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Expanding the Grain Legume Food Production in Southern Sweden

– Qualitative insights from producers and representatives from the food industry

Camilla Olsson

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Utökning av Baljväxtproduktionen för Livsmedel i Södra Sverige
- En kvalitativ studie med producenter samt representanter from livsmedelsindustrin

Camilla Olsson

Supervisor:	Georg Carlsson, SLU, Department of Biosystems and Technology
Co-supervisors:	Fredrik Fernqvist, SLU, Department of Work Science, Business Economics and Environmental Psychology
Examiner:	Erik Hunter, SLU, Department of Work Science, Business Economics and Environmental Psychology

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SLU, Swedish University of Agricultural Sciences
Faculty of Landscape Architecture, Horticulture and Crop Production Science
Department of Biosystems and Technology

Abstract

The success of modern agriculture has so far primarily been assessed by productivity and economic returns, and not on nutritional value or on the ecosystem services provided besides food and fiber. Despite their high nutritional value, environmental benefits, and economic advantages for the farmer, legume crops are grown on less than 2 % of the arable land in Europe. Expanding the domestic grain legume production could bring a lot of benefits across different scales and levels within the food system, including yield enhancement of subsequent crops, a reduction in the use of agrochemicals and environmental impact caused by fossil fuels, and providing consumers with locally produced, legume-based foods containing good sources of protein and fiber, and several essential vitamins and minerals. This study is part of a larger multi-stakeholder project called "New legume foods" (NLF), a four-year project working on developing climate-smart and protein-rich food products containing domestic legumes. Agroecological principles and inductive theory were applied to explore the preconditions, and barriers to overcome, of expanding the domestic production of legumes for food in Southern Sweden. This was achieved through semi-structured interviews with farmers and key actors from the food industry. All the respondents were generally positive towards an increased, domestic grain legume cultivation, with an increase in volumes or varieties. Challenges that were identified in this study in terms of expanding the grain legume cultivation in southern Sweden included finding suitable varieties for cultivation outside of the current area of production, developing alternative weed and disease practices for grain legume cultivation, and solving the issue of high investment costs for special machinery needed for some grain legume varieties. The underlying motivations of the food industry to promote an expansion of grain legume production seemed to be mainly economical, recognizing the market opportunity and the potential added value of products associated with the ongoing trend of plant-based and locally produced food, and that consumers have become more aware of the nutritional aspects of grain legumes. For the farmers to succeed with the cultivation of a new crop the advisory services needs to be improved, and the farmers also requested the security and stability of knowing that they have a buyer at a fixed price. Based on what the farmers mentioned as motivations for incorporating grain legumes into their crop rotations, they have a high awareness of the potential benefits of growing grain legumes, but they were concerned about the profitability of the production in terms of low price of the produce. The farmers also seem to fail in realizing the economic values outside of the actual returns from the produce, such as reduced need for fertilizers and pesticides in the subsequent crops. Due to this, there seems to be a need to translate the extended services provided by grain legume crops to economic values, and incorporate in the economic calculations, both on a farm level but also in terms of price of the produce. In other words, the farmers need to be paid for the ecosystem services to the environment and society that they provide by including grain legumes in their cropping systems. From the perspectives of the processing industry the challenge of profitability was mainly the uncertainties in yields, volumes and quality of the grain legume produce. This challenge could be mitigated by storing parts of the produce for the following year as a buffer, although with increased costs of storage. This study has further illustrated the importance of collaboration and communication between different key actors in the food system, when developing a complex food system that promotes other services besides the provision of food and fiber. The insights from producers and key actors in the food industry presented in this study can hopefully contribute to the sustainable development of Swedish cropping systems and the expansion of the domestic grain legume production for food, and might also be used as guidelines when moving forward with the NLF project.

Foreword

Before attending the agroecology masters' program, I completed a BSc degree in biology, were my main focus were on ecology, biodiversity and communication. During my previous studies, I recognized that many of the sustainability challenges that we are facing today involves food production, and agricultural production systems. Most of the knowledge I obtained during my biology studies were based on studying natural processes on a microscale level, and after my graduation I wanted to know more about the role of these microscale processes at a macrolevel, and how the knowledge of these processes can be applied to improve the overall sustainability of our society. When I applied to the agroecology masters' program I saw an opportunity to learn new perspectives on the complex matter of sustainable development of food production and the surrounding "natural" environment, and how to shift focus from the microscale level to apply a more holistic approach to problem solving.

If there is one thing I have learned during my agroecology studies it is that there are many dimensions of creating sustainable agricultural systems than just understanding the fundamentals of biology. My previous education and knowledge was based on the perception of agricultural systems as mainly a problem, and how it was effecting the surrounding environment in a negative way. In many cases these negative effects of agricultural production on the overall environmental sustainability of our society was not addressed as strongly as other human activities that cause environmental degradation, because of the importance of producing food for the global population. My motivation during this program has therefore been to learn more about how to work with knowledge and experiences across different disciplines to limit the negative effects of farming on the environment, and to improve the food production system by making it more economically and socially successful by creating production systems that contribute to the environmental sustainability instead of just focusing on repairing the damage caused by unsustainable production methods.

For my MSc thesis I wanted to do a qualitative study, to explore and deepen my knowledge in methods were I have no previous experience in practice, to be able to further broaden my views and perspectives that have been mainly formed by my natural-science background. When working with this thesis project, I have had the opportunity to experience for myself the importance of adaptive management, and participation by involving multiple stakeholders in decisions making processes. My hopes are that the lessons that I have learned during the course of the Agroecology program, and the new experiences that I have obtained when working with this thesis project, will facilitate me in my ambition of a scientific career in research where I hope to contribute to the sustainable development of our production systems and society.

Camilla Olsson, May 22th, 2017

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Camilla Olsson, May 22th, 2017

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Abbreviations

BNF	Biological Nitrogen Fixation
Fazer	Fazer Group Oy
HIR	The Rural Economy and Agricultural Sciences
KÖTP	Kalmar-Ölands Trädgårdsprodukter
N	Nitrogen
NLF	The project “New Legume Foods”
Orkla	Orkla Foods Sweden
SLU	Swedish University of Agricultural Sciences
Vara	Varaslättens Lagerhus

Introduction

During the later half of the twentieth century, the production of staple crops like cereals and rice has greatly increased, mainly due to technological and scientific advances including the increased use of agrochemicals and extensive irrigation practices (Gliessman 2015). The intensification of agricultural production has mainly been focused on high productivity and economic returns, promoting simplification and specialization of agricultural systems (Emmerson et al 2016). This has resulted in intensive, homogenous production systems replacing a more diverse, low-intense agriculture, with a decline in landscape heterogeneity, and biodiversity across several trophic levels and spatial scales in Europe (ibid). Modern agriculture has also become to rely on an increasingly high use of natural resources and inputs to maintain the high production levels, and the high consumption of animal products (Emmerson et al 2016, Odegard & van der Voet 2014). With a growing world population, the demand for food, feed, fiber, and bioenergy will continue to increase (ibid). Multifunctional agricultural systems are needed to maintain productivity while simultaneously conserving biodiversity, and the consumption of animal products needs to be reduced to be able to feed the future global population and increase the living standards worldwide (Emmerson et al 2016, Karp et al 2012, Odegard & van det Voet 2014).

Many leguminous plants (*Fabaceae*) have the ability to fix atmospheric nitrogen (N) through the symbiotic relationship with *Rhizobium* bacteria (Vandermeer 2011). After infection, the *Rhizobium* bacteria lives whiting the root nodules of the plant, where it enables the conversion of atmospheric N to a form that the plant can use, receiving carbohydrates in return from the plant (ibid). Fixed N is supplied to the soil, through decomposition of roots and other crop residues after the death of the plant, and to some extent through leakage of N into the soil also from the living nodules and roots (ibid). The amount of fixed N, and the amount of N that is leaked into the soil from the living plants, varies between different legume varieties and is dependent on the efficiency of the plant as well as the efficiency of the specific species of *Rhizobium* bacteria (ibid). Specific species of *Rhizobium* bacteria are associated with specific species of legumes, and particular varieties or species are believed to perform better or worse in terms of biological nitrogen fixation (BNF) under certain conditions (ibid). The supply of N to the soil through N fixing legumes is thus dependent on the availability of the specific *Rhizobium* bacteria in the soil and its suitability for symbiosis with the legume variety that is grown, the efficiency of the leguminous plant and bacteria, and it could furthermore vary under more or less favorable conditions. Due to these factors, the N supply of legumes to the soil can vary significantly, but in a review by Zander et al (2016), the supply of N to the soils by leguminous plants is estimated to between 130 and 153 kg N ha^{-1}. Because of the capacity of legumes to fix atmospheric N, the need for N fertilization is reduced with 24-38 % in the agricultural production (Reckling et al 2016), by not needing to fertilize the legume crop, as well as needing less N fertilizers for the subsequent crop (Björklund et al 2012, Nemecek et al 2008, Preissel et al 2015). Besides increasing the N availability for the following crop, legumes have other beneficial pre-crop properties through break crop effects, and improved soil structure and fertility (Jensen & Haugaard-Nielsen 2003). Legumes promote phosphorous use efficiency, and have general effects on micronutrient availability by altering the soil pH level and solubilizing nutrients that would otherwise remain unavailable for the crops (Jensen & Haugaard-Nielsen 2003, Watson et al 2012), long-term cultivation of legumes has for example been shown to increase the plant available Mn by lowering the pH in alkaline soils (Watson et al 2012). Due to the beneficial pre-crop properties, yield enhancement of subsequent crops has been estimated to between 0.2 and 1.6 t ha^{-1} following legume cultivation (Preissel et al 2015, Zander et al 2016).

The resilience of a system is its ability to continue to provide vital services such as food production despite being exposed to constraints like for example increased temperatures or heavy rainfall (Kremen and Miles 2012, Lin 2011). Building resilience into agricultural systems, to improve their

adaptivity towards external changes and pressures, is important in a societal perspective because of the provisioning ecosystem services provided by agricultural systems, such as food, fuel and animal feed, and it is also important for the individual farmers to be able to protect their income and livelihood (ibid). Effects of climate change includes greater climate variability, shifting temperatures and precipitation patterns, that further alters the conditions of agricultural production systems by changes in the nutrient cycling, soil moisture, and shifts in the occurrence of pests and plant diseases (ibid).

Crop biodiversity is generally seen as having an important role in the resilience of agricultural systems, as diversity allows for the coexistence of multiple species with similar functions in the environment, that responds differently to changes in the in the environment. Through diversification, a kind of insurance is created within the cropping system against environmental fluctuations by increasing the ability of the system to retain its functional capacity despite the obstruction of individual components (ibid). Diversity within the agricultural system can occur in many forms (genetic, specie or structural diversity) or across different scales (crop, field or landscape level) (ibid). The role of crop diversity is critical as it determines the total biodiversity in the system, with an increased species richness and diversity in terms of spatial and temporal distribution of crops, the agricultural systems resembles more of natural systems and are therefore also able to maintain a greater diversity of animals, many of which may function as natural enemies of crop pests (ibid). By harboring greater natural enemy biodiversity, a buffer for future pest outbreaks is created, contributing to long-term pest suppression in the agricultural system (ibid). Pest and plant disease can cause significant losses in production, with economical losses for the individual farmer, and chemical and mechanical weed control are often major expenses. Adding an additional crop to the cropping system, by for example incorporating legumes, could increase structural species diversity as well as temporal diversity through crop rotation, and diversity on a landscape level by adding to mixed land use (ibid).

Diversification of the cropping system with legumes has been shown to reduce pesticide application (Jensen et al 2012, Nemecek et al 2008, Vandermeer 2011), with a 20-25 % savings in reduction of agrochemical costs as a result when cereals are cultivated as a following crop (Zander et al 2016). Diversification of the crop rotation provides a system approach to improve the resilience and natural pest and weed management of the cropping system, and has further been shown to reduce yield variations. A study by Gaudin et al (2015) showed that temporal and spatial diversification of the crop rotation significantly increased yield stability in the cropping system, also when exposed to environmental stresses, and especially when legumes were introduced to the system. A study by Nemecek et al (2008) has furthermore showed that legume crops respond with maintained yields, and sometimes even increased yields, with reduced tillage. Thus, by introducing legumes into the cropping system the possibilities of using reduced tillage techniques are improved, with potential cost savings for the farmer.

Yield enhancement, reduction of agrochemicals, increased resilience, reduced tillage and natural pest and decease management are all major economic incentives for farmers to incorporate legumes into their cropping systems. Besides the economic incentives for the farmers, factors like lowering the use of fertilizers and pesticides has several benefits to the environment, and has been shown to reduce energy use, global warming potential, ozone formation, acidification, eutrophication of surface water as well as human, terrestrial and aquatic toxicity (Altieri & Nicholls 2005, Jensen et al 2012, Jensen & Haugaard-Nielsen 2003, Nemecek et al 2008). Inclusion of legumes in cropping systems has also been shown to enhance soil C accumulation, legume crops could therefore have a significant contribution to soil C sequestration (Jensen et al 2012). The main advantage of reducing the use of agrochemicals is the saving of fossil fuels that are used in the manufacturing process, mainly of synthetic N fertilizers (ibid). N emissions in terms of ammonia and nitrous oxide are also reduced

due to lower use of N fertilizers, thus reducing the acidification potential of the agricultural system (Nemecek et al 2008, Reckling et al 2016, Zander et al 2016). There are several additional benefits to be made to the environment and human health of reducing the use of pesticides in agricultural systems. Pesticides applied in the fields poses a direct risk of pesticide poisoning to the farmers, kills of beneficial insects, and disrupt the natural systems food web (Gliessman 2015). Residues from pesticide use are further leached into surface- and groundwater where it enters the food chain and affects the animal and human population for decades after being used (ibid).

Major changes in the management of plant nutrients and pest and disease control is needed within the cropping systems to allow for a reduction in the use of agrochemicals, without compromising yield levels and stability. Incorporating legumes into the crop rotation provides the system with an alternative source of nutrients, maintenance of soil fertility, and interruption of weed, disease and pest cycles (Altieri & Nicholls 2005). Because of the range of ecosystem services provided by legume crops, they are believed to play an important role in enhancing the multifunctionality of systems and crops, and promoting sustainable development of agriculture (Jensen et al 2012).

One environmental challenge to discuss in terms of legume cultivation is the tendency for an increased nitrate leaching potential in cropping systems where grain legumes are introduced (Nemecek et al 2008). Increased risk of nitrate leaching with legume crops is partly due to the BNF, that causes the N content in in the biomass to be higher and the N uptake from the soils to decrease, but it is also affected by the crop management practices (ibid). In the study by Nemecek et al (2008), higher nitrate losses in cropping systems containing legumes were mainly explained by the fact that many autumn sown grain legume varieties (peas for example) cannot be grown in regions with cold winters, and when comparing nitrate losses in research studies, comparisons are usually made with an autumn-sown crop (for example winter wheat) and a spring-sown legume crop (for example spring peas) (ibid). The increase in nitrate losses in the cropping system are thus mainly due to the period of bare soil during winter and not to the specific crop type. Part of the nitrate leaching can therefore be mitigated by including catch crops or by sowing the winter grain legumes earlier (ibid).

Agricultural land in Northern Europe have in general low micronutrient concentrations in the soils, resulting in food crops often fail to meet nutritional requirements (Watson et al 2012). Improving the nutrient composition of food is an important aspect of food security and human health issues, as micronutrient deficiency affects billions of people around the world, including both developing and developed countries (ibid). Grain legumes for food are associated with several health benefits for the consumer, as they are good sources of protein and fiber, and contain several essential vitamins and minerals, and due to the many health benefits of grain legume foods public health is recommending an increased intake of legume foods (Messina 1999, NCM 2014).

Despite the environmental benefits, the economic incentives for the farmer, and its high nutrient value, legume crops are grown on less than 2 % of the arable land in Europe (Reckling et al 2016). The economic effect of the ongoing trend of specialization in crops, and the advantages it brings with economy of scale, are believed to be one of the main pressures behind the historical decline in legume production in Europe (Reckling et al 2016, Zander et al 2016). In Canada, grain legume production (especially chickpea, lentil and pea) has increased since the 1980's, making Canada the world's leading producer and exporter of pea, and a major actor on the world grain legume market (Preissel et al 2015). Grain legumes are much less attractive crops in Europe compared to countries like Canada and Australia, mainly due to high production intensity of cereals, leading to high yield advantages of cereals over grain legumes, that usually cannot be outweighed solely by the price difference between grain legumes and cereals, especially not when the grain legumes are sold and used for animal feed (ibid).

Because of the environmental and health benefits, and the contributions to the development of sustainable and resilient agricultural systems, an increased, domestic grain legume production for food would benefit the environment, as well as the consumers and the individual farmer. In a study by Preissel et al (2015), the majority of the crop rotations with grain legumes that were reviewed were more economically competitive than comparable non-legume rotations, and in studies by Reckling et al (2016) and Björklund et al (2012) several cropping systems with legumes were identified that managed to have high economic returns and simultaneously have positive environmental impacts.

In a study based on surveys sent to conventional and organic farmers in Luxembourg, lack of knowledge and information on grain legume cultivation were identified as the main barrier amongst the farmers to initiate a grain legume cultivation, although the many benefits of incorporating grain legumes into the cropping system were appreciated by the farmers (Zimmer et al 2016). Other factors that discouraged farmers to adopt grain legume cultivation were cultivation problems and poor economic conditions (ibid). The main incentives that could be identified for farmers to start grain legume cultivation, besides making research results and information more available to the farmers and improving the extension services, were economical (ibid). There have been further studies that suggests a need for increased policy support on a national level, genetic and agronomic improvements in legume cultivation, analyzing current constraints of agricultural systems, identifying ways of including more legumes in cropping systems, finding new and innovative uses for legumes in the food chain, developing a supportive market development to increase the domestic legume cultivation, and maximize the utilization of the environmental benefits associated with legume farming (Peltonen-Sainio & Niemi 2012, Preissel et al 2015, Voisin et al 2014, Zander et al 2016).

In order to reach a more sustainable production, there is a need for change in our educational thinking and practice, but there are no universal practices or approaches that can be implemented or suggested to farmers or other key actors, regardless of the specific local conditions (Pretty 1996 & O'Brien et al 2013). There is increasing awareness among scientists and policy makers that the development towards more sustainable agriculture requires the adoption of new paradigms and systemic approaches that promotes the creation of structures that provide long-term incentives, taking into consideration the importance of all relevant actors in the agricultural sector and the institutions that influence them (Knickel et al 2009 & Röling 2009). Thus, to facilitate a sustainable development, farmers' and other important actors' way of thinking needs to be understood, takin into account different social and economic perspectives (Leeuwis 2004). It is, therefore, interesting to take studies into account that have been exploring different factors influencing stakeholders' attitudes, motivations, choices, and behavior. A study by Bratt (2002) is one example where concepts such as risk and attitudes have been used, aiming to understand farmers' choices in terms of environmental management practices. In depth-interviews with key actors within food production and processing, on the challenges and possibilities of expanding the legume production in southern Sweden, could give important insights into the current situation, and what steps that need to be taken to develop the domestic grain legume production for human consumption.

The project "new legume foods"

This study is part of a larger multi-stakeholder project called "New legume foods" (NLF), a four-year project that started in 2017 (SLU 2017). The partners in the project includes several universities as well as actors from the food industry; The Swedish University of Agricultural Sciences, The Linnaeus University, Jönköping International Business school, Orkla Foods Sweden (Orkla), Fazer Group Oy (Fazer), Oatly, and Kalmar-Ölands Trädgårdsprodukter (KÖTP), and the regional councils of Kalmar and Scania. (Röös 2017). The aim of the project is stated below.

> "The aim of this project is to develop climate-smart and proteinrich food products containing domestic legumes (e.g. beans, lentils, peas), to increase the food system sustainability and stimulate a growing bio-economy based on novel, attractive and health-promoting foods." – Röös 2017

One of the main characteristics of the project is its system approach that involves trans-sectorial collaboration between scientists, the food industry, regional councils, farmers and consumers. The research within the project includes several parts of the food system, from cultivation to food processing and consumption, and the project further includes several student projects at different levels (between 10 and 30 credits, from basic to advanced level) performed at the universities that are involved in the project (Röös 2017). The sub-projects within NLF ranges in content from purely quantitative research concerning cultivation or nutritional aspects of grain legumes, as well as projects based on social and economic perspectives (ibid). The objectives of the NLF project includes identifying strategies for incorporating grain legumes that are suitable for cultivation in Nordic climate into the Nordic diet, and also to develop new legume-based cropping systems that is more reliant on ecosystem services and less on fossil resources (ibid).

Objectives and limitations

The aim of this study is to explore the preconditions, and barriers to overcome, of expanding the domestic production of legumes for food in Southern Sweden by mapping farmers' experiences, attitudes, and expectations, and the interest, motivations and capacity of the processing industry. The overall purpose of the study is to contribute with insights from producers and the food processing industry, that can be used within the project NLF to identify and develop strategies for incorporating domestic grain legumes into Swedish diets and develop cropping systems that are more reliant on ecosystem services and less on fossil resources. The objectives of this study are to:

- Investigate if there is an interest amongst farmers and key actors within the food industry in the region to produce grain legumes for food
- Identify knowledge-gaps amongst farmers that are interested in grain legume cultivation
- Assess the capacity of the food processing industry to manage a grain legume produce
- Define motivational factors and perceived challenges amongst farmers and actors from the food industry in terms of expanding the domestic grain legume production for foods
- Evaluate the interactions between the producers and the processing industry, and what kind of expectations the parties have on an extended cooperation with the cultivation of a new, grain legume, crop.

The results of this study can provide useful insights from the producers and the processing industry on the practical limitations and possibilities of a domestic production of grain legumes for human consumption. It could furthermore give an indication of what supportive measures needs to be taken on a production and processing level, to reach the long-term goal of increasing the grain legume cultivation in southern Sweden and the availability of regionally produced legume foods for Swedish consumers. By identifying knowledge gaps and uncertainties, these can be managed through knowledge and informational inputs from other sources such as from scientific studies or from more experienced farmers, or through communication between different stakeholders, in order to encourage new farmers to include grain legume crops into their cropping systems.

The focus of this study will not be on one specific legume variety, but on grain legumes in general, and it will mainly target farmers that have little or no experience of producing grain legumes for food. The study will not include the entire food system, only producers and the processing industry, and the geographical focus will be on the Southern parts of Sweden, with the main focus on the region of Scania. Other aspects of the system are excluded from this study because of the limited time frame of the project. However, considerations have to be made when interpreting the results of this study, that there are other aspects of the system that might have an influence on the overall outcome and practical implications of the study.

Conceptual framework

> "The ultimate goal of agroecological design is to integrate components so that overall biological efficiency is improved, biodiversity is preserved, and the agroecosystem productivity and its self-regulating capacity is maintained. The goal is to design an agroecosystem that mimics the structure and function of local natural ecosystems; that is, a system with high species diversity, and a biologically active soil, one that promotes natural pest control, nutrient recycling and high soil cover to prevent resource losses." – Altieri & Nicholls, 2005

There are various definitions of agroecology, the definition currently used within the Agroecology program at SLU is largely inspired by Francis et al (2003); "Agroecology is the integrative study of entire farm and food systems, encompassing ecological, economic and social dimensions". Agroecology encourages system approaches, with the main focus on the interconnections within and between agricultural systems, nature and society, and stimulates a focus on the uniqueness of a specific setting and solutions that are appropriate to the available resources and constraints of that specific system (ibid). Agroecology further promotes expanding the perspectives, beyond the impacts of the production at the immediate field and farm level, towards a more holistic approach where all relevant system levels are included (ibid).

In this study, agroecology is mainly seen as a scientific discipline, providing new management approaches that are more in tune with the objective of developing a multifunctional, diverse and sustainable agriculture (Altieri & Nicholls 2005). The development of production systems according to agroecological principles has shown to enhance yields and increase production stability, although the approaches used are very context-specific and differ between different agricultural systems (ibid). An agroecological production system is characterized by long-term sustainability in terms of optimizing resource use, reducing the use of external and non-renewable resources, assuring safe recirculation of nutrients, and adaptation to environmental challenges in terms of climate and landscape pre-conditions (ibid). An agroecological production system should furthermore be multifunctional, providing other ecosystem services besides food and fiber, as well as value and conserve biological biodiversity in both wild and domesticated landscapes (Altieri & Nicholls 2005, Zander & Groot 2006).

Agroecological principles has shaped and influence this study, mainly in terms of systems thinking, interdisciplinarity, value of stakeholder knowledge and experience, as well as recognizing the uniqueness of a specific system and adapting the approaches according to the specific context. Systems thinking has been applied throughout the study, although the time frame of a MSc thesis did not allow for a true system approach, involving all relevant levels of the system. In this thesis, the production and processing aspects will mainly be covered, but the influence of other parts of the system and how the aspects covered in the thesis project will affect the food system in a greater context are also reflected upon. Realizing the complexity of a system approach, interdisciplinarity has also played an important role in this study, where agricultural, ecological and social sciences are

combined to be able to analyze the system from different perspectives. In a study performed by Björklund et al (2012), it was found that in developing sustainable agroecosystems, the participation of farmers and major stakeholders were crucial, because of the importance of specific knowledge and "learning by doing" when developing the system. To examine if an expansion of the grain legume production for food is feasible, this study explores, uses and shares knowledge and experience derived from practitioners within different parts of the food system, emphasizing the value of stakeholder knowledge and experience, and the importance of multidirectional exchange. One important aspect of agroecology is that it is often context specific, making the results valid only in that specific context, and difficult to generalize from the study results. However, generalization is not always the goal of all research, which is further reflected upon in the methods discussion. In this study, the context and setting of the study has had a major influence in all aspects of this study, and the outcome will hopefully contribute to the sustainable development of this specific system.

The research strategy of this study is that of an inductive approach, where patterns are described through observations, and where the interpretations of the findings are fed back to previous knowledge and literature on the topic, as opposite to a deductive approach which follows a more linear approach and where methods and theory guides the research (Bryman 2008). Inductive theory is a widely-used approach to qualitative research, and as stated by Bryman (2008); there are numerous examples of where the approach of inductive theory is used on qualitative data derived from in-depth interviews. Although this study will be based on an inductive approach, there are still some deductive elements of the study, as theory is used to some extent as a background to plan the interview study. The approach of this study could be described, using Bryman's terms (2008), as using an inductive strategy with some deductive tendencies.

Materials and Methods

The purpose of this study is to examine the preconditions, and barriers to overcome of an increased legume production in the southern parts of Sweden, by taking part of previous knowledge of producers and from the processing industry, and understanding the motivation and perceived challenges amongst these stakeholders. For this study, a qualitative research strategy was chosen, because it is based more on an unstructured approach that leaves room for exploring these issues and generate new theories rather than testing theories based on previous research (Bryman 2008). The study is based on individual, semi-structured interviews with 11 respondents, supplemented by two occasions of observational studies that took place at a producer-organization meeting and a start-up meeting for the project NLF. The data collection process was performed in southern Sweden during approximately 5 weeks, between February and March of 2017.

In the following sections the entire study process will be explained, starting off by covering the sampling method and the informant backgrounds, followed by a description of how the interviews and own observations were conducted in the field. The analysis and presentation of data are later described, and at the end of this section some ethical considerations are further discussed.

Selecting the interviewees

Purposive sampling method was conducted when selecting the interviewees, as informants that are relevant to the objectives of this study was needed, and the method of purposive sampling is characterized by referring to the goals of the research and the research by sampling according to specific criteria (Bryman 2008). The organizations that are participating in the NLF project represent

some of the key actors in Swedish legume production, it was therefore natural to use this source to get in contact with relevant representatives from the food industry. The main criteria when choosing producer informants was that they were located in the southern parts of Sweden and that they had experience working closely with the industry, to be able to evaluate the interactions between the producers and the processing industry, and further explore the expectations the parties would have on an extended cooperation. The producer informants that was chosen were contracted farmers for Orkla, the organization had approximately 70 contracted producers in the region at the time of this study and could therefore provide a large sample size that fulfilled the main criteria for respondents. The interviewees are briefly presented in table 1.

In terms of sample size, key actors from the processing industry was chosen to be interviewed, and during the interviews the respondents were asked if they think there were any additional actors that needs to be involved in order to give a more complete picture. When interviewing producers, "the saturation effect" was applied to decide when enough respondents had been questioned, meaning that when no new inputs were given to the main themes that had been identified during the interview process, a point of saturation had been reached for the sample size and no further interviews were performed (Bryman 2008).

Table 1: A presentation of the respondents from the individual interviews. The table contains general information about the respondents, where P1-5 are representatives from the food industry and G1-6 are farmers.

ID	Actor	Information
P1	Orkla	Development manager at Orkla Foods Sweden, working with innovation, product development, and the launching of new brands. Other areas of responsibilities include the communication between the development department and outside sources, such as academia and research, entrepreneurs, and other projects.
P2	Fazer	Senior research manager for Fazer in the region of Scandinavia. Main areas of responsibilities are within product innovation, research and product development of new foods.
P3	Orkla	Agricultural manager at Orkla Foods Sweden, mainly responsible for providing the factory with potatoes, red beets and gherkins from contracted growers and imports. Manages all agreements and communication between the organization and contracted producers, including delivery and storage of produce.
P4	Vara	Responsible for purchase and sales of grains at Varaslättens Lagerhus (Vara). Other responsibilities include quality-control, storage, as well as contact and agreements with contracted growers.
P5	KÖTP	Agricultural production manager. Manages agreements and communication with members and growers within the business association, and is also responsible for arranging deliveries and cleaning/sorting of produce.
G1	Farmer	A conventional producer in south-east Scania that delivers potatoes to Orkla. Soils vary between sandy soils and up to 13 % clay content, with low water retention capacity. Other crops in the rotation includes; cereals, rapeseed, sugar beets and onions. The producer has previously grown peas for animal feed.

G2	Farmer	This producer from the south-western parts of Blekinge, close to the Scanian border, delivers red beets for Orkla. Other crops in the rotation are; potatoes, cereals, onions and strawberries. Raspberries are also produced on the farm. The farmer has previously tried cultivation yellow peas and faba bean, without much success.
G3	Farmer	A farm in the north-western parts of Scania with crop production, and egg production for hatching. This producer delivers potatoes, red beets and gherkins for Orkla. Other crops in the production includes: spinach, seed production (spinach), cereals and pumpkins. They producer has occasionally cultivated green peas. The soils that are cultivated tend to be sandy and warm.
G4	Farmer	A producer based in north-west Scania that delivers potatoes for Orkla. Rapeseed, sugar beets, cereals and ley are also cultivated on the farm, and besides crop production the farmer also has sheep. The soils are heavier, about 20 % clay-content, with a considerable amount of stones. The farmer has no previous experience of legume cultivation.
G5	Farmer	A farmer in south-west Scania that delivers red beets to Orkla. Besides red beets, the farm also produces faba bean, pea, potatoes, sugar beets, cereals, rapeseed, celeriac, white clover seeds and several cabbage varieties. Half of the production is organic and the rest is conventional, legumes are currently only represented in the organic production system. The soils have a clay content between 10-20 %, and contains a fairly high amount of organic matter.
G6	Farmer	The farm is situated in north-western parts of Scania, where red beets are produced to Orkla. The production is conventional, and is based on sandy soils where potatoes is the main crop. Other crops that are produced at the farm are cereals, oilseeds and sugar beets. The farmer used to produce green peas for Findus, but it was more than ten years ago.

Observational studies

During the 18-19th of January I attended the kickoff workshop for the project "New Legume Foods". The meeting was the first within the project NLF, and was held in the city of Malmö, at a venue at the office of one of the participating organizations. At the startup meeting, all the participating actors, except from the region of Scania, where represented. The outline of the workshop was for all in the organizations to present themselves, and to finalize the draft for the letter of intent for the project. By attending this meeting I was able to get familiar with the project, and to learn more about current research and development work on legumes for food production. It was also a great opportunity to get in contact with relevant actors for the forthcoming interviews with industry representatives. The participants of project NLF from the organizations Orkla, Fazer and KÖTP all expressed an interest at the meeting to participate in the interview study, and was later contacted to set up individual interviews.

I was invited by one of my contacts from Orkla (respondent P3) to attend a meeting with the organization and some of their contracted farmers on the 16th of February in Veberöd (region of Scania). The first part of the meeting was for the producers only, where they discussed recent negotiations that had been made between the farmers' association and Orkla. The second part of the meeting was attended by me and my main supervisor, representatives from Orkla and The Rural Economy and Agricultural Sciences (HIR), and approximately 20 contracted farmers that are

currently producing potatoes for Orkla. During the meeting, the previous and upcoming growing season was discussed in terms of yields, changes in the agreements, pest problems and other challenges. The purpose of attending this meeting was to get in touch with the producers, to present myself and the thesis work, and to be able to observe the communication between the farmers and the processing industry.

Observational studies allow to collect data in a more natural setting, compared to for example individual interviews (Bernard 2006). It is a widely-used practice in social studies for making people feel comfortable with the researcher, in this study it acted as a way to get the producers and processing industry familiar with the study and me as a researcher, to facilitate the invitations to individual interviews and increase the response rate. The role of me as a researcher during these meeting was that of a participating observer, an outsider that participated in some interactions but where the main focus of the researcher was to observe (ibid).

Semi-structured interviews

For the individual interviews, a semi-structured approach was chosen, where the emphasis was put on what the interviewees considered important to address within the specific issue of an increased legume production in Sweden. The semi-structured interview is a flexible method that allows for continuous change in the interview guide, and is suitable for research where the focus is more on the interviewees own perspectives, promoting detailed and rich answers and leaving room for the researcher to follow new leads that may emerge during the interview process (Bryman 2008). Semi-structured, in-depth, interviewing is generally recommended when you only get one chance to interview someone (Bernard 2006), which was the case in this study due to the limited time available for data collection.

A total of 11 individual, in-depth interviews were conducted. The first 4 interviews were held face-to-face, between the 17th and 24th of February, with representatives from Orkla, Fazer and Varaslättens Lagerhus (Vara). The following interviews with the 6 producers were performed by telephone during the 17th and 21th of March. The interview with the representative from KÖTP was conducted lastly, on the 29th of March, to be able to address perceived challenges that arose during the previous interviews with an actor that has practical experience in legume cultivation. When meeting with the industry representatives, the interviews were held at the respondents' office space, expect for in one case (P2) where the respondent specifically asked to come to SLU for the interview, in that case a small meeting room at the department of Biosystems and technology was arranged. For the telephone interview, the call was taped. During the face-to face interviews, two, sometimes three, recording devices was used to ensure good quality of sound, since the conditions of the venue was not known on beforehand. The duration of the interviews varied, between 40-60 minutes for the face-to-face interviews with the industry representatives and for the interview with KÖTP (P5), and between 30-40 minutes for the telephone interviews with the producers.

The interviews were scheduled, and based on the use of an interview guide that contained a list of topics and open-ended questions, that sometimes needed to be covered in a particular order. The prepared questions were general, and developed from the objectives of the study, and were not

always asked word-for-word, leaving room for reformulation depending on the specific situation. The initial and ending parts of the interviews were similar with all respondents.

The conversation started with a short introduction of the researcher, the project NLF and the purpose of the thesis. The respondents were told that the interview was being recorded, and that they were giving their consent to be part of the study by participating in the interview. An estimated duration of the interview was also given. Before the interview commenced, the individual contribution was addressed, assuring the respondents that their participation was of great importance to the study and that I was truly interested in what they had to say. The outline for the interviews, including the interview guides are available in Appendix I-III.

The industry representatives (P1-P5) were informed that their names will not be mentioned in the paper, but that it can be possible to identify them based on the company that they are representing and the description of their role in the company. To ensure that the respondents would feel comfortable participating in the study, and that they would be able to speak freely, they were offered to read and comment on a draft of the parts that concern their participation before publication of the MSc thesis. When the introduction part of the interview was finished, the industry representatives were asked to begin by telling me about their role in the company, and how they are working with legumes currently. The questions were then based on general themes or overarching questions that were similar between the respondents P1-P5. They were asked what kind of possibilities and challenges they see with an increased legume production with larger volumes or more varieties, what they are aiming for and what their motivations are with an increased legume production, what kind of properties or specific legume varieties they desire, and what thoughts they have on the current and future relations with the growers. The respondents were also asked more specific questions based on their background, and the company that they are representing. Actors directly involved in the project NLF were asked about their expectations on the project, respondents working with product development were asked about consumer demand and how it has influenced their interests in legume production, and industry representatives from the food industry that were involved in the cultivation or in the relations with the producers, where asked more specifically about the existing cropping systems and how legumes would fit into those systems. The interview questions are specified in Appendix I-III.

The interview with the representative from KÖTP (P5) included more in-depth questions about the current cultivation of legumes for food, if there are any specific obstacles that they recognize for the Swedish production to meet the increasing demand of grain legumes, and what they think of the differences in environmental conditions between Kalmar/Öland/Gotland and other parts of Sweden and how it might affect the cultivation of grain legumes and choice of varieties. The respondent was also asked what they believe their role is as a company and key actor in contributing to an increased production in other parts of Sweden, and what challenges that need to be solved to be able to establish a successful legume production outside of the existing area of production.

The producers that participated in this study was guaranteed complete anonymity. When the introduction part of the interview was finished, the producers were asked to share about their farm and existing crop rotation, partly to get some background information, but mainly to get the respondents to feel comfortable and open up by talking about something that they are confident in. The respondents (G1-G6) were then asked questions involving their previous experience in legume

cultivation, what made them interested in legumes, if there are any specific properties they find important or varieties that they think are especially interesting, and what they think of an increased legume production for food in Sweden in terms of opportunities and challenges. The producers were also asked about their relationships with the industry today, and what would be important to them in terms of future cooperations if they would increase their existing, or adopt, legume cultivation.

During the interviews, general impressions and reflections were noted and directly after the interview a short summary of the interview were added to the field notes. This was done do document immediate thoughts and interpretations to assist in the final analysis of the interviews, and it was also used to alter the interview guide for the following interviews. The interviews were ended by thanking the respondents for their participation and asking them if there is anything else that they would like to add, and about the possibility to come back with more questions if needed. The industry representatives were also asked at the end of the interview if there is anyone else that they believe could be important for me to talk to, another key actor, to complete the picture. After each interview, the sound quality of the recordings was checked, and copies of the material was made.

Open-ended questions were generally employed during the interviews to get the respondents to answer thoroughly to the question. If further stimulation was needed, probing or "the probing method", mentioned by Bernard (2006) and Bryman (2008) was used as way of encouraging the respondents to elaborate, giving more information to the interviewer without leading or nudging in a certain direction or to a specific answer. Some ideas of probes were included in the interview guide (Appendix I), to make sure to have a way to stimulate the respondent to produce more information in case their first answer was short or insufficient. Examples of probes that were prepared and used where questions like "would you give me an example?", "can you elaborate on that?" and "would you explain that a bit further?". The silent probe, remaining quiet and waiting for the informant to elaborate on the subject, giving them time to reflect, is another example of a probe that was used (Bernard 2006). This technique was however mostly used during the face-to face interviews, as it was easier to "read the room" in person than by telephone, and it was used more frequent in the latter interviews as I got more comfortable in my role as an interviewer. The "uh-huh probe" was another probe that was frequently used, by making affirmative comments such as "uh-huh", "yes" "I see" "right", a relatively neutral probe that seemed to work well with the majority of the informants (Bernard 2006, Bryman 2008). Further, I felt like the "uh-huh" probe also was a good way of affirming to the respondents that I was listening actively and was truly interested in what they were saying, without interrupting them. The "tell-me-more probe" was also used a couple of times, especially when following new leads where no specific follow-up question had been prepared on beforehand (Bernard, 2006).

Analysis and presentation of data

Analysis is the search for patterns in data and for ideas that facilitates the endeavor of explaining why those patterns are present, and is an ongoing process throughout the entire study, starting even before the actual data collection with the ideas of the researcher of what the study will entail (Bernard 2006). This section will mainly describe the handling of the qualitative information derived from the interviews. The material was analyzed using an explorative, thematic framework within the qualitative data analysis software NVivo version 11 (QSR International Pty Ltd, 2015).

The transcribed interview material was entered into the program NVivo and sorted into various themes, that were used to define, describe and interpret the patterns found. The analysis was mainly performed according to Boyatzis (1998) on how to transform qualitative information, in combination with guidance from the supervisors (Fernqvist, F. & Carlsson, G.), who has practical experience in qualitative studies and methodology. The themes were generated inductively, as patterns found in the raw information, and since the use of the thematic analysis is purely descriptive, no statistical analysis was performed (Boyatzis 1998). Clustering of themes, a simple scaling method, was used to organize the identified themes and subthemes for further analysis and interpretation, and facilitated the presentation of the qualitative findings (ibid).

According to Boyatzis (1998), thematic analysis has a number of purposes, in this study the purpose of using the process of thematic analysis was mainly a way of analyzing the qualitative information derived from the interviews performed. The process of thematic analysis provides a way to sort and use the type of information derived from qualitative interviews in a systematic manner, that increases the accuracy and sensitivity when interpreting the observations (ibid). Thematic analysis also facilitates communication with a broad audience, making the results of the study more comparable to other qualitative studies performed with various methods and within different research fields (ibid).

The interviews were performed and transcribed in Swedish, but the material that was to be presented in this paper was translated to English to be able to give illustrative examples. Care was taken when translating the thoughts and insights from the interviewees, to try and capture and present their answers with minimum interference. Numeric presentation was only used to check the consistency of judgement, to increase the reliability of the results presented. When referring to individual interviews, the abbreviations shown in table 1 will be used.

Ethical considerations

No deception was involved in this study, as the participants was informed prior to their participation about the research and its purposes, how long their participation in the interviews was going to take and how the information was going to be used and presented. This is also an important part of informed consent, as the participant can only give their true consent to participate if they are not deceived (Bryman 2008).

The participants were guaranteed anonymity, however, the representatives from the processing industry were informed of the risk of being identified through the company name and the description of their role in the company. Therefore, the industry representatives were given the opportunity to read a draft of the paper. Care was taken when sharing information about the participants in this study, to limit the risks of the participants being identified.

Results and Discussion

"Setting the scene"

In this subsection, the different actors from the industry involved in this study are discussed in terms of how they are currently working with legumes at their company and in their geographical area. The knowledge state and previous experiences in grain legumes are later discussed with focus on the cultivation, and the farmers and representatives from the food industry that participated in this study are briefly introduced in table 1.

Orkla bought the brand Anamma in 2014, that produces vegan food products based on extruded soybean [P1]. The extruded soy product is usually mixed with water, seasoning and salt to become a paste that can be used to create various food products, such as vegetarian "meatballs". Orkla also uses whole beans as components in their pre-cooked meals. The company has recently launched a project within the brand "Felix", called "Felix veggie rätter"/"Felix Veggie dishes", with vegetarian pre-cooked meals. The company also has an ongoing cooperation since 2013/2014 with a clinical research company that works mainly with pharmaceuticals but also with diet research. The research company and Orkla has together developed a concept that is based on replacing half of the meat content with legumes. The majority of the legumes used for the pre-cooked meals are today imported, the soybeans mainly from Serbia and the US. Orkla currently produces two dishes, "Brown beans" ("Bruna bönor") and "Pea soup" ("Ärtsoppa") that are based on Swedish legumes, originating from Öland and produced by KÖTP [P1].

Fazer launched their first bread products containing beans around the year of 2015. The breads are baked with a flour or a paste based on beans, that is used as a base, then root vegetables and other ingredients are added [P2]. The paste is made by soaking whole, dry beans in water. The company works towards using more bean-based flour and less whole beans, as the treatment of the whole beans demand a lot of space and workers, and is therefore more expensive and time consuming. Their product segment of legume-based bread has grown, starting out with two products, and today they have five. For the bean paste the company currently uses white navy bean (*Phaseolus vulgaris*) in all their products, the informant shared that it was the only variety that has been possible to get hold of in sufficient quantities. Chickpeas (*Cicer arietinum*) are also used on top of some of the bread, to get a nice and crunchy topping on the crust.

Vara trades mainly with cereals, but also with faba bean (*Vicia faba*), and yellow and green peas (*Pisum sativum*) [P4]. They receive the produce directly from the fields, to be dried and stored, and before delivery to the industries the produce is cleansed according to each customer's specifications. The majority of the faba beans are exported, both for animal feed and for human consumption. Vara performs own cultivation trials, for example in cooperation with some of their industry customers that sometimes comes up with specific requests of for example trying a certain variety [P4].

KÖTP are currently working with dry peas and dry beans for food. Dry beans (Common bean, *Phaseolus vulgaris*), have been produced on Öland in several hundreds of years, and KÖTP owns several cultivars of brown beans that have been developed on Öland [P5]. The last couple of years the bean varieties have been developed and the number of varieties of common bean has increased, today they are also producing red kidney, black kidney, white and borlotti beans. They continuously try new varieties to see what works in the cultivation, and what the market wants, usually in field trials in collaboration with HIR. For varieties where KÖTP has not developed their own cultivars, the seeds usually originate from specific regions in the US where the climate is somewhat similar to that of Sweden. Yellow pea is the main variety of pea that they are currently producing, but as with the bean varieties, they are working with developing new varieties. KÖTP produces a dry commodity, that has an 18 % water content when stored, the produce is stored all year round, and the cleansing

process is performed continuously. The produce first goes through a cleansing system, and is then sorted by color, and lastly it goes through radiology where the produce is sorted by density. Advanced cleansing and sorting facilities are used to guarantee a high-quality produce, and the company has worked a lot during the recent years on developing the processing technique after harvest to maintain quality, and satisfied customers. Their contracted farmers have accumulated experience and knowledge about legume cultivation during several generations. Other crops that are common to grow in the area, in the same rotation as grain legumes, are vegetables, potatoes, strawberries, and more traditional crops like cereals and rapeseed [P5].

Legume cultivation - experiences and knowledge

One of the objectives of this study is to identify the knowledge-gaps of farmers in the southern parts of Sweden, that were interested in grain legume cultivation, and an important part of identifying these potential knowledge-gaps were to map the farmer's previous experiences in grain legume cultivation. The overall experience of legume cultivation was limited amongst the farmers that were interviewed; some had experience of growing legumes for animal feed [G1], some had experience of cultivating grain legumes for food production but it was a long time ago or only for occasional years [G2, G3, G6] (faba bean, yellow peas, and green peas). One of the farmers had no experience of legumes at all [G4], and one farmer is currently cultivating a couple of varieties of legumes in an organic cropping system [G5] (table 1).

The agricultural manager at Orkla was asked about the general experience amongst their contracted farmers during the interview [P3]. About 2 or 3 farmers out of 5 that are currently cultivating gherkins on Öland for Orkla, also have experiences of cultivating dry beans. The agricultural manager also believes that there are some experiences of producing green peas to Findus, especially amongst the potato farmers, and amongst the red beet producers in the Kristianstad region (North-east of Scania).

According to the agricultural production manager at KÖTP, the dry beans are quite challenging to cultivate, compared to for example peas, but it works very well on Öland and has done so historically. The informant believes that the successful cultivation of dry beans on Öland is mainly because of the favorable climate, with dry and warm autumns that gives the beans time to mature and dry properly. The soils in the region of Öland are warm and calcareous, and usually contains a considerable amount of small sized stones that helps retain the heat in the soils, that stimulates the growth and early development of the beans during the spring [P5]. The beans are seeded quite late, during the end of May and beginning of June, since the crop is extremely sensitive to frost [P5]. The agricultural manager at KÖTP stated that being situated on an island is a huge benefit when it comes to frost sensitive crops, since it is very unusual with frost late in the spring season. Special machinery is used for the harvesting process, where the plants are loosened and put in strings to dry before being harvested with a specialized combine harvester [P5]. There are currently a couple of specialized combine harvesters in the Kalmar-Öland region that have been imported from the US, the technique used for harvesting the dry beans originates from peanut harvesting [P5]. Chemical control is used, but KÖTP also have KRAV certified growers of dry beans, and methods like row cultivation and row hoeing are common practices [P5]

> P5: "The harvesting is very special, the beans are extremely sensitive and consists of two halves with a thin peel, if you are too reckless with a conventional combine harvester, you will break the beans in two pieces"

During the last couple of years, the weather conditions have been very favorable for dry bean cultivation in the area of Kalmar-Öland, with high temperatures and limited rainfall [P5]. However, even if the cultivation usually works very well, there has been occasional years were the rainfall during the autumns have been too frequent, making it impossible to harvest some of the fields [P5].

Vara has seen an increase in the cultivation of faba bean amongst conventional farmers in their region during the last ten years [P4]. According to the informant, it used to be only organic farmers that cultivated faba beans, in order to incorporate a N fixing crop in the rotation, and it was mainly used for animal feed at the own farm. But now, conventional farmers have become more interested in faba beans, starting out with farmers mostly using it to feed their own animals, but as more and more farmers has seen how well it works to cultivate in the area, also farms specialized in crop production has adopted faba bean cultivation [P4]. Vara has mainly had very good experiences from faba beans, the only negative aspects of the cultivation is that the crop matures quite late in the season, and one year (2012) the harvest was even more delayed due to frequent rainfall, causing the produce to have an unusually high water content, which made the harvest and post-harvest processing difficult [P4]. Sowing as early as possible is important when cultivating faba bean, because they need a relatively long growth season [P4]. The crop is not sensitive to frost, as long as it is dry enough it is possible to sow, and the crop is especially suitable for the heavier soils with a high clay-content [P4]. One of the farmers that were interviewed had a lot of previous experience of organic faba bean cultivation, and was overall very satisfied with the production. The faba bean has been good for the soil structure, and other benefits with faba bean that was mentioned was that the crop is an extremely good competitor against weeds if they get a good start during spring and that it was a particularly good pre-crop for potatoes [G5].

As previously mentioned, Vara trades with green and yellow peas, and pea cultivation is in general quite common in their region. The peas are however much more sensitive to rainfall compared to faba bean, and some years they have very high amounts of rainfall in the area, which has been a problem [P4]. According to the informant, the root systems of peas are not as good as that of faba beans, so they generally do not recommend farmers to cultivate peas on their heaviest soils, but rather on more well drained, warmer soils if possible [P4]. Peas are grown also around the region of Kalmar-Öland, but the contracted farmers of KÖTP have not had any major issues with the production [P5]. The peas are considered less of a challenge compared to dry beans, and does not require any special machinery for the harvesting, the crop is harvested with a conventional combine harvester [P5].

Amongst Orklas contracted farmers that were interviewed, there were mixed experiences of pea cultivation. One of the farmers had previously tried cultivating yellow peas but the weather conditions where too wet to be able to harvest efficiently [G2], and it was mentioned that green peas did not work well on some fields where the drainage were insufficient [G3]. Other challenges with pea cultivation that was mentioned by the farmers where birds and weeds, and that it was sometimes difficult to use mechanical weed control with peas because of their sensitivity [G5, G6]. But the majority of the farmers where overall satisfied with the pea cultivation [G3, G5, G6], and one benefit of peas in comparison to other crops according to a couple of farmers where that the produce is harvested quite early in the season, leaving plenty of time to establish the following crop [G5, G6].

For the farmers that have been cultivating legumes for a long period of time, several benefits to the cropping system have been observed. According to the agricultural production manager at KÖTP, legumes are a great improvement of the cropping system overall, and is a good pre-crop for cereals [P5]. Legumes have also reduced the need of fertilizers for many farmers because of the BNF, and besides the environmental benefits of less fertilization, it has also had a positive impact on the economy of the farmers [P5]. The producer that has incorporated legumes into the organic cropping system had experienced similar benefits of having legumes in the crop rotation, and it was furthermore an important element in the nutrient management on the farm [G5]. According to the farmer, legumes are a great supplement to the chicken manure that is used, due to the high phosphorous content in the manure it is not possible to reach sufficient N levels in the soil for cereals, without overfertilizing with phosphorous, if only chicken manure is used [G5].

A review of the main results

The success of modern agriculture has so far primarily been assessed by productivity and economic returns, and not on nutritional value or on the ecosystem services provided besides food and fiber. Expanding the domestic grain legume production could bring a lot of benefits across different scales and levels within the food system, in this section a short review of the main results is presented, together with what steps that needs to be taken to towards an expansion of the production of grain legumes for food in southern Sweden.

There was a high willingness to participate in the study, and all the respondents were generally positive towards an increased, domestic grain legume cultivation, with an increase in volumes or varieties. Although the majority of the farmers that were interviewed had limited experience in grain legume cultivation for food, many of them recognized a market opportunity and they seemed intrigued by the challenge of developing and improving their cropping system by the cultivation of a new crop. The farmers seemed aware of the many benefits to gain by incorporating grain legumes in their cropping systems, including the break-crop effect, diversification of the crop rotation, soil improvement, and the BNF, and that all of these factors contributes to the overall profitability of the farm by making it more diverse and resilient, and by reducing the need of expensive inputs. Furthermore, incorporating a new crop into the system can also directly increase the farmers chance of making a larger profit, through the opportunity of replacing a less profitable crop and thus maximizing the potential profit per hectare.

The main expectations of the actors within the food industry to participate in the project NLF were to explore new raw materials that can be cultivated in Sweden and that can later result in new, exciting products of bread and pre-cooked meals, to get in touch with potential partners, and to develop their relations with the producers. The underlying motivations of the food industry to promote an expansion of grain legume production seemed to be mainly economical, recognizing the market opportunity and the potential added value of products associated with the ongoing trend of plant-based and locally produced food, and that consumers have become more aware of the nutritional aspects of legumes in particular. The representatives from the food industry seemed aware of the environmental benefits that could be gained with an increased, domestic production of grain legumes, and that by engaging in such projects the company would not only promote healthy food consumption and contribute to the reduction of the environmental impact of their production, but engaging in such project would also give positive associations to their company.

When evaluating the current interactions between Orkla and their contracted farmers, both parties were positive towards the current cooperation. Long relationships between the company and the producers were seen as a strength in the cooperation, and an important factor in the future development of the cooperation, although some uncertainties in the long-term viability of the cooperation were raised by the producers. According to the company, the volumes decide whether to invest in contracting a fourth crop because of the high investments of expanding the current facilities. The capacity of the food industry to receive a grain legume produce directly from the field are very limited in general, Orkla has no facilities currently for handling an additional crop, Fazer buys all their products from wholesalers and need additional facilities for processing the legume to a flour to be able to incorporate domestic grain legumes into their products, and although KÖTP seemed very open towards an expansion, they need to increase the storage capacity as well as the capacity of the production to make a large expansion happen. Vara were the only actor that seemed ready to receive additional varieties or expanded volumes, but they are limited when it comes to handling new varieties in smaller volumes in an initial phase of expanding the cultivation of grain legumes, since the facilities and management are adapted to large volumes. The capacity of processing the grain legume produce needs to be developed to be able to expand the grain legume production for food in Southern Sweden.

Challenges that were identified in this study in terms of grain legume cultivation included finding suitable varieties for cultivation outside of the current area of production, developing alternative weed and disease practices for grain legume cultivation as the chemical alternatives are getting fewer and some legumes seem sensitive to mechanical weed control, and solving the issue of high investment costs for special machinery needed for some grain legume varieties. There are several agroecological management practices like intercropping for increased weed suppression, reduction of pest organism impacts through the addition of allelopathic compounds by cover cropping, or the control of insect pests by promotion of beneficial insects that could be applied to the cropping system as an alternative or complement to chemical weed and pest control (Gliessman 2015). Field trials are needed to be able to find suitable varieties, and alternative measures for weed and pest control, that is compatible with the specific soil, climate and cultivation practices on the farm. To provide farmers with alternatives to chemical weed and pest control can possibly save costs for the farmer for agrochemicals, and is furthermore beneficial to the environment and human health. The demand for special machinery for some legume varieties is a potential obstacle that needs to be solved already in an initial phase of expanding the domestic grain legume cultivation in southern Sweden, as it is a big investment. If the volumes are big enough, the farmers seemed willing to invest, or open to establish a cooperation in terms of co-ownership of machinery between farmers in the area that has the same machinery requirements, something that might be difficult for the farmers to establish by themselves as the grain legume production is still limited, and scattered. Thus, with smaller volumes, support from the industry might be needed to establish such a cooperation, or to provide the farmers with machinery services, if a grain legume variety that requires special machinery is going to be produced outside of the current area of production.

Profitability was one of the main concerns of the farmers, as long-term profitability is important, especially with input-intensive crops where the investment in time and money is higher. And as previously stated, the crop that they are incorporating into the system has to be more profitable than the crop that they are (partially) replacing. The relationship between supply and demand, and the price of the produce, seemed to be the main issues in terms of profitability for the farmers. Therefore, the farmers requested more information from the food industry about the actual pre-conditions for a grain legume cultivation for food involving a cooperation with Orkla, mainly in terms of what volumes and varieties are needed and an estimated price of the produce.

In a previous study by Zander et al (2016), the development of new mechanisms to appreciate non-market outputs such as payments for ecosystem services and greenhouse gas abatement payments from carbon markets, could potentially promote the increase of grain legume cultivation. Based on what the farmers mentioned as motivations to incorporate grain legumes into their crop rotations, they have a high awareness of the potential benefits of having grain legumes in the cropping system, although they seem to fail in realizing the economic values outside of the actual returns from the produce. Due to this, there seem to be a need to translate the extended services provided by grain legume crops to economic values, and incorporate in the economic calculations, both on a farm level but also in terms of price of the produce; that the farmers are paid for the ecosystem services provided to the environment and to society.

From the perspectives of the processing industry the challenge of profitability was rather the uncertainties in yields, volumes and quality of the grain legume produce. This challenge could be mitigated by storing parts of the produce for the following year as a buffer, as a dry produce is fairly easy to store. However, the storage costs will increase, as will the production costs, and the process of product development could be extended by one year. The estimated costs of this will therefore be needed to take into consideration when doing the economic calculations.

The farmers seemed positive towards extended cooperation with Orkla, with the cultivation of a grain legume crop, but for the farmers to succeed with the cultivation of a new crop the advisory services needs to be improved. The current knowledge exchange was redeemed sufficient when cultivating crops that they have long-term experience with, but with the cultivation of a new crop more support is needed from the food industry and advisory services for the farmers to become successful with the production. The farmers also requested the security and stability of knowing that they have a buyer at a fixed price, preferably by contract. But, as stated by the agricultural manager at Orkla, contracting of a new crop is not established until the volumes are quite large. This could be a potential problem in the initial phase of establishing a functioning cooperation between the farmers and the processing industry around the production of grain legumes, as the volumes are usually small at the beginning of such a project. As stated previously when discussing the interactions between Orkla and their contracted farmers, the communication between the company and their producers needs to be improved, giving the producers a greater sense of security and stability to feel invested in the production for the company, and to feel comfortable in continuing and also expanding the cooperation. Factors that needs to be discussed is for example what responsibilities are put on the farmers in the new production, for example in terms of machinery, storage, and workload, what kind of support is offered by the company, and what the demands are.

There seemed to be no preference towards a certain grain legume variety amongst the different actors, they were open to different varieties of peas, beans and lentils in general. There were however certain properties that were important when choosing what variety to work with, including; i) Suitability in terms of soil type and climate, ii) that there are mechanical and chemical techniques available to manage the crop, pests and weeds, iii) that the variety is a good weed competitor and pest resistant, iiii) and that the variety is suitable to incorporate in food products in terms of taste, texture, protein and nutrient content. When it comes to legume properties for cultivation and product development, it was clear that what kind of variety that could be suitable varies depending on area of cultivation and use, and that different varieties need to be tried to find a good match that is suitable for the producers, the food industry, as well as for the market and consumers.

Attitudes towards an increased, domestic grain legume production

One of the objectives of this study was to investigate if there is an interest amongst the processing industries and producers in the area to cultivate and use grain legumes for food. All the industry companies that were interviewed for this study were involved in the NLF project, except for Vara that is linked to the project only by delivering grains to Fazer, one of the actors in the NLF project. Because of the involvement of the companies in the NLF project, where the aim is to develop new products based on domestic grain legumes, it is assumed that the general interest amongst the participating actors to increase the production of domestic grain legumes is high. This interest was also expressed and articulated by the participants at the start-up meeting for the project NLF.

During the interview with the representative from Vara, it became clear that they were very positive towards an increased legume production in Sweden, and they have witnessed a recent change in the trade with locally produced legumes in general, and particularly so with faba bean.

> P4: “The most recent change has been that faba bean has entered as a kind of accepted crop here, because that was not the case 10 years ago, back then we did not buy in any kind of beans, other than organic beans occasionally, but we did not trade with conventionally produced legumes at all. “

The interviewee also expressed an interest in the project NLF and was overall very positive towards the involvement of major actors within the food industry, and stated that there could be great possibilities of change when major actors are invested in a project [P4]. When asked about their role as

a company in increasing the Swedish legume production, the respondent explained that they were very excited about such a development, and that they were interested in getting involved in a more long-term cooperation, in terms of for example field trials and such, if possible [P4].

There seemed to be an overall interest in grain legume cultivation also amongst the farmers that were interviewed. Already at the farmers meeting, where the project NLF and this thesis work was introduced, we (G. Carlsson & C. Olsson) were approach by four different farmers directly after the presentations that were interested to learn more about grain legume cultivation and how they could get involved. One of the farmers that were interviewed, shared during the individual interview that he attended the farmers meeting and that he was inspired by the presentations of the projects to look further into legume cultivation as a way of diversifying his cropping system and try something new [G3]. The respondent was therefore also very positive towards being a part of this study, when he was contacted and invited to participate in the individual interviews.

> G3: "Then I was thinking, I was at that potato meeting (Veberöd, februrary 16th), when you were there and presented it briefly, and I was thinking that we have a variety of different crops as it is but we don't ha a legume so it would be, I mean if you have a 7-year rotation approximately then I have four years with crops like red beets, spinach, potatoes, gherkins maybe, but then I have cereals two years in a row at one location for example, and that is a bit unnecessary.. "

During the interviews that were performed, several of the farmers mentioned that they had thought about adopting legume cultivation before [G1, G2, G4, G6], and that they had recognized an increasing demand and cultivation of grain legumes. When presenting this study and the project NLF at the beginning of the interviews, the farmers seemed genuinely interested and asked several questions about the project and about market development and cultivation of grain legume foods. At the end of the interview, when the farmers were asked how they felt about being contacted in the near future regarding getting involved in a more long-term cooperation within the NLF project, all the farmers seemed positive and willing to get involved.

One of the farmers are currently producing organic legumes on approximately 10-15 hectares, which is about 10 % of their total, organic, production [G5]. Speaking generally about an increased legume production in Sweden, the farmer was very positive, but he was not interested in expanding the production in terms of cultivated area within the organic production, however, he seemed positive towards trying new varieties of grain legumes in his production. When the farmer was asked about how he felt about incorporating legumes in the conventional production, he was a bit hesitant, and said that it depended on the price of the produce. He recognized the many benefits of incorporating grain legumes in the rotation, and especially emphasized that it would be good to be able to reduce the amount of fertilizers used in the conventional production, a big expense during the spring [G5].

Factors motivating farmers to get interested in grain legume cultivation for food

During the interviews, multiple motivational factors could be identified for farmers to adopt grain legume cultivation, based on discussions with the farmers about their interest and views on incorporating a grain legume into their cropping system. These factors are discussed under separate subsections below.

The break crop effect, diversification of the crop rotation and soil improvement

All of the farmers that were interviewed mentioned that the break crop effect and the diversification of the crop rotation are two important factors that makes it interesting to look at new crops to incorporate in the cropping systems. Even though none of the farmers considered their crop rotations

as being particularly homogenous, they were all in agreement that legumes could add valuable variation to the cropping system, especially when dominated by cereals and oilseeds, which is common in the area. Some of the farmers also mentioned that legumes are especially good for improving the soil structure and fertility compared to many other crops [G1, G5].

The biological nitrogen fixation and pre-crop properties

The majority of the farmers found the BNF as a beneficial aspect of cultivating grain legume crops [G1, G5, G6], and for one of the farmers that had experience of cultivating legumes in an organic cropping system it was an important part of the nutrient strategy[G5]. Because of their beneficial impacts on N availability, the soil improvement aspects and the diversification of the cropping system, legumes where also considered a good pre-crop, especially for potatoes and cereals [G2, G5].

Trying new crops, an important way of developing and improving the cropping system

During the interviews, all of the farmers expressed in some way that they enjoyed the challenge of trying new crops that could fit into the cropping system, it was also mentioned that the fact that it was not common in the area to cultivate grain legume crops for food made it even more of a challenge, and that the farmers were curious if they could make it work. When discussing the subject of trying new crops, it became clear that incorporating new crops into the cropping systems, and altering the crop rotation, where an important part of developing and improving the system. However, the main pre-condition of doing so was that the new crop was profitable in a long-term perspective, for the new crop to be kept in the system.

> G4: "I don't know about the beans and grain legumes, how difficult they are to grow, but potatoes are a quite demanding crop that need a lot of inputs and such, and I think it is pretty interesting with that type of cultivation, you can affect/influence it so much more than what you can do with for example cereals, because there it so little money to work with so to say."

> G1: "The economy has to work, otherwise… you can't do it just because it is fun. But it is fun to try something new that could fit well and it is good for the soils, and with the nitrogen fixation and all of that."

> G6: "You have to try new things to move forward, but eventually it has to become profitable for it to work in the long-term"

The farmers seemed very aware of the fact that trying out something new might not be profitable in an initial phase, and that was in general not considered a problem as long as the long-term profitability and other benefits of incorporating the crop into the system, such as for example the BNF, outweighed the risks of investments. Two of the farmers that were interviewed also discussed trying new crops in a wider perspective, and that it was important from a societal perspective to keep developing Swedish agriculture towards self-sufficiency and diversity, and being able to offer the consumers an alternative to imported foods.

> G3: ".. I think you have to be open to try new ways and to cultivate more in Sweden, that we can produce ourselves instead of importing, and keep some variation and money in Swedish agriculture".

> G6: "I am positive towards everything that we can produce ourselves, you have to see it like that"

Recognizing a market opportunity

When it came to grain legume crops specifically and not just the adoption of any new crop in general, most of the farmers had recognized an increased demand of legume foods, and foods of Swedish origin on the market [G2, G3, G4, G5].

> G6: "Then there is the economy, if there is a demand for it there are usually a willingness to pay as well. "

With an increasing demand for a crop on the market, the possibilities for the farmer of making a profit also increases. When discussing all of the motivational factors that has been mentioned previously in terms of incorporating grain legume crops into the cropping systems of Swedish farmers (the break crop effect, diversification of the crop rotation, soil improvement, the BNF, and developing and improving the cropping system), all of these factors contributes to the overall profitability of the farm by making it more diverse and resilient, and by reducing the need of expensive inputs. Furthermore, incorporating a new crop into the system can also directly increase the farmers chance of making a larger profit, through the opportunity of replacing a less profitable crop, thus maximizing the potential profit per hectare. Some of these conclusions, such as the reduced costs of fertilizers and the possibility to replace less profitable crops were made directly by the majority of the farmers during the interview [G3, G4, G5, G6], while the other farmers spoke of increased profitability in more general terms [G1, G2].

Industry motivations and expectations on project NLF

When asked about their expectations of the NLF project, Orkla stated that their main purpose of participating in the project is to explore new raw materials that can be cultivated in Sweden and that can later result in new, exciting products [P1]. Some important steps towards that goal that could be identified during the interview was to get in touch with potential new partners for cooperation's concerning Swedish grain legumes, and to connect closer to their contracted growers by helping them to get started with a cultivation of grain legumes, that later can be used in their products. The informant stated that they feel like they have an important role as a company to contribute to society by incorporating health and environmental aspects in their decision-making processes and product development, and further pointed out that the project feels good from environmental and nutritional perspectives, and is something that they would like to support and be associated with as a company. Orkla is very much involved with market research and customer contact, and has recognized that there is an ongoing trend of vegetarian and locally produced foods. The have also noticed that the interest in vegetarian foods are expanding to not only include vegetarians, but is also becoming very popular also amongst people with other food habits that want to have a more varied diet. Historically, they have marketed many of their brands and products as very traditional and Swedish, and over the years they have noticed that the positive and strong driving force towards native foods amongst the consumers, a trend that seem especially strong in Sweden, compared to many of its neighboring countries. Grain legumes are in general considered as a good protein source when you want an alternative to meat, and the company already has grain legumes incorporated in some of their products, but sees an added value in being able to market their legume-based food products as Swedish. The informant gave an example of soybeans, that are used in some of their products currently, that soybeans are a good protein source but has a negative ring to it amongst the consumers, mainly because of the many times unsustainable cultivation practices associated with the crop. The informant was very careful to point out that the company does not import soybeans from rainforest areas, but the crops still originate from very far away and therefore requires long transports, which is not good from an environmental perspective [P1].

The agricultural manager at Orkla was very positive towards an increased grain legume production in Sweden, and mentioned that there where many benefits to gain by incorporating more legumes into the cropping systems, such as the BNF, the diversification of the crop rotations and the beneficial properties of many legume varieties as a pre-crop [P3]. The informant pointed out that they did not give any advice to their contracted farmers about how to improve their cropping systems overall, the advisory services where focused only on the specific, contracted crop. However, the informant expressed that incorporating legumes into the cropping systems of the farmers will probably benefit the other contracted crops as well. The Agricultural manager stated that even though the main motivation as a company to engage in grain legumes cultivation is probably primarily economical, there are a lot of environmental gains to be made as well, and that these two factors often goes hand in hand [P3].

When discussing expectations on the project NLF with the representative from Fazer, their desired outcome from the project seemed very similar to that of Orkla; they hope that the project will result in some kind of native production of a grain legume variety that is possible to integrate in their products, to be able to replace existing, imported legume varieties, and to develop new, exciting products [P2]. When speaking of the "dream-scenario" in terms of the outcome of the project NLF the informant talked about having products with minimal environmental impact, that are delicious and that has good nutrient values. The informant acknowledged that this might be difficult to achieve in a 5-year project, but that one important step on the way is to be able to produce both cereals and legumes in close proximity to the mill and bakery, and they want to know more specifically if it is possible to cultivate grain legumes in the area (Västergötland region, south-west Sweden), that are suitable to incorporate in bread. When asked why they are interested in incorporating Swedish grain legumes in their products, the informant said that it was the combination of the environmental benefits of native, legume cultivation, together with the good nutritional composition of grain legumes as a food product and the increasing consumer demand of legumes and locally produced foods. Fazer has launched a couple of products with grain legumes that has been successful on the market, and sees an opportunity to develop that product section with the increasing demand, and also to add value to their existing products with the Swedish brand. The informant also believes that using Swedish legumes is a good complement to their company profile, and a way be innovative and stay competitive on the market. Health is, next to taste, the most important aspect of the Fazer brand according to the informant, and the company has seen a recent development in people's diet towards eating less carbohydrates and gluten, that has affected their sales negatively. Legumes are however known to be a good source of protein, and by adding it to some of their breads, they hope to change people's perceptions of bread by increasing its protein content and nutritional values, reinforcing the association to health and nutrition of the Fazer brand and hopefully attracting new consumers [P2].

Although the informant from KÖTP was not personally working with the project NLF, he recognized that the project was a way for KÖTP as an organization to work towards the customers and the market demand, and as a source of inspiration and innovation that could add valuable inputs in developing the organization further [P5]. The fact that the company is owned by its members, the producers, is a great motivation to keep improving the cropping system, and profitability, and having a sustainable and long-term approach is important within the company [P5]. The demand for their products has recently increased, and the informant believes that the positive trend that they have experienced is mainly due to an increased awareness amongst the consumers, primarily about the health and nutritional aspects of legume foods, but also that many of their customers from the food industry have discovered the market opportunity and added value of being able to market their food products with the Swedish origin [P5].

> P5: "Some customers that has previously worked with imported legume produce, has contacted us because they see the added value of putting the Swedish flag on the packaging."

They are of course hoping that the trend will stay positive, and that they can continue to increase their production, but it was important for the informant to point out that it is not only because it is good business that they hope to increase the legume cultivation, but also because they believe it is important that people eat better food [P5]. It is mainly the new legume varieties that has experienced an increase in demand, the market development for brown beans and yellow peas has been quite stagnant [P5].

> P5: "we sell a lot of yellow peas, basically for Pea soup, but there is a lot more that you can do with peas. And that is an important part as well, to make the customers aware of that you can do so much more with the products, for us to increase the volumes."

The informant believes that brown beans and yellow peas are associated with more traditional Swedish foods that were common amongst the older generation, and as new, perhaps more exiting food, has become available on the market, these traditional dishes are sometimes discarded amongst the younger generation [P5]. To be able to continue to grow on the market, and develop the organization further, it is especially important for KÖTP to enlighten their customers and the consumers about what is possible to do with the products, both regarding older varieties that is sometimes overlooked by consumers, and also for new varieties where the characteristics and possible applications are currently unknown.

The representative from Vara has seen an increase in the interest and the cultivation of legumes amongst the farmers in the area, and believes that it is mostly due to changes in legislation with the requirements of incorporating fallow or leguminous crops in the rotation to obtain full subsidies from EU regarding the ecological focus areas [P4]. The ecological focus areas are part of three greening measures, also including crop diversification and maintenance of permanent grassland, that were introduced in the 2014-2020 Common Agricultural Policy as a new policy instrument (Underwood & Tucker 2016). The main motivation of Vara to promote the cultivating of grain legume crops for food to their farmers is that they see an opportunity of added value for the produce. Many of the farmers that deliver to Vara are currently producing grain legumes of high quality, for example faba bean, green peas and yellow peas, very successfully, but the majority of the grain legumes that are currently cultivated in the area is sold to export, because it usually pays better. If the Swedish market for grain legumes such as for example faba bean, green peas or yellow peas, for human consumption develops, there is a potential of retaining a higher profit for the farmer. One example of where a switch from a conventional variety to a "premium-crop" has been successful is given by the informant, where many farmers in the area that previously produced barley for animal feed now produces malting barley instead with a better profit. Vara represents the farmers, trying to get the best price for the produce, and is therefore positive towards any change that could potentially benefit the producers, for example by finding new crops or varieties that are more profitable to cultivate [P4].

Evaluating the interactions between farmers and the food industry

To evaluate the current cooperation and interactions between Orkla and their contracted farmers, and exploring their expectations on an extended cooperation with a cultivation of grain legumes for food, were also part of the objectives in this study. The relationship between the food processing industry and the producers are investigated in more general terms, as well as focusing specifically on the relations between Orkla and their contracted farmers and what implications it may have on an extended cooperation.

Orkla has approximately 30 contracted growers for potato, and about 80 % of the estimated need is contracted to these farmers, the other 20 % is bought from the free market or imported [P3]. By having only 80 % of thee need on contract, Orkla avoids having more produce then they need, because they are obligated to take care of all the produce from the contracted farmers, and some years the yields are less and other times more than what was estimated [P3]. Due to economic reasons, the company does not want to have a surplus of produce [P1, P3]. All of the contracted farmers on potato are conventional, the company buy in a lot of organic potatoes as well, but they are reluctant towards contracting for organic potatoes because of the great variations in quality and yield levels between different years [P3]. For the gherkin cultivation, Orkla has 16 contracted farmers, of which two are organic [P3]. The company also has 21 contracted farmers for red beets, 6 of them are organic [P3]. Only 80 % of the need is contracted, as for the potato cultivation. However, since there are no other gherkin producers in Sweden the remaining 20 % of the produce that is needed is imported [P3]. The season starts with price negotiations between the company and the contracted farmers, and when the marketing department has calculated an estimated need for the following year, the total cultivation area that is needed is divided between the farmers [P3]. The farmers are paid a fixed price per kilo, and it is decided on beforehand how many hectares of a certain crop each farmer is supposed to cultivate. Orkla is then obliged to buy and take care of all the produce that are harvested from the contracted cultivation area [P3]. Orkla provides their contracted farmers with seed and advisory services [P3]. HIR has been hired to take care of the advisory services of the potato production, while Orkla themselves takes care of the advisory for gherkins and red beet cultivation [P3]. The conditions for the potato cultivation changes a lot every year, and it was important for the company that the farmers receive the most recent knowledge and can use the best methods available, therefore additional advisory services was bought in [P3]. A delivery plan of the produce is also established each season, to ensure continuous supply of raw materials to the factory [P3]. The price of the produce is fixed; however, samples are taken on each delivery, and deductions are made on the price depending on the quality of the produce [P3]. The quality of the produce is decided based on mechanical damage or damage caused by pests, and also by purity [P3]. The setup of the farmer cooperation between Orkla and their contracted farmers has been pretty much the same historically, although the scope of the contract has grown from half a page to several pages, the basic principles are the same [P3].

> P3: "I Have been here for more than 15 years, there are one or two farmers that has left us, and some years we have had to expand, but other than that I have pretty much worked with the same farmers the whole time."

The cooperation with the contracted farmers is based on very long relationships, and working with the same farmers for many years greatly increases the opportunities of being able to develop the cultivation, both in terms of environment but also with yield levels and new varieties [P3]. It is a very rewarding way of working with the farmers according to the agricultural manager [P3]. During the interview, the informant (P3) was also asked about how it came to be these three crops (potatoes, red beets and gherkins) that are cultivated on contract, and about the possibilities of expanding the contracts to involve a fourth crop. According to the agricultural manager, the volumes decide if it is reasonable to establish contracts or not on a specific crop, because of the investments needed in the facilities to be able to handle the produce directly from the field.

As opposed to Orkla, Fazer does not have any contracted farmers, and the company very rarely buys produce directly from the field, most trades are done through a wholesaler or a mill [P2]. For the majority of the products, the wholesalers can guarantee a Swedish origin, but for some products the origin cannot be guaranteed, then the wholesaler only has to ensure that they can provide the company with the prearranged quantity of a certain product [P2]. Despite this uncertainty, Fazer seemed very satisfied with the setup, and one advantage of not having their own contracted farmers

is that the responsibility of providing the production with raw materials is not on the company, but on another actor [P2].

Vara works in a similar way compared to Orkla with the produce that they buy in and then trade to the industries; the majority of their deliveries are from contracted farmers, where the cultivation is contracted per hectare with a fixed price of the produce and where the company is obliged to buy and take care of all the produce derived from the contracted cultivation area [P4]. However, as opposed to Orkla, Vara is owned by its' members, farmers in the western parts of Sweden. This is also the case with KÖTP, which makes the two companies slightly different compared to the other actors that has been previously mentioned [P4, P5]. KÖTP also works with contracts, and is responsible of taking care of the farmers produce [P5]. The main objectives of KÖTP and Vara is to sell the farmers' produce to the best price available on the market, to maximize the members' returns [P4, P5].

When discussing the interactions with the food industry, the farmers where in general positive both towards the cooperations with industries in general, but also towards the system of contracted crops [G1, G3, G4, G5, G6]. The main motivations that were mentioned towards working directly with the food companies by contracts, as opposed to selling their produce on the free market, seemed to be the security and stability it offers [G1, G3, G4, G5, G6]. The farmers that were positive towards contracted crops, were aware of the fact that it could be difficult sometimes to get the best price for their produce, but that they believed that the contracts was economically beneficial to the farmers in a long-term perspective. The majority of the farmers also recognized that having a buyer for the produce before establishing the crop is a necessity, and for specialized crops that is only possible to sell to one actor, a contract is needed [G1, G3, G4, G6].

> G3: "Some years the prices of for example potatoes can be really good on the free market, and other years the prices are really bad, producing on contract gives much more stable results. And you always know that you have a buyer for the produce".

During the interviews with the farmers, there were some indications that the farmers sometimes felt pressured from the industries to increase the efficiency in the cultivation, and the quality of the produce, making it increasingly difficult for the farmers to stay profitable and still meet the needs of the industries.

> G1: "It is a bit difficult when it comes to producing for human consumption, it is always a matter of increasing the quality all the time."

A couple of farmers expressed that with time, there are limitations to how much more efficient you can get in the cultivation, and that is was even more difficult for farmers with smaller, and more scattered fields where the management of the fields and crops are much more time consuming [G1, G2]. It was also mentioned that the industries sometimes could be difficult to negotiate with, and that they always had the alternative of importing the produce instead, if the demands of the farmers did not suit them.

Looking specifically at the cooperation with Orkla, all the farmers that were interviewed seemed overall satisfied, although there seemed to be some uncertainties about the long-term perspective of the cooperation. Even though the cooperation between the farmers and the company has been working well historically, some recent changes in the conditions has left two of the farmers a bit insecure of the future possibilities of a continued cooperation [G1, G4]. One of the farmers had the opinion that more and more responsibilities was put back on the farmers, that were previously handled by the company, and specifically mentioned the storage of potatoes [G4]. Orkla has the ambition that the farmers should take over the storage of the potato produce that are not used in the factory immediately after harvest, something that was previously stored in different storage facilities

run by the company [G4, P3]. The farmer is unsure how to handle the storage at the farm, because he only has a small production and to be able to invest in storage facilities you need quite large volumes for it to be reasonable to do such a large investment [G4]. The farmer says that if own storage of the potato produce becomes a reality, he is considering to end the cooperation with delivering potatoes for Orkla, and deliver for starch production instead, alternatively end the production of potatoes completely and replace the production with another crop [G4]. Another farmer also mentioned that the factory in Eslöv, where all of the contracted produce is currently delivered and processed, needs to be rebuilt to fulfill new standards that has been developed for processing facilities, a big investment for the company, and Orkla had not at the time of this study confirmed if they had decided to invest or not. The farmer assumed that if the company did not want to invest in rebuilding the factory, the production of all crops for Orkla on contract will stop completely. The issues with storage facilities and the investment in the rebuilding of the factory were also discussed during the farmers meeting, were several farmers expressed their concerns regarding the future production.

Perceived challenges with an increased, domestic grain legume production

The perceived challenges of the farmers and key actors in terms of an increased, domestic, grain legume production are discussed in this section, both from the individual farmer's perspective of incorporating a grain legume crop into their existing cropping systems, as well as the perceived challenges of an increased, domestic, grain legume production in Southern Sweden in general. Considering an expansion outside of the current areas of production and also the cultivation of new grain legume varieties.

Finding suitable varieties

The perceived challenge that was most prominent during the interviews with the farmers and industry representatives when it comes to expanding the production of grain legumes for food outside of the current locations in southern Sweden, was to find suitable varieties. This challenge was mentioned by all the informants, although the different actors had slightly different perspectives; farmers where mostly focused on the suitability in terms of climate and soil, and the industry representatives on what kind of varieties would be possible to cultivate and at the same time suitable to incorporate in their specific products, cultivation was only mentioned in terms of climate and not soil conditions. When the farmers were discussing the soils, it was mainly in the context of different legume varieties demanding different soil characteristics, one example that was mentioned frequently where differences in suitable soil type between faba beans and dry beans [G1, G2, G3, G4, G6]. The climate was generally seen as a potential challenge, based on that there are differences in climate and weather conditions between the region of Kalmar-Öland and other parts of southern Sweden, but also that there are great varieties between different areas of southern Sweden, even within a specific region [G1, G2, G4, G5, P1, P3, P4, P5]. A more specific challenge with the climate could be that the growing season might be too short in some areas, where the seeding starts later and where the rainfall is quite frequent and early during autumn, factors that could further limit the choice of legume varieties that is possible to cultivate [G1, G2, G4]. With a change in climate conditions, and area of use for the produce, there might be a need of other seed varieties then those currently used today in Sweden, or even completely new legume varieties that needs to be developed to fit the growing conditions in a new cultivation area, a potential problem that was mention by two industry representatives [P4, P5].

The agricultural production manager at KÖTP further explained that it is already a difficult task sometimes to get hold of new seeding material that is suitable to cultivate in Sweden in general. One example was given during the interview where seed producers and wholesalers has been contacted in Canada, where grain legume production is quite extensive and the climate is somewhat similar, but where they have been reluctant to export seeds [P5]. The agricultural manager believes that field trials

will be necessary to be able to find and develop suitable seeds for a specific region, due to the importance of knowing that the cultivation works, and how to optimize the cultivation of a specific variety in a certain setting, before investing in a production [P5].

Weed and pest management

During the interview with the agricultural manager at Orkla, one of the potential challenges that was highlighted in terms of legume cultivation was the weed management. The informant stated that high weed occurrence could become a potential problem for the individual farmer since many legume varieties are weak competitors against weeds and often do not form a dense ground cover [P3]. This concern was shared amongst some of the farmers that were interviewed, and the farmers further stated that in some areas the weed occurrence was very high, and they were concerned about the range of options available for managing weeds in a legume cultivation [G1, G2, G3]. The agricultural production manager at KÖTP shared these concerns, although the weeds are not considered a problem currently in the production, the informant stated that many chemicals have been banned during recent years, and very few new chemicals are approved, leaving the farmers with less and less chemical options to use. The informant further stated that if no chemicals are available in the future, it will greatly limit the cultivation possibilities in some areas. None of the interviewed informants considered pests as being a potential problem, although it was mentioned by the agricultural production manager at KÖTP that the increase in cultivation of a few varieties might stimulate pest outbreaks where there have not been any previous problems. There were also concerns raised by some of the farmers about birds, a recurrent problem amongst farmers that had previous experience of peas and faba bean cultivation [G2, G5, G6]. One of the farmers that have had problems with birds for many years experienced that intercropping with barley relieved the problems with birds in fields with peas, compared to cultivating peas in pure stands [G5]. The farmer also believed that an increased cultivation of grain legumes in the area might further decrease the pressure of birds on individual fields [G5].

Machinery and storage facilities

Due to the fact that some grain legume varieties demand special machinery for harvesting, and also cleansing equipment, the high investment in time and money to acquire such machinery is seen as potential challenge for the individual farmers. To be able to invest in new machinery, the volumes of the production needs to be big enough, or there should preferably be other farmers in the area interested in a cooperation regarding the machinery, something that could be difficult when the specific crop is not commonly grown. This challenge was articulated by every farmer that were interviewed, including the agricultural production manager at KÖTP, and could become a difficult obstacle to overcome in the initial phase of a potential legume production if the responsibility of purchasing machinery is put on the individual farmers.

Profitability

Amongst the farmers that were interviewed, the challenges of profitability in a grain legume production for the food industry was mainly discussed in terms of prices of the produce and the potential income. Some of the farmers specifically gave faba beans as an example,

that the price of the produce has not been good recently, and that the prices needs to increase to be able to make a profit [G4, G5, G6]. All of the farmers agreed that in order to incorporate a new crop in the production, calculations has to be made and long-term profitability for the farmers has to be ensured before establishing the production. This was believed especially important for more demanding and

input-intensive crops where the investment in time and money are higher [G4, G5]. Another concern that was raised was that the prices might decrease even more with an increased cultivation of specific varieties, as the availability on the market increases. This concern seemed to be derived from uncertainties in the relationship between the supply and demand of grain legume produce on the current market, and the actual needs of the food processing industries [G1, G2, G4, G6].

> G1: "The legumes that the farmers on Öland are producing are pretty interesting. I have already thought of that for a while, if I was to try it out, but they have a pretty large head-start, they have already managed to expand to quite large areas. And you don't know how much is needed."

> G4: "I can see that there are possibilities, but I don't know what the demands are. But from what I have understand there is an increase in demand, and that there are large volumes that are imported already. "

Based on these uncertainties, all the farmers that were interview requested more information from the industry representatives on the actual pre-conditions for a grain legume cultivation, in terms of what volumes and varieties are needed and to what price, for the farmers to be able to make a decision on whether to start cultivating grain legumes for food or not. In studies by Von Richthofen & Pfahl (2006) and Zimmer et al (2016), poor economic conditions were identified as one of the main barriers for farmers to initiate a grain legume cultivation, mainly in terms of low grain yield, low market prices and high seed costs. In several studies on the subject of increasing the grain legume cultivation in Europe, the need for increased policy support and the importance of a supportive market development has been mentioned as key factors in improving the profitability for grain legume producers (Peltonen-Sainio & Niemi 2012, Preissel et al 2015, Voisin et al 2014, Zander et al 2016).

From the perspectives of the processing industry the challenge of profitability was rather the uncertainties in yields, volumes and quality of the grain legume produce. Because of the long process of product development, and the obligations that the food processing industry has towards the stores regarding delivering the agreed products, the representatives from Orkla and Fazer stated the importance of knowing in advance what is available in terms of variety and volumes of a certain produce [P1, P2, P3]. Because the companies are planning on marketing the origin of the legume-based products as Swedish, they are also bound to use only native produce, thus limiting the possibilities to replace the produce with imported goods if the producer cannot meet the needs due to for example low yields or insufficient quality [P1, P2, P3]. This challenge is even more prominent when it comes to crops or varieties that is not commonly grown, because of the difficulties finding alternative suppliers or producers.

> P1: "… I Know that the farmer doesn't want to start producing something if no one wants it, and it is difficult for us to start a developing process from something that we don't have today but that the farmer says they can deliver in a year."

As previously mentioned, Orkla has been reluctant with their other contracted crops to contract for 100 % of the need, because they do not want to produce more than they can use in their own production, but they still need to be able to fill the needs. This challenge of possibly not having an alternative supply, could increase the costs significantly for the processing companies. Vara has experience in working with industries that requests a certain produce from a specific farm or area, and in order to be able to handle variations in yield or quality, part of the produce is stored for the next year [P4]. A similar setup could be applied to the grain legume cultivation, however, it would mean increased costs in terms of producing a surplus of the crop, as well as costs of storing the produce an additional year. Another alternative is to not guarantee a Swedish origin on the packaging

of the legume-based product, but since one of the main motivations of the processing industries to use native produce is the added value of the product, such a solution would limit the potential of increased profit.

Capacity of the food industry

One of the objectives of this study was to investigate the capacity of the processing industry in terms of managing a grain legume produce. When discussing this with Orkla and Fazer, it became evident that the current capacity of receiving a grain legume produce directly from the fields are very limited. Orklas facilities are developed for the crops that are currently produced on contract (Potatoes, red beets and gherkins) and are not built to take care of another crop, and Fazer has no contracted farmers at all and does not have any facilities to manage produce directly from the fields since the products that they use today in their production are bought through wholesalers [P1, P2, P3]. KÖTP were very open towards an increased production with larger volumes, or an increase in the number of varieties which they are currently working on developing [P5]. For a larger expansion, they need to increase the storage capacity as well as the capacity of the production, something that was not seen as a challenge according to the agricultural production manager but rather as a way to develop the company [P5]. Vara are currently receiving grain legumes directly from the fields, and saw no problem in expanding the production of the varieties that they are currently trading with [P4]. However, there are some limitations when it comes to handling new varieties because the facilities and management practices are adapted to take care of large volumes, which might be a challenge in an initial phase when the volumes are smaller [P4]. Another important aspect in the capacity of the processing industry is the possibility to convert the produce to a form that can be used in developing new products, something that was mainly a challenge for Fazer since they prefer working with a flour or powder rather than whole beans, and they cannot use the existing facilities for converting whole beans to flour that is currently used for cereals because of allergens [P2]. When asked about the possibilities within the company to invest in new facilities for legumes, the senior research manager at Fazer expressed that such an investment is not impossible, but is not in question at this stage [P2]. The agricultural production manager was also asked about the possibilities of KÖTP investing in processing facilities, and it seemed like it was something that was currently up for discussion in the company as a way of developing their products further [P5].

One of the reasons why economic reasons where the main barrier for grain legume cultivation, that where proposed in the study by Zimmer et al (2016) was difficulties selling the produce; only 14 % of the farmers that were surveyed had the capacity of drying the grain legume produce on the farm, and only 10 % had the facilities for cleaning the grain. A grain legume processing industry were lacking in the study in Luxembourg, and without the capacity and infrastructure of processing the grain legume produce for human consumption, the market opportunities for the farmers were limited. Improved marketing opportunities has previously been identified as important drivers when it comes to involvement of major stakeholders in developing the agricultural systems towards sustainability, for example by crop diversification (Björklund et al 2012).

As with the case of the grain legume production in Luxembourg, the capacity of processing the grain legume produce needs to be developed to be able to expand the grain legume production for food in Southern Sweden.

Knowledge exchange and advisory services

All the farmers that were interviewed agreed that advisory service will be needed in order for them to succeed with the cultivation of a new crop, on which they have limited previous experience. The farmers were in general satisfied with the advisory services that is provided today by Orkla and HIR,

as discussed previously, but stated that they would have to rely more on the advisory service with a grain legume crop compared to the other crops that they cultivate on contract today, that they have several years of experience with. The farmer that had more previous experience in grain legume cultivation did not think that the current advisory services that he had been in contact with has had enough knowledge about legume cultivation, the farmer relied rather on knowledge that was shared by other farmers with practical experience [G5].

> G5: "It is good knowledge. That you can call him and talk to him about it. You can't call too much, you know he needs to work too, but he doesn't keep his experiences to himself, but is happy to share and have an exchange."

Although the majority of the farmers that were interviewed believed that they had very little experience and knowledge about grain legume cultivation, they did not see that as a hindering factor, as long as they got good support from the food processing companies, advisory services, and preferably also by other farmers that are more experienced in grain legume cultivation [G1, G2, G3, G4. G6]. These results corresponds well with the conclusions drawn by Zimmer et al (2016), where lack of knowledge and information, and support from extension services were identified as one of the main barriers amongst farmers to initiate a grain legume cultivation. The need for making research results and information more available for the farmers, and improving extension services such as advisory services, concerning grain legume cultivation, were suggested as supportive measures for expanding the grain legume cultivation on a European level (Zimmer et al 2016). These supportive measures could be applied also in a Swedish context, as the need for improved advisory services and knowledge exchange were requested by the farmers for expanding the grain legume cultivation in southern Sweden.

Expectations on an extended cooperation

The farmers were all very positive towards an extended cooperation with Orkla, with the cultivation of an additional crop. It seemed like the main reason for their positive attitudes were the fact that the majority of the farmers were satisfied with the current cooperation, and also that the initiative of grain legume production came from an industry that already has established market connections in terms of legume-based food products. The farmers seemed further positive towards the fact that Orkla wanted to develop the current cooperation with their contracted farmers, instead of buying the produce from an alternative source or contract new farmers for a fourth crop.

As previously been discussed, profitability is an important aspect for the farmers when it comes to cultivating a new crop. Based on what the farmers expressed during the interviews, they expect that the cooperation involves having a buyer for their produce, and that the price is good enough to be able to make a profit, not only in terms of the individual crop but the grain legume produce must give a higher profit than the crop that is being replaced in the rotation.

From the industries perspectives, the expectations that were articulated during the interviews were mainly that Orkla wanted to have first-hand rights to the produce, to be able to have a competitive advantage towards their competitors [P1]. The development manager at Orkla also mentioned that by having their own contracted growers of grain legumes, they also had the opportunity to affect what kind of varieties to cultivate, and in what volumes.

> P1: "But of course, if we have the growers and can help them to get started with legume cultivation, we also make sure that we are the ones who gets the produce, to give ourselves a competitive advantage towards our competitors."

The agricultural manager at Orkla, who is mainly responsible for the communication between the company and their contracted farmers, further pointed out that it would probably be easier to develop a cooperation around a new crop with farmers that they already have contact with, and where a relationship that works well has been previously established. There were no other specific conditions for the extended cooperation that were articulated during the interviews with Orkla and their contracted farmers. However, more information about the expectations and conditions for such a cooperation were requested several times by the farmers, since the initiative came from the processing industry, the farmers felt like they needed more information on what the company has in mind. Orkla also seemed aware of the importance of open communication in order to establish a cooperation that works well, and to be able to reach their goals of establishing a grain legume cultivation that they can use to develop their legume-based products.

> P1: "I think that the communication is very important, what do we have in mind and what can they offer, to be able to develop a well-functioning cooperation with something that is possible to cultivate in the area and that can be used in our products."

Relating to previous interactions between the company and their contracted farmers, lack of information and transparency has previously caused uncertainties about the future relations amongst the farmers, as was previously discussed in the matter of shifting responsibilities of storage facilities and with the rebuilding of the factory. As previously mentioned when discussing uncertainties about profitability, security and stability were specifically expressed by the farmers as important factors when discussing the development of the cultivation. Even though the farmers were satisfied with the way the cooperation with Orkla is working today, and they seemed positive towards an extended cooperation, the uncertainties amongst the farmers about the development of the cooperation and the future plans of the company might pose a threat to the development of an extended cooperation. The farmers repeatedly stated that they needed more information regarding what Orkla would have in mind for a future, extended cooperation, to be able to make a decision on whether to get involved or not. Even though Orkla seem aware of the importance of communication, open communication about the expectations of the different key stakeholders and involving the farmers more in the decision-making, might become even more important when establishing a cooperation surrounding a new crop since a negative outcome surrounding the new crop might affect also the relations concerning the other, existing, crops that are currently functioning well. Factors that needs to be discussed is for example what responsibilities are put on the farmers in the new production, such as in terms of machinery, storage, and workload. But also what kind of support is offered by the company, and what the current and future demands are.

Desirable legume properties

When talking to the informants about grain legume cultivation, the specific variety seemed less important, there was rather a desire to find a variety with certain properties that is suitable to cultivate in the southern regions of Sweden, and that can be used to develop products based on native grain legumes. During the interviews, certain desired properties where mentioned amongst the different actors, these properties will be discussed in this section and can be used as guidelines when looking at what varieties that could be suitable to work with in the future.

Table 2: Overview of the grain legume properties requested by the interview participants

Desirable legume properties	
Suitability to cultivate in terms of:	
- Soil type	G1, G2, G3, G4, G6
- Climate	G1, G2, G3, G4, G5, P1, P3, P4, P5
- Mechanical and chemical techniques available to manage the crop, pests and weeds	
- The variety should preferably be a good weed competitor	G1, G2, G3
- Pest resistance is desirable	G2, G5, G6
- Availability of seed material	G3, G4, P4, P5
Suitability to incorporate in food products in terms of:	
- Taste	P1, P2
- Texture	P1, P2
- Protein and nutrient content	P1, P2
- Baking qualities	P2

The majority of the farmers said that they had no preferences towards a certain grain legume variety, but that it was mainly the market and the demand that influenced what variety to cultivate [G2, G3, G4, G5, G6]. Some of the farmers came with suggestions of varieties that they found particularly interesting, but when discussing the underlying causes of why they felt more drawn towards those varieties, it turned out that the majority of the varieties they proposed where based on their own thoughts of what they believed the industry and consumers want, and what would be possible to cultivate on their land based on their own knowledge and what they have heard from other farmers with more legume experiences. Examples of varieties that were mentioned by farmers were lupin (*Lupinus albus*) [G5] and soybean (*Glycine max*) [G1]. Lupin because the farmer had heard that the variety has a higher protein quality compared to other grain legumes, therefore the farmer believed that the demand and also profitability for the variety could possibly be higher due to the added value of increased quality. Soybean was mentioned because of the high import numbers, that there is an established market for the variety, and also because the farmer had some previous experience cultivating soybeans when working abroad. One potential reason to why the farmers might have been reluctant to mention specific varieties that they would be willing to cultivate, could be because of limited knowledge. The farmers mentioned that the suitability to cultivate was very important, and since few of the farmers had long-term experience of grain legume cultivation, they might not feel like they had enough knowledge of the subject to be able to suggest specific varieties that would be suitable for their specific soil and climate conditions. The one farmer (G5) that gave the specific suggestion of lupin, were the only farmer with more extensive practical experience of legume cultivation.

During the interviews with the development manager at Orkla and the senior research manager at Fazer, the processing companies seemed very open towards different varieties of peas, beans as well as lentils. The desired properties of the legumes varieties, when it comes to processing and product development, were not as clear as with the cultivation properties, since what was seen as desired in terms of processing properties depended on what the grain legume produce was going to be used for [P1, P2]. The actors were open to creating something completely new, and thereby using what was available and possible to cultivate in the region in terms of climate, and they were also open to

replacing an imported legume component in an existing product to a variety with Swedish origin [P1, P2]. In the first case, the variety and its properties are less important, while in the second case, it should be somewhat similar to what they already use [P1, P2].

Suitability to cultivate in the region was mainly discussed in terms of trying to mitigate the perceived challenges that were proposed by the farmers and processing industry, for example by choosing a variety that is well adapted to the climatic conditions, soils and farming methods in the region (table 2). When talking about climatic conditions, factors like temperature, rainfall, and length of growing season where mentioned that could influence the production of grain legumes in the specific region. Another aspect that seemed important when it comes to choosing suitable varieties for grain legume cultivation were the availability of, and knowledge on how to use, different mechanical and chemical techniques in the best possible way to manage the crop as well as potential pest and weed problems (table 2). If limited methods were available for weed control, for example because of sensitivity of the variety to mechanical control in some stages in the growth cycle or if the chemical alternatives are few, the variety should preferably be a strong competitor against weeds. Other important factors that should influence the choice of grain legume variety were pest resistance, to be able to prevent possible outbreaks, and also the availability of seed material that is suitable for cultivation in the specific region (table 2). In the study by Zimmer et al (2016) on barriers amongst farmers to adopt grain legume cultivation, one of the identified factors that discouraged farmers from grain legume cultivation were cultivation problems. The farmers in this study seemed aware of the potential weed problems, and the importance of knowing which crop is suitable for different soil types. However, they did not have any knowledge on how to manage pests and weeds in a grain legume cultivation, and how different legume varieties behaves under various soil and climatic conditions. The importance of education and extension services to farmers' knowledge is emphasized in a study by Abtew et al (2016), where these factors contributed significantly to farmers knowledge of grain legume pest management. In a doctoral thesis by Bergeå (2007) the interactions between farmers and advisory services is investigated in a Swedish context, which emphasizes the need for face-to- face interactions in advisory encounters, and for advisory services to become more participatory. As previously stated, the farmer that had some experience in grain legume cultivation mentioned that he believed that the advisory services in the region did not have sufficient knowledge on legume cultivation to support the farmers in terms of grain legume production for food [G5]. Another farmer in this study further stated that he believed that the current advisory services provided by Orkla and HIR did not visit the fields often enough, compared to his experiences with other advisory services, and that the need for sufficient advisory services that were present out in the fields was even more important with the cultivation of a new crop where he had limited previous experience himself [G3]. This indicates the need for improvement of advisory services in terms of grain legume cultivation under Swedish conditions, and making knowledge available to farmers, especially when expanding the production to areas where the farmers have little or no previous experience of grain legume cultivation.

> P1:"Taste is very important, we want to deliver products that tastes good. No matter how healthy and environmentally conscious it is, it won't stick if it doesn't taste good."

> P2:"But the taste is really the most important aspect. That is, the bread has to taste good otherwise it won't sell. That's just the way it is."

Taste, texture, and the protein and nutrient content of different varieties where important factors according to the processing industries, to be able to develop products based on grain legumes (table 2). When discussing what a desirable texture entails, it mainly depended on the area of use according to the informants, for example if were to be used as a component in a soup or as the base ingredient in a vegetarian burger. Overall, specific taste and consistency that could be desirable in a grain

legume variety needs to be tested in market research and in a context of product development. Another important grain legume property according to Fazer more specifically, were the baking qualities. The company only have experience working with beans, and do not know anything of the baking qualities of peas and lentils, but seemed open to look further into the possibilities of using peas and lentils as well in their products. The protein and nutrient content in the grain legume variety were also important to the informants from the processing industry, and seemed especially important to Fazer, as one of their main purposes of including grain legumes in their products were to improve the nutritional composition in their breads [P2]. The informant from Fazer also mentioned that it would be good if the variety is possible to get a hold of from other suppliers, if their own supplier cannot deliver, from imports or preferably from native producers. When asked if there is any legume variety that they would be less inclined to incorporate in their products, Soybean was mentioned. Mainly because they have some issues with allergens in soybeans, but also because of the negative associations in terms of environmental impacts of soybean production [P2].

During the interviews with the representatives from KÖTP and Vara, the informants were asked if there were any specific grain legume varieties that they thought would be especially suitable to expand the production of in Southern parts of Sweden, for human consumption. Vara, that has long-term experience of faba bean production, and KÖTP, sees great potential in expanding the area of cultivation of faba bean for food production in southern Sweden. Partly because of the high protein content compared to for example peas, but also because there are a lot of knowledge and experience in faba bean cultivation amongst Swedish farmers, and the crop has proven suitable to grow under the Swedish climate and soil condition [P4, P5]. Faba bean is further considered as less demanding in terms of soil, climate and cultivation techniques compared to common beans, and is therefore probably easier to establish a cultivation of faba beans in a new area [P5].

Evaluating the Qualitative Research

As the process of social research is influenced by several factors, this section will focus on discussing the choice of methods and some of these factors, in the context of how and to what extent they may have influenced the results of this study. A lot of thought was put into the choice of methods in the planning stage of this study, to choose methods suitable for the purpose and objectives of this study, and that was possible to carry out considering the time frame and my limited experience in qualitative research methods. Purposive sampling methods were applied as it seemed appropriate to use, as opposed to randomized sampling methods. This was based on the fact that the study involves particular categories of people to be sampled, producers and key actors from the process industry in a specific region, and because of the fact that there will be no attempt to generalize the results to a wider population, but rather to describe the situation in its specific context (Bryman 2008). The interviews with the representatives from the food industry were performed face-to-face, as this was seen as a more thorough way of collecting information compared to telephone interviews, as it is possible to also read body language or facial expressions, increasing the possibilities of interpreting the responses of the interviewee and also making it easier to "read the room" and ask the right questions to get the interviewee to open up (Bryman 2008). The producers were interviewed by telephone, mainly because it is less time consuming both for the interviewer and the respondents, to increase the chances of participation as the producers at the time of the interviews were very busy, and also to be able to perform as many interviews that was necessary within the time frame of the study to reach a point of saturation in the information that was given (Bryman 2008). According to Boyatzis (1998), thematic analysis can be used in all stages of research, but is believed to be especially useful in the pilot stage of a project, as the thematic analysis enables the researcher to explore a variety of information as an inductive beginning of the inquiry process.

Thematic analysis was further believed suitable to apply to this study because it is believed to facilitate communication with a broad audience, making it more comparable to other qualitative studies performed with various methods and within different research fields (Boyatzis 1998). This was considered especially important when doing a qualitative research study within an agroecological framework since agroecology encompasses many different disciplines and areas of research.

The sample size of this study is believed to be adequate, as the purpose of this study is not to make a complete evaluation of the expansion of grain legume production, as such an objective would have to involve other aspects of the system that was not included in this study. The purpose was rather to improve the understanding of the preconditions and perceived challenges brought about by producers and the food industry on the subject of expanding the grain legume production in southern Sweden. The broader the scope of the study, the more heterogeneous the sample is, and the more comparisons that are made between groups within the sample, the larger the sample size needs to be (Bryman 2008). In this study, no comparisons are made between groups, and the scope of the study has been designed to fit the time frame of this project. One strength of this study is the involvement of different stakeholders in the study, although a possible error in terms of obtaining a representative sample is that the respondents that agreed to participate in the interviews may not be completely representative, as it is a possibility that only the highly-motivated ones agree to participate. This could be a potential bias to the results, especially when discussing producer motivations and interests. However, when inviting producers to the telephone interviews, it was not difficult to get people to participate, only a few chose not to participate, and the reasons that was given for not participating was either; 1) because they had recently gone through a generational shift, in that case the person referred to their child/children that had taken over the responsibility of the farm, 2) that the farm was very small and highly specialized, or 3) that the farmer that was contacted had no say in the future crop rotation on the farm, because the farmer was in the process of retiring within the near future. In the second and third case, the farmers argued that they did not feel like it was relevant for them to participate, and that they had little to contribute with, as they did not have the possibilities of including grain legumes into their cropping systems.

One challenge with qualitative research, is that it is influenced by a complex environment with constantly changing variables, and based on personal values and beliefs of the informants, making it difficult to verify the results. Reliability and validity are mainly discussed in relation to the quality of quantitative research, but it can also be relevant when making an effort in trying to evaluate qualitative research (Bryman 2008). An important aspect of reliability and validity is the dependability of the result, for example by keeping complete and detailed records of how the study was conducted (Bernard 2006). To increase the dependability, the materials and methods section has been written with the intention of giving a thorough description of the process of performing this research project, to ensure complete transparency. Another important aspect of reliability is that the findings correspond well with the perspectives and experiences of the respondents (Bryman 2008). Reliability is therefore very dependent on the skill of the researcher to ask the "right" questions, that are interpreted correctly by the interviewee, and to interpret and analyze the responses as they were intended.

External validity is more about to which degree the study is replicable, it is however impossible to make a complete replicate of a qualitative study because of the implications of the social setting and circumstances surrounding the study at a given time. In qualitative research, the importance of external validity is more that of replicating the social role of the researcher, and being able to generalize across different social settings, which is often a problem for case studies and qualitative, in-depth studies with small samples (Bryman 2008). As the goal of this study is more to provide depth to the issue in this specific context, the possibilities to transfer or relate the findings to another

context is limited, and irrelevant within the scope of this study. Therefore, external validity will mainly be discussed in terms of choosing the accurate methods and instrument to investigate the objectives of this study (Bernard 2006), which has been covered previously in this section when discussing the choice of methods. According to Bernard (2006) validity is often based on consensus amongst researchers, by choosing to design the research according to what other researchers in the field agrees to be appropriate for this type of study and research question, it is most likely a valid instrument or method for the specific measurements. The study has been designed using widely applied methods and methodology within the research field, and the design of the study has been developed in agreement with supervisors that are well experienced within the specific research field.

Internal validity is about succeeding in linking the study observations with the theoretical ideas or concepts they develop. In qualitative research, one way of ensuring internal validity is to ensure good practice when performing the study. I have no previous experience of performing similar studies as a researcher, which may influence the quality of the study. However, I have been supported in my work from well experienced supervisors. To further ensure validity, another technique frequently used in qualitative research is respondent validation, to ensure that the views and beliefs of the respondent are correctly reflected. This was done throughout the interview process of this study, by verifying my thoughts and interpretations by for example repeating some of the impressions I had during the interviews, for example by telling the informant that "I get the impression that… ", and waiting for a validation or a correction. The interview guide was also altered continuously thorough the study by removing, adding or changing the questions to make sure that they were easily understood and resulted in information that was relevant to the study. To further verify my interpretations, the main findings were presented to the key actors that were interviewed from the processing industry. One difficulty with respondent validation is that it may cause defensive reactions amongst the participants, and even censorship (Bryman 2008). In this study however, when informing the participants from the food processing industry that they will have a possibility to read through the main findings from the interviews, they seemed relieved and more prone to speak freely, rather than becoming defensive.

Two important aspects of performing qualitative studies is to ensure maximum objectivity, and minimize the projection of own beliefs to the respondents, to make sure that the results reflect the actual views of the interviewees. Complete objectivity is unreachable, as the background, values and beliefs of the researcher will always have some effect on the design and outcome of the study (Bryman 2008). However, it is important to be aware of the importance of objectivity throughout the study, and to make sure that the feelings and competencies of the researcher is not projected onto the people being interviewed, and read into the raw information (Boyatzis 1998). To achieve this, it is important to be aware of your own experiences, opinions and values and try to critically assess "if I have seen what I wanted to see or what is really out there" - Bernard 2006, something that was done continuously throughout the study. The risk of affecting the outcome of the research by projecting increases if one person is encoding the information, by limiting the array of perspectives when interpreting the patterns. This can be prevented by developing explicit themes that are used consistently when analyzing the results (Boyatzis 1998), which was done in this study. Consistency when analyzing the themes, meaning that the encoding is performed in the same or similar way independent on when the analysis is performed, is important, and is facilitated by having a detailed description of what the different themes entail. Another way of preventing projection of the researchers own values and beliefs to the results is to have several people encoding the information (Boyatzis 1998), that was however not possible in this case since it is an individual thesis project. However, for the interviews with the industry representatives, the interviewees was allowed to read a draft of the results section of the thesis before publication, to make sure that their views and thoughts was not misinterpreted.

The results of the study rely on the fact that the informant answers are the precise, or close to, truth, when in fact it may be far from. Informant accuracy is difficult to assess, and inaccurate responses may arise from several different reasons, for example that they simply do not remember correctly, some things are easier to remember then others, or that they try and answer all the questions that the researcher asks, even though they might not understand what the researcher is after (Bernard 2006). People often tend to manipulate any social encounter to their own advantage, resulting in exaggerations or minimizations depending on the situation, and people can generally be expected to overreport socially desired behaviors and underreport social undesirable behaviors – also called the social desirability effect (Bernard 2006). I tried to limit the social desirability effect by formulating the interview questions, so that they are not leading, to avoid that the respondents can read any value into them. As been mentioned previously, when it comes to interests and attitudes towards an increased production of grain legumes, there are some risks of informants being overly positive, because they might think that is what the interviewer wants to hear. To work against this, the respondents were asked questions about the perceived challenges and how they may affect their desire to start cultivating grain legume production, also lifting the negative aspects. At the beginning of the interview, efforts were made to clearly state the objectives of the study, and that the purpose of the interview involved exploring different views on the matter, and that their individual experiences and thoughts were very valuable. As one of the objectives of the study was to investigate the preconditions of an extended cooperation between Orkla and their contracted farmers, the outcomes of the study could be beneficial to both parties in terms of expanding the current production and improving the relations, by portraying the current relationship different from what it really is will not serve the purpose and the results will be less useful also for the participants. Another important aspect of making sure that the producers would feel comfortable enough to be honest in their responses, was making sure that they were anonymous. This was more difficult with the processing industry since they are all part of the project NLF and therefore the companies were not anonymous even if the individual representatives are unknown to the reader. The risk of the participants not being completely honest with their answers are therefore potentially higher amongst the industry representatives, and some topics are more likely to be affected by this than others, for example the motivations and interest are likely to have been exaggerated to some extent, and maybe also altered to give a beneficial reflection of the company brand. The challenge of dishonesty or the social desirability affect is difficult to completely eliminate and should therefore always be taken into consideration when interpreting results based on interview studies.

During the telephone interviews, although the quality of the sound was good, sometimes bad reception resulted in breaks in the recording and missing out on single words or sentences. Although this only occurred at some occasions, there could be some information missing from the interviews, as the breaks in sound was not noticeable during the interview but emerged when transcribing the material, hence there was no possibility to for example ask the respondent to repeat the sentence. Fortunately, a short summary was written directly after the interviews containing the main points or topics that were discussed, as well as personal reflections of the interviewer that emerged during the interview. Therefore, any missing data would probably not have any significant impact on the overall results of the study. As the interviews were performed in the native language of the respondents, Swedish, the results from the study were translated, and are therefore not an exact word-for-word presentation of the interview. However, factors like recording the interview and performing the transcription and translation within a short time frame after doing the interviews, and also having thorough understanding of the English and Swedish language, as well as the Swedish customs and culture, greatly improves the chances of providing an adequate translation as well as capturing tacit information and nuances in the responses of the interviewees.

Conclusions

Improving the current food systems are a complex matter, and it is a challenge to recapture knowledge that has been developed over centuries of agricultural practice and experience, and connect this accumulated knowledge in cultivation practices with the functional efficiency of natural systems, and new technology (Francis et al 2003). This study has illustrated the importance of collaboration and communication between different key actors in the food system, when developing a complex food system that promotes other services besides the provision of food and fiber. The insights from producers and key actors in the food industry presented in this study can hopefully contribute to the sustainable development of Swedish cropping systems and the expansion of the domestic grain legume production for food, and might also be used as guidelines when moving forward with the NLF project.

The implications of the results presented in this study differ between different legume varieties, in this specific context. Based on the insights from the farmers and the key actors from the food industry, the possibilities of expanding the faba bean and pea production in southern Sweden for food is believed to be rather high in general, as there are a lot of experience of successful cultivation in various areas in the southern regions of Sweden, and no investments in special machinery is needed to expand the production outside of the current areas of production. Previous research has shown a high suitability of faba bean to include in food products in terms of protein and nutrient content, and that the nutritional values can be further increased by fermentation of faba bean flour, or by germination of dried faba beans (Chandra-Hioe et al 2016, Hefni et al 2015. Karatas et al 2017). However, the suitability of the faba bean, or peas, to incorporate in bread and pre-cooked meals in terms of taste and texture needs to be further evaluated. The challenges of expanding the domestic production of common bean outside of the current area of production are believed to be greater compared to faba bean and peas, as the investments are higher in terms of special machinery, and the experiences amongst farmers in terms of cultivation are lower outside of the region of Kalmar and Öland. Considering the challenges of profitability of the processing industry, further favors the expansion of faba beans and peas over common beans as they are more extensively cultivated and more common on the Swedish market today, and it is therefore easier to regulate variations in yield or quality for the food industry.

In a large review covering farmers' adoption of conservation agriculture, it was found that there are no universal variables that explain the adoption of certain management practices or new crops, and the authors concluded that efforts to promote specific practices or crops need to be tailored to the particular conditions of the specific context (Knowler & Bradshaw 2007). Few studies have covered the socio-economic constraints from a producer and processing perspective in terms of expanding the grain legume production for food, but similar patterns were found in a study by Saka et al (2004), where a socio-economic survey with farmers showed that major constraints included profitability, mainly in terms of a low market demand, high costs of labour, low yields, but also an inadequate seed supply. In a study exploring the success factors of adopting legumes, covering all continents, meeting the needs of the farmers, building relevant partnerships, understanding the socio-economic context and skills of farmers, and organization of seed supply where all described as important features for increasing the legume adoption (Shelton et al 2005).

If the results derived from this study were generalizable, there are several steps that needs to be taken for the expansion of a grain legume production for food to be successful in southern Sweden, such as; i) developing alternative weed and disease practices for grain legume cultivation that is suitable in a Swedish context, ii) solving the issue of investments needed in special machinery and facilities for grain legume cultivation and processing, iii) economic calculations needs to be made on the profitability of a domestic grain legume production from the perspective of both farmers and the food industry, iiii) a functioning communication and cooperation needs to be established around a

grain legume crop between producers and the food industry, iiiii) field trials, product development projects, and research on consumer preference are needed to find suitable grain legume varieties for an expanded, domestic production. On a more long-term basis, new mechanisms to appreciate non-market outputs in a Swedish context needs to be developed to promote a domestic grain legume production, for the environment and society to be able to benefit from the ecosystem services associated with incorporating grain legume crops into Swedish cropping systems. The steps presented can be used as inspiration for future research, and for the development of the NLF project. Future research on the economic pre-conditions of grain legume food production and processing is suggested from both farmer and industry perspectives, field trials could contribute to the development of the grain legume cultivation for food in a Swedish setting, and exploring the market and consumer preferences of various legume varieties could give useful insights on what legume varieties are more or less suitable from a product development perspective.

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Appendix

Appendix I: Here the basic structure of the interview guides is shown. The interview guide further contained interview questions that were prepared for each individual interview, these questions are presented in appendix II and appendix III. The basic structure for the interview guide were similar for all interviews, parts that were specific for farmers (G) or representatives from the food industry (P) are marked respectively.

Interview Guide

Prior to the interview:

- The study was presented

The respondent were then informed:

- that the interview was being recorded
- regarding anonymity*
- that by participating, consent is given to be part of the study
- about the possibility to read a draft of the results before publication (P)
- about the estimated length of the interview

During the interview:

- The interview was recorded
- Notes were taken on general reflections and impressions

The beginning of the interview:

- Can you tell me a little bit about your role in the company, and how you currently work with grain legumes? (P) (varieties/volumes/origin)

// Du får gärna berätta lite om din roll i företaget, och hur ni jobbar med baljväxter i nuläget?// (Sorter, volymer, härkomst)

- Can you tell me a little about your farm and current production? (G)

//Du får gärna börja med att berätta lite om din gård och vad du odlar idag?//

The ending of the interview:

- Is there something else you would like to add or discuss?

//Är det någonting mer som du känner att du vill ta upp?//

- The respondent were asked about being contacted afterwards regarding follow-up questions
- The respondent were asked if there were anyone else he/she thought I should meet (P)
- The respondent recieved thanks for participating in the interview

After the interview:

- The audio recording were checked and copied
- A short summary of main points were written
- The interview guide was revised

Probes:

Would you like to give me an example? Can you develop that thought further? Would you like to explain that a little bit more closely? Is there something else you would like to add? Do I understand you correctly that.. ?

// Vill du ge mig ett exempel? Kan du utveckla det lite? Vill du förklara det lite närmare? Är det någonting mer som du känner att du vill lägga till? Förstår jag dig rätt att… ? //

**The terms of anonymity were slightly different between producers and the representatives from the food industry, see "Materials and methods" for more thorough description of what anonymity entailed for the different actors*

Appendix II: In this table, the interview questions that were prepared for the individual interviews with the representatives from the food industry are presented. Since a semi-structured approach were applied to the interviews, follow-up questions and additional questions were asked as well during the interviews. The questions presented in this table represents only the original questions that were prepared prior to the interviews, divided into themes. The figures in the right margin (P1-P5) shows which respondent the specific question was aimed for, since the interview questions differed between the different interviews.

Interview Questions - The Food industry (P1-5)

Legume experiences

- Are there any challenges with the production today?	P4, P5
//Har ni några utmaningar med produktionen idag?//	
- How are you currenly working with grain legume production, in terms of cultivation practices? (Soil, irrigation, climate, machinery, storage, chemicals)	P5
//Hur jobbar ni med baljväxter rent odlingstekniskt?// (Jordart, bevattning, klimat, maskintekniskt, lagring, kemisk bekämpning)	
- How would you describe the yield stability for the varieties that you produce today?	P5
//Hur ser odlingssäkerheten ut för de baljväxter ni odlar idag?//	
- What other crops are common for the farmers to have in the crop rotations besides grain legumes?	P5
//Vilka andra grödor är vanliga för era odlare att ha i odlingssystemen förutom baljväxter?//	
- Have you experienced any advantages or disadvantages of having grain legumes in the cropping system?	P5
//Har ni upplevt några för- eller nackdelar med att ha baljväxter i odlingssystemen?//	
- What kind?	P5
//Vilka?//	
- Are there any information or knowledge missing within grain legume cultivation that could help make it more succesful?	P5
//Finns det någon information eller kunskap som du känner saknas inom baljväxtodling för att göra den framgångsrik?//	

Increasing the domestic, grain legume production for food: attitudes, percieved challenges and possibilites

- Have you seen any change over time in the demand of grain legumes on the food market?	P1, P2, P5
//Har ni sett någon förändring över tid av efterfrågan av baljväxter på livsmedelmarknaden?//	
- In what way? Why do you think that is?	P1, P2
//På vilket sätt? Varför tror du att det har blivit så?//	
- How are you working to meet this change in demand?	P1, P2
//Hur jobbar ni för att möta denna förändring i efterfrågan?//	
- What possibilities do you see with an increased, domestic grain legume production for food? (Volumes/varieties)	P1, P2, P3, P4, P5
//Vad ser du för möjligheter med en utökad, svensk baljväxtproduktion för livsmedel, med större volymer eller fler sorter?//	
- Do you think that there are any challenges with such a production?	P1, P2, P3, P4, P5
//Ser du några utmaningar med utökningen av en sådan produktion?//	
- What do you hope to achieve, as a company, with an increased grain legume production?	P2, P2, P5
//Vad skulle ni vilja uppnå/vad har ni för mål som företag med en utökad baljväxtproduktion?//	

- Can you tell me a little bit more about what motivates you to look at an increased grain legume production?	P1, P2, P3
//Kan du berätta lite mer om vad som motiverar er till att titta på en utökad baljväxtproduktion?//	
- What are your expectations on the project NLF?	P1, P2, P5
//Vad har du för förväntningar på projektet NLF?//	
- Do you have any other thoughts on potential challenges with using domestic grain legumes in your production?	P1, P2
//Har du några andra tankar kring vilka utmaningar som finns för att använda regionalt producerade baljväxter i er produktion?//	
- How do you plan the production in terms of needs and yield levels with your current crops?	P3
//Hur planerar ni skördarna för de grödor ni har idag?//	
- How do you handle yield variations?	P3
//Vad gör ni om skörden överstiger/understiger prognosen?//	
- How do you go about estimating the yield levels for new crops or new varieties?	P3
//Hur gör ni med skördeprognoser för nya sorter eller grödor?//	
- What do you think of grain legumes in terms of yield stability and yield estimations?	P3
//Vad tror du om baljväxter i förhållande till odlingssäkerhet och skördeprognos?//	
- How do you think grain legumes would fit in the current cropping systems of your farmers?	P3, P4
//Hur tror du baljväxter skulle passa in i era odlares befintliga odlingssystem?//	
- What are you thoughts on new varieties, or potentially handle a greater number of crops than you do today?	P4
//Hur tänker ni kring nya sorter, eller att eventuellt hantera fler sorters grödor än vad ni gör idag?//	
- Are there any specific obstacles that you can think of that could lead to the Swedish grain legume production not being able to meet the increasing demand?	P5
//Ser du några konkreta hinder som riskerar att innebära att den svenska baljväxtodlingen inte lyckas möta en ökande efterfrågan?//	
- Considering the differences in climate and growing conditions between Öland and other parts of southern Sweden, how do you think those factors might affect the cultivation and choice of varities in terms of expanding the grain legume production outside of Öland?	P5
//Med tanke på att det är ett annat klimat och andra odlingsförutsättningar på Öland är i övriga delar av södra Sverige, hur tror du att det påverkar odlingen och sortvalet om man tittar på en utökad baljväxtproduktion även utanför Öland?//	
- Considering your recent expansion in cultivated area of grain legumes, do you think that the market is saturated with what is currently grown on Öland/Kalmar, or are there possibilities also for, for example, farmers in Scania to get into the Swedish market of grain legumes for food?	P5
//Med tanke på er expansion av odlingsmark för baljväxter till livsmedel den senaste tiden, tror du att marknaden är mättad med det som odlas kring Öland och Kalmar idag, eller finns det möjligheter även för till exempel Skånska odlare att ta sig in på marknaden?//	
- What challenges do you think needs to be solved in order for a grain legume cultivation to become succesful, also outside the area of Öland/Kalmar?	P5
//Vilka utmaningar tror du behöver lösas för att en baljväxtproduktion (framförallt bönor) utanför Öland/Kalmar ska bli framgångsrik?//	
- How do you view the role of KÖTP in terms of contributing to an increased grain legume production in for example Scania?	P5
//Hur ser ni på KÖTPs roll i att bidra till en ökad baljväxtproduktion i t.ex. Skåne?//	
- One of the challenges that emerged during the interviews with the representatives from the food industry, was that they currently use grain legumes mainly in a processed form, what are your thoughts on that?	P5
//En av utmaningarna som framkom vid intervjuerna med livsmedelsindustrierna var att de i dagsläget använder baljväxter i en processad form, hur tänker du kring det?//	

- The farmers from the regions of Scania/Blekinge that I spoke with expressed that they have had big problems with birds when cultivating peas and faba bean, is that something that you have had any experience dealing with?	P5
//De odlarna i Skåne/Blekinge trakten som jag har pratat med som har testat att odla ärter och åkerböna hade haft stora problem med fåglar periodvis, är det ett problem som ni har upplevt med era odlingar, och hur har ni isåfall hanterat det?//	

Interactions between farmers and the food industry

- What are your thoughts on an extended cooperation with you contracted farmers, in terms of producing grain legumes for food?	P1, P3
//Hur tänker ni kring ett utökat samarbete med era kontraktsodlare, kring baljväxter för livsmedel?//	
- What are you expectations on such a cooperation?	P3
// Vad skulle ni ha för förväntningar på ett sådant samarbete?//	
- What do you think such a cooperation should entail?	P3
//Hur skulle ett sådant samarbete se ut tror du?//	
- How would you describe the current cooperation with the farmers, and how has it developed with time?	P2, P3
//Hur ser samarbetet med odlarna ut idag, och hur har det utvecklats med tiden?//	
- How would you describe the cooperations with the farmers and the food industry today, and how has it developed with time?	P4, P5
//Hur ser samarbetet med odlarna och industrin ut idag, och hur har det utvecklats med tiden?//	
- Are there any challenges with the cooperations?	P4, P5
//Har ni några utmaningar med samarbetena som det ser ut idag?//	
- How would you like a potential grain legume production to look like in the future, at your company? (Contract-based?)	P2, P3
//Hur skulle ni vilja att en eventuell baljväxtproduktion skulle se ut hos er i framtiden?// (Kontraktsodling?)	

Legume properties

- Do you have any quality-demands on the grain legume produce, what are the demands? (recieve/deliver)	P1, P2, P3, P4, P5
//Har ni några kvalitetskrav på baljväxterna, hur ser de kraven ut? (ta emot/leverera)//	
- In what form can you make use of the legumes? (i.e. is processing needed before delivery)	P1, P2
//I vilken form behöver baljväxterna vara i? (dvs. kan ni ta hand om en hel, nedtorkad produkt, eller krävs det någon form av bearbetning?//	
- Have you already established a contact with a middle-man for processing, or how does it work today?	P1, P2
//Finns det i så fall redan en kontakt med en mellanhand, eller hur ser det ut idag?//	
- Considering your product development, what legume properties are important for you?	P1, P2
//Om man tänker på er produktutveckling, vilka egenskaper hos baljväxterna är viktiga för er?//	
- Are there any specific legume varieties that you are interested in?	P1, P2, P3, P4, P5
//Finns det några särskilda sorters baljväxter som du tycker skulle vara intressanta?//	
- Why?	P1, P2, P3, P4, P5
//Varför?//	

Appendix III: The table shows the interview questions that were prepared for the individual interviews with the farmers. Since a semi-structured approach were applied to the interviews, follow-up questions and additional questions were asked as well during the interviews, the questions presented in this table represents only the original questions that were prepared prior to the interview.

Interview Questions - The Producers (G1-6)
- What are your current experiences in legume production?
//Vad har du för erfarenheter av baljväxter idag?//
- Are they mostly positive or negative?
//Är de mest positiva eller negativa?//
- Any challenges?
//Några utmaningar?//
- Have you experienced any advantages or disadvantages by having legumes in your cropping system? What kind?
//Har du upplevt några fördelar eller nackdelar med att ha baljväxter i odlingssystemet? Vilka?//
- What motivated you to start cultivating legumes?
//Vad motiverade dig till att börja odla baljväxter?//
- Would you consider expanding your current production of legumes? Why/Why not? (Varieties or volumes)
//Skulle du kunna tänka dig att utöka din befintliga baljväxtproduktion? Varför/Varför inte?// (Sorter eller volymer)
How do you think grain legumes would fit into your existing cropping system?
//Hur tror du att baljväxter skulle passa in i ditt befintliga odlingssystem?//
- What made you become interested in legume production?
//Vad var det som väckte ditt intresse för baljväxtproduktion?//
- What are your thoughts on an increased, domestic grain legume production for food?
//Hur tänker du kring en utökad, svensk baljväxtproduktion för livsmedel?//
- Why positive/negative?
//Varför positiv / negativ?//
- Do you think that there are any challenges with such a production?
//Ser du några utmaningar med en sådan produktion?//
Based on your experience cultivating on contract for Orkla */ Baserat på dina erfarenheter av att kontraktsodla till Orkla:*
- What are your expectations on an expanded cooperation with Orkla, in terms of a grain legume production?
//Vilka är dina förväntningar på en eventuellt utökat samarbete med Orkla, kring en baljväxtproduktion?//
- If you were to start/expand your production of grain legumes, is it important to you that it is contract-based?
//Om du skulle börja odla/utöka din odling av baljväxter, är det viktigt för dig att det sker via kontrakt?//
- What information or knowledge is requested, for you as a farmer to feel comfortable (or expand) a grain legume produktion?
//Vilken information eller kunskap efterfrågar du som odlare för att ta steget och satsa på en (utökad-) baljväxtodling?//
- Are there any specific grain legume varieties that you feel would be especially interesting?
//Är det några särskilda sorters baljväxter som du tycker skulle vara särskilt intressanta?//

- Why these varieties in particular?

//Varför just dessa?//

Would you be interested in a more long-term cooperation regarding grain legumes, within the project NLF?

//Skulle du vara intresserad av ett mer långsiktigt samarbete, gällande baljväxter, inom det större projektet NLF?//