenges create a structure that the actors react upon (Chiasson & Saunders 2005; Giddens 1984). The respondent mentioned several opportunities with perennial grains. All respondents mentioned that their impressions are that perennial grains can bring great benefits to the environment, for example the decreased tillage when the grain grows year after year. The labour saving aspect perennial grains brings is a social aspect that several respondents mentioned as important for motivation as agriculture is a time-consuming industry. Sofia mentioned:

> "The lower working hours are highly valued in relation to lower returns, as long as it is profitable"

Preferences about perennial grains that were brought up by the other respondents ahead of an implementation were high profitability, high quality and similar yield as annual grains. Expressed challenges with perennial grains were according to Joel and Gustaf that it may involve increased risk for plant diseases while using perennial grains. Sofia mentioned the Swedish climate and establishment on the

market as challenges. Gösta believes that the implementation of perennial grains in Sweden can meet resistance from other players in the grain business, which he sees as a potential challenge for perennial grains to be established on the market. Linked to Gösta's view of challenges, Lars, Sofia and Joel expressed that it is important with demand on the market and an area of use for perennial grain products. Lars described that in a small market, a product goes quickly from deficit to surplus, which results in a loss of value of the product. He also claimed that it is important that the market of the product correspond to the demand:

> "If the grains do not become products like beer or bread, what do we do? Is it suitable for animal feed? And if it is not suitable for that, Swedish grain producers will probably not dare to try it in that case"

Preferences, such as those mentioned above, make it difficult for a niche such as perennial grains to break through the paradigms and establish on the market (Alló & Loureiro 2014). If a person perceives a situation as threatening or odd and can't find meaning for it, the person works to maintain existing routines instead and unconscious consciousness is used (Poole & McPhee 2005). While most of the respondents expressed benefits with environmental aspects, there are challenges that make them wait with the implementation of perennial grains until the conditions are better. They choose to maintain the current production system instead to try this non implemented grain and unconscious consciousness is used. It is difficult to change broad institutional structures because they represent valuable resources for the actors that benefit from the existing system, for example producers of annual grains and actors connected to production of annual grains (Farla et al. 2012). Lars has chosen to implement perennial grains based on the benefits he experiences due to the environmental benefits it brings, discursive consciousness is used during this decision. His actions create opportunities for structural changes on a niche level that can change the established market (Alló & Loureiro 2014).

5. Discussion

The focus of this thesis is on a smaller spatial level with six cases in a specific region. The grain producers are operating in different contexts with different perspectives and therefore the questions are interpreted differently which affects the result (Guba & Lincoln 1994). The result is also affected by the researcher's skills, prejudices and feelings (Bryman & Bell 2017). As mentioned in chapter 3, the researchers are aware that the result was affected by how the collected material was interpreted. In order to reduce the risk that one individual's understanding colours the result, triangulation was done when the two researchers interpreted and analysed the result (Noble & Heale 2019). The researchers have deliberately interviewed a varied sampling, respondents who have contributed with different perspectives, which increased the dependability further (Bryman & Bell 2017; Guba & Lincoln 1994). The specification of the six cases allows the researchers to zoom-in on perceived opportunities and challenges of structures reaching for sustainability, implementation of perennial grains and the attitude, which Darnhofer (2015) means plays a crucial role in the niche-regime interactions and the start phase of a transition in Swedish agriculture.

5.1. Structures mostly inhibit the grain producers' work towards sustainability in their business

The experiences about how the agricultural sector affects the daily work towards sustainability differs among the respondents. Different knowledge combined with underlying norms, meaning and power affect how the grain producers face challenges and opportunities (Jack & Kholeif 2007; Poole & McPhee 2005; Geels 2004). As mentioned in 3.2.2, the sampling of respondents consists of grain producers with different production methods, age, gender, and background which affect the findings of the thesis. Poole & McPhee (2005) describes that norms, power and meaning are part of every interaction as underlying factors of how the actors react and act. The findings in this thesis consists of several identified structures affecting the grain producers in their sustainability work.

All respondents experienced those major players in the socio-technical system inhibit the development of a sustainable transition through established structures (Farla et al. 2012; Stauber 2007). At the same time as the respondents experience a need for change within research and development and within policies, the respondents expressed that they feel an individual responsibility to act to prevent further damage to the environment. Structures make it difficult to act sustainable and at the same time be profitable (Geels 2004). The different MLP-levels share the power in the event of making sustainable structures (Avelino et al. 2016). One example from the collected data connected to the niche level is Lars regenerative agriculture and his new initiative to start with the perennial grain Kernza. These are sustainability initiatives outside the existing socio-technical regime (Farla et al. 2012; Stauber 2007). In food systems, conventional agriculture and the institutions that maintain the system is the socio-technical regime (El Bilali 2019). All the grain producers are affected by the structural complexity because it creates stability and inertia to change (Geels & Schot 2007; Geels 2004). An example from the patchwork of regimes and the inertia to change connected to the grain producers is that they express that they want to be more sustainable but are dependent on tillage, which requires fossil fuels. Regarding fossil fuels, the landscape level can, through climate change, put pressure on the patchwork of regimes in that matter. An example from the collected data is Gösta, which will reduce his environmental impact through Arla's directive to use less fossil-based fuel. By seeing structuration theory through sustainability transitions, the framework contributes to a reality-based picture of how grain producers react upon structures from the MLP-levels that affect them in their sustainability work.

5.2. The attitude towards perennial grains is positive but the perceived risk of low profitability inhibits the implementation

The respondents' positive attitude towards perennial grains is due to its reduced environmental impact compared to monoculture grain production with annual grains. The reduced environmental impact can be connected to the reduced use of diesel by less driving and less working hours by growing the grains without being re-sown for several years. Expressed challenges with perennial grains in a Swedish context such as climate sensitivity, low profitability, low yields, and low demand show the need for structural changes for grain producers to act (Giddens 1984). The grain producers' prioritization of profitability affects the attitude and interest towards the implementation of perennial grains that are not integrated into the current system. None of the grain producers are growing the perennial grains yet which could affect the result. If the consequences of growing the grain were

commonly known, the result would affect their individual agency through duality since individual agency both shapes and is shaped by structure (Giddens 2013; Giddens 2011; Layder 1994). The agency issue in this thesis is whether or not to begin growing perennial grains.

Clear influencing factors on how different attitudes are created are through knowledge and reflexivity (Giddens 1984). This can be linked to the fact that all interactions are influenced by norms, meaning and power (Poole & McPhee 2005). The attitude is affected by discursive consciousness and how different knowledge affects the reflection and motivation to act (Layder 1994). Lars values risking high profitability by focusing on developing sustainability. The other grain producers can imagine a somewhat lower yield if reduced labour weighs up and that profitability is still at a good level. The different attitudes show different ways of valuing meaning in implementing perennial grains, where the power of profitability influences action. Perceived negative characteristics of perennial grains can create unconscious consciousness, as grain producers choose to maintain current routines with annual grains instead of risking a non-working alternative (Poole & McPhee 2005).

The farms vary in production focus and size which can affect their attitude and individual agency when it comes to perennial grains (Guba & Lincoln 1994; Giddens 1984). Anna, Sofia and Gösta with cattle and milk production may have been affected by other influences and underlying factors compared to the other respondents with organisations that mostly consist of grain production. The share of hectares of grain production varies as well. Anna with fewer hectares of grain production may have another attitude compared to Lars with a larger share of hectares of grain production. The attitude of implementing a new grain such as perennial grains vary depending on the result at each specific farm, the business model affects how the grain is used. For example, it can be positive for those who grow a few hectares of grain since there is a lower risk of affecting the business negatively if it does not work. At the same time, the motivation of changing production methods might decrease as it makes less difference compared to a farmer who grows a large share of hectares. An incentive for Anna, Sofia and Gösta with animals can be that the straw from perennial grains can be used for animal feed.

As mentioned in 3.2.3, the interview guide was used to get an understanding of how the respondents are affected by structures. The selected themes with implementations, sustainability and perennial grains were selected to understand how the respondents perceived sustainability from their point of view and what attitude they have towards perennial grains. Other selected themes in the interview

guide or other questions could get other perspectives and findings about structures affecting grain producers. This study is not supposed to be generalized, instead the constitution is an in-depth understanding of how these selected respondents act towards sustainability analysed through structuration theory and sustainability transitions.

6. Conclusion

This thesis aims to create an understanding of how structures affect grain producers' work with sustainability and to investigate if perennial grains can be part of future grain production in Sweden. Through the theoretical framework, Giddens' structuration theory shows that individual agency both shapes and is shaped by structure and Geels' MLP shows how there is structure at different levels. Structures through duality and individual agency show a strong connection to the different levels in the MLP. The connection between action creating structure that creates action is the same as how the different levels in MLP create a transition. By answering the research questions *How do structures affect the grain producers' work towards sustainability in their business?* and *What is the grain producers' attitude towards perennial grains?* This thesis resulted in the following findings.

Structures mostly inhibit the grain producers' work towards sustainability in their business. Depending on what kind of structures affect them, their possibility to act sustainably differs. Politics, research, and consumers are examples cited by the grain producers as actors who have a great impact from the landscape level that inhibits their sustainability work. The mainstream market with strongly established structures on a patchwork of regime level makes it difficult for the grain producers to make sustainable decisions. Current structures on the mainstream market makes it difficult to maintain profit when making sustainable decisions. Factors such as lack of time for sustainable decisions, male coded values, anonymous products, and low consumer knowledge are perceived challenges that inhibit the grain producers and their individual agency. Instead of risking profitability, most of the respondents prioritize productions with methods that are well integrated, with high profitability and therefore use unconscious consciousness to work for maintaining routines. In situations when the grain producers perceive opportunities, for example on patchwork of regime level and niche level by the positive influence of colleagues and nearby farms, sustainable initiatives can be taken. When experiencing opportunities, discursive consciousness is used and the grain producers themselves act sustainable which affect the structures in the agricultural sector positively.

Most of the respondents' experience that perennial grains would be more interesting if they had better characteristics such as higher profitability and higher yield and a

market with demand. To implement perennial grains, the respondents believe that better conditions need to exist, partly for implementation in own operations but also for the grain to be able to be established on the market. Profitability comparable to current grains in operations motivates grain producers. The labour-saving aspects also affect the motivation and attitude. These conditions entail a need for structural changes in both companies in the market within policy, research and development and consumer demand before perennial grains can be integrated into the agricultural sector in Sweden.

The attitude towards perennial grains is positive but the perceived risk of low profitability inhibits the implementation. By analyzing the grain producers in their own context with the selected theoretical framework, this study shows that a system is needed that supports sustainability through all levels and farmers who take risks when they are in situations where they have a choice to act sustainable. The system needs to support increased profitability for sustainable initiatives, which can be done by, for example, providing grants for grain producers who dare to take risks for a sustainable industry. Support from researchers and retailers is also important for there to be resources and structures that make it easy to act sustainable. The role for the grain producers themselves is about taking risks and acting with discursive consciousness and dare to change to a new production method for reduced climate impact. One important factor the study shows linked to this is the fact that what is perceived as sustainable by one grain producer does not necessarily transmit to other producers. Their own reality and specific contexts affect what they perceive as sustainable. As a conclusion, it is a shared responsibility and together everyone must realize the risk of not acting sustainably and the consequences it entails for our earth.

6.1. Further research

This study focuses on how structures affect grain producers within their sustainability work. As Röös (2017) claims, social structures within the agricultural sector are difficult to measure. Research is needed to investigate and understand how traditional organisations with their established social structures can take more sustainable initiatives, as Berthet et al (2018) argues. Suggestions for further research on attitudes to sustainability and perennial grains are to focus on other perspectives and through an analysis with other theories to create a deeper understanding of the grain producer's behaviours. Through an analysis linked to the theory *triple bottom line*, the conditions for a development towards more perennial grains in the agricultural sector could be investigated. In this way, economic, ecological, and social values can be analysed together to create more understanding of the subject.

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Uppsala, June 2021

Ebba Kuylenstierna

Karin Andrén

Appendix 1 - Cover letter posted on Facebook

Translated from Swedish
Hey! Are you a grain farmer in Skaraborg and want to take part in a master's study? We are two students studying the last semester of Agricultural Business Management at SLU in Uppsala. We are in the beginning of our master's thesis and are looking for respondents to our thesis where we will conduct a number of interviews with grain producers in Skaraborg.
Our purpose is to examine the attitude to sustainability work and perennial grains. We are looking for you who usually grow at least 10 hectares of grain, regardless of other orientation on the farm or attitude to sustainability.
Do the criteria suit you, or someone you know who would be interested in setting up for an interview? If you have questions or are interested, feel free to write a comment here on Facebook or by email: knen0006@stud.slu.se and ebku0001@stud.slu.se

All the best,
Karin Andrén and Ebba Kuylenstierna

Appendix 2 - Interview guide

Background

- Can you tell us a little bit about your background, how old are you and do you have any education?
    - What is your role on the farm?
- Can you tell us a little bit about the farm, what is the production?
    - Organic? Conventional?
    - How big is the farm in hectares?
- In what part of the lifecycle is the business?
    - Introduction phase, growth phase, maturing phase, decline phase?

Sustainability and implementations

- Do you work actively with reducing climate impact on the farm today? Motivate!
- What do you think are the biggest challenges of being sustainable today?
- How does the sustainability issue affect the business finances?
- Would you work more with sustainability if your financial situation allowed it?
- Have you made any changes in the form of an implementation in the business (changed machines, changed feed system?) What factors are prioritized in an implementation?
- How do you experience research and development in the agricultural sector regarding sustainability?
- How does it affect your own sustainability decisions?
- Do you feel that you are influenced by what investments and decisions that are made of nearby farms or colleagues in the industry?

Perennial grains

- Have you heard of perennial grains before? Do you see any advantages or disadvantages of implementing perennial grain in your business?
- What preferences of perennial grains would motivate you to implement it? Motivate! (Dream scenario?)
- What challenges and opportunities do you see with the implementation of perennial grain in Sweden?

- How do you see the development of agriculture in the future when it comes to sustainability? Which actors do you think are most important for development?