Cultivating a Food Conscience: A Case Study of the Oslo Eggshed

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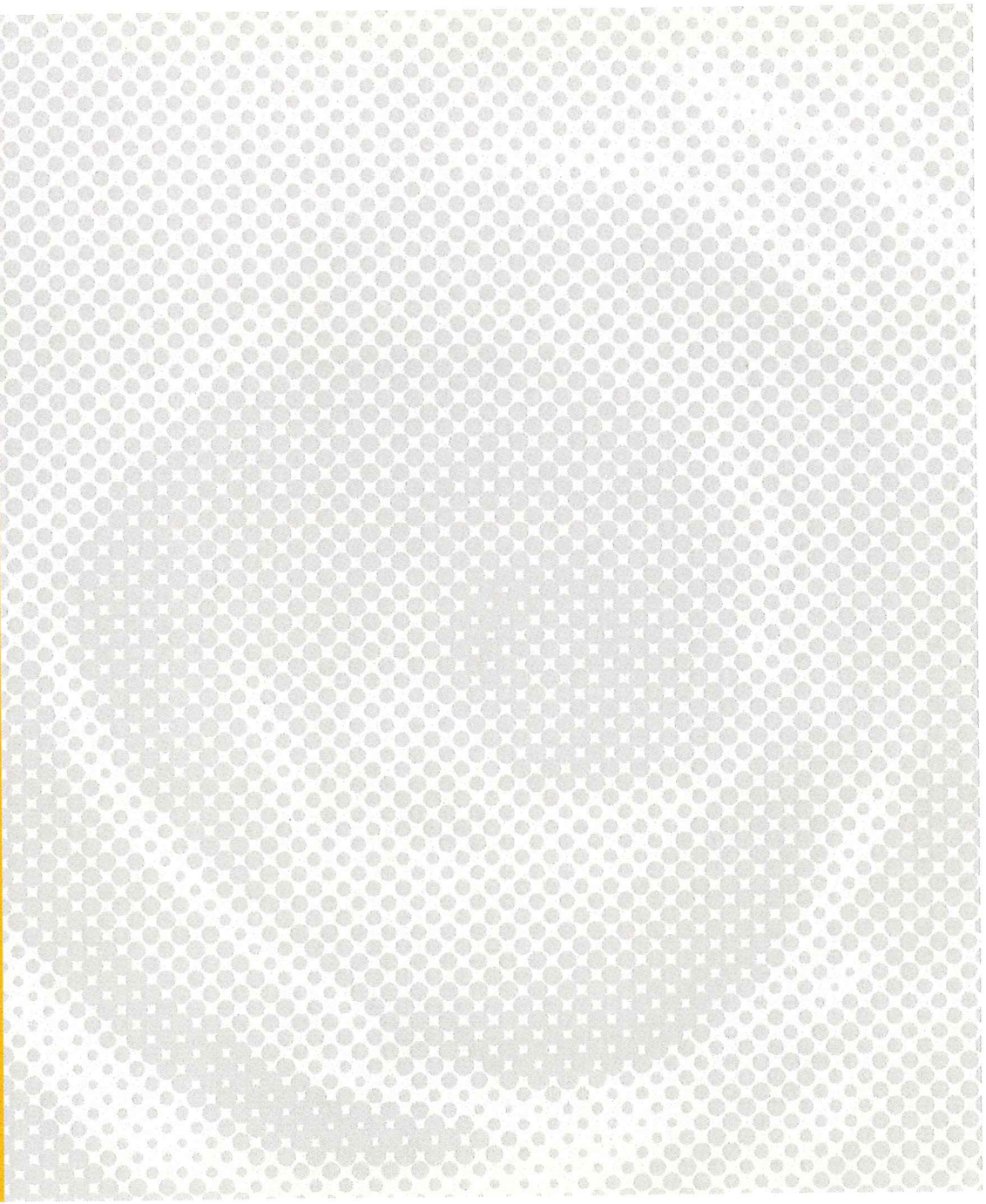

Preface

The purpose of this assignment was to explore how industrialisation has influenced the development of agriculture. The original research idea was inspired by a food system report from Great Britain called "Who feeds Bristol"? The proposal to write a thesis on "Who feeds Oslo?" was launched by Line Tveiten, a previous agroecology student and employee at the Urban Environment agency (Bymiljøetaten) in Oslo. Oslo takes part in the European exchange and learning program, which promotes sustainable urban development (URBACT). The objective is to develop a sustainable food policy for Oslo. The network for sustainable food in urban communities has ten member cities that work towards developing low carbon and resource efficient urban food systems. Three topics are emphasized: growth, delivery and enjoyment. In addition Oslo has added a fourth area: waste. From the initial idea, the research has developed into a foodshed analysis of the eggs sold to citizens in Oslo. Financially support has been kindly given by Bymiljøetaten in order to attend a conference hosted by Norsk Landbrukssamvirke in Oslo, as well as providing an office to work in during the course of the research.

This study explored the flow of feed for the hens and eggs sold in Oslo. A foodshed analysis was implemented with regard to discussing the three perspectives: industrialisation, transparency and agricultural policy.

The research has benefited from a close collaboration with my supervisor, Geir Lieblein, which has supported me with academical input. My external supervisor, Line Tveiten, from Bymiljøetaten in Oslo has contributed with Oslo related information. Kathrine Jensen has developed the design of The Oslo Eggshed as well as the geographical map of the stakeholders in the Oslo eggshed. Benjamin D. Henning contributed with the cartograph of Norway's dependence on import.

Acknowledgements

A special gratitude goes to my supervisor Geir Lieblein for academic support, personal interest and the time spent on developing this research. I also want to thank my external advisor Line Tveiten, for challenging me with reality, Bymiljøetaten in Oslo for providing an office and financial support, Kathrine Jensen for the creative collaboration, Benjamin D. Henning for providing his expertise in cartographs and my student co-workers for feedback and inspirational talks. Thank you!

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"Cultivating a Food conscience: A Case Study of the Oslo Eggshed"

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"Eaters must understand that eating takes place inescapably in the world, that it is inescapably an agricultural act and that how we eat determines, to an considerable extent, how the world is used"

Wendell Berry

Key words: *Foodshed, egg production, animal feed, hen, industrialisation, disconnection, transparency, self-sufficiency, food flow*

Abstract:
This study explores the flow of feed used in egg production and the eggs sold to the consumers in Oslo. The Oslo eggshed is described with the question: "*where* are the eggs coming from and *how* are they coming to us?" with the mean to explore which stakeholders that is involved, where the production is located and how the eggs are being produced. The case study of the Oslo eggshed is then discussed from multiple perspectives. Industrialisation, transparency and agricultural policies are used to analyse the current status of the Oslo eggshed. The findings show that the food system has developed to a high input industry with few big stakeholders controlling the market of eggs. The Oslo eggshed have a lack of transparency and are not entirely aligned with the current agricultural policies.

Introduction

According to Peter Zimmer in Kriener (2001), "the current egg production of a hen corresponds to that of a woman with a menstrual cycle of fifteen hours". His point is not just about food production being dependent on natural cycles, but that these cycles are increasing in time and space. Food is being produced in big quantities over a larger geographical area. With the growing population worldwide, the pressure for a more resource efficient food system is increasing. At the same time there is a growing concern for the environment and demand for a more transparent, socially just food system. The aim of this study is to explore how the hen egg has been, and is, influenced by the agricultural development.

1. Industrialisation

At the end of the 18th century the farmers did not depend on a market to sell their products to the eater. It was a physical interaction that created direct communication with the citizens. The food was produced in local agroecosystems (Harris, 1969) resulting in diets that depended on season, location and tradition. After the industrial revolution a specialized agriculture was developed and traders became important actors (Lieblein et al., 2001). Means of production like fertilizers, machines and commercial distribution of seeds emerged and enabled the farmer to increase the efficiency of food production. These new tools and functions such as transportation and storage, increased the amount of stakeholders between the producer and the consumer from one to multiple (Johansson, 2008). Industrialisation lead to increased productivity through new production methods and varieties, so the provision services of food increased. Before means of production were introduced into the farming system, the farmer took advantage of the ecosystem services present in the farmland.

Increased distances between the farmer and the consumer have created alternative food supply chains, such as community shared agriculture, farmers markets and community gardens (Feagan, 2007). These types of social enterprises have shorter supply chains and physically connect the farmer and the consumer. Feenstra (2002) proposes that these locally based food supply chains can reduce uncertainties about how food is produced. According to the International Federation of Organic Agriculture Movements (IFOAM), an important goal in organic farming is to reduce inputs and circulate nutrients, meaning increased self-reliance. Sundkvist et al. (2005) argue that organic agriculture can therefore tighten the feedback loops, thus creating a more sustainable system. If feedback loops are loose and less direct, they need to be strengthened in order for the institutions to handle large geographical and temporal

distances. If decisions are taken in the higher levels of the food production hierarchy, labelling can be a tool for enhancing communication of environmental impacts of production (Sundkvist et al., 2005). It can be a link between the farmer and the consumer, and thus function as a feedback loop for sustainable development of food systems.

In the 1970s there was a fundamental shift from producer-driven supply chains to buyer-driven chains (Gereffi and Lee, 2012). The geography changed from being a regional production sharing agreement to global supply chains. In the producer-driven supply-chain big corporations integrated several nodes in the value chain, thus controlling the chain according to own need (Gereffi and Korzeniewicz, 2004). In buyer-driven chains it is the retailers that have the powerful role through promotion of mass consumption of strong brand names. The latter is often longer and more flexible in dealing with changes in the commodity flow than the producer-driven value chains (Gereffi, 2004). Because of long history of cooperatives, Norway did not have big retailers until the 1980s when the two retailers Rimi and Rema where developed. Up until 1950 Norway had a law that prohibited a person to own more than one store (Nordahl, 2008).

In the last ten years egg production has increased by 25 % worldwide (Røsnes, 2011). With the fortification of vitamins in feed the hens could live inside (Adler and Lawler, 2012) while advances in nutrition, disease control, processing and breeding lead to low production costs (Boyd and Watts, 1997). In 2004 an international team of geneticists mapped the chicken's genome (Wallis et al., 2004). This provided the opportunity to study the domestication of the specie. Mutation in TSHR (thyroid-stimulating hormone receptor) enabled hens to breed and lay eggs all year (Svemer, 2012). In todays egg production egg laying hens eat 110-115 grams of concentrated feed each day and lay an egg of 63,5 grams six times a week (Hovland et al., 2012).

Eggs are normally produced out of sight for the consumer. Without visiting farms or understanding how the eggs are produced creates a physical as well as a psychological distance. One of the interviewees in the article of Jackson et al. (2009) though chickens were hard to empathize with because they are no longer seen "scratching around on a farmyard". He states that the scale of the industry and the fact that it takes place behind closed doors reduces the visibility of the production, thus separating the consumer from their food. In the same article the product labels are discussed in the context of connection between the producer and the consumer. The labels were designed to give just enough information so the consumer wouldn´t

become "squeamish" (Jackson et al., 2009). The perception of a label has big impact on which product the customer buys in the store. Unable to separate genuinely ethical from market-driven labels, a customer may become lost in the supermarket (Johnston et al., 2009).

2. Transparency

In the 21st century, there have been several incidences of mislabelling food products. Recently there were findings of horsemeat in several products in Europe. The food safety authority of Ireland (FSAI) found horsemeat in frozen beef burgers, leading to the discovery of a pan-European food fraud (O'Mahony, 2013). 50 000 tons of meat was pulled back from a Dutch company because of the findings of horsemeat mixed with cattle in April this year (Mattilsynet, 2013a). Norway had a similar situation concerning mislabelling in the same period of time. 94 out of 195 checked products, were mislabelled (Mattilsynet, 2013c). The Norwegian food safety authority states that to avoid such incidents in the future strict labelling requirements, transparency and traceability is needed throughout the whole food value chain (Mattilsynet, 2013b). When customers buy food products they must be assured that the food they buy has been processed and produced in specific ways (Watts et al., 2005). However the lack of first-hand knowledge can lead to opportunities of, what Karl Marx described in his book "Capital: Critique of political economy", as commodity fetishism (Johnston et al., 2009). Strategic narratives like local, family stories or linking the product to a geographical area can all give an illusive view of the product. The customers may think undertake conscious food choices, but might not be given enough information in order to truly do so. In some cases this can be a strategic choice of the processors. The poultry buyer, Cathrine Lee, mentioned in the article of Jackson et al. (2009) that their company don't provide much information about production, and slaughtering conditions to the consumer because the "customers don`t want to know that at all". When having access to information about food, production wise or geographically based, the customer can take a more conscious food choice, thus voting with their fork.

Transparency is being used as an instrument for protecting civil rights and improved public services (Fung et al., 2002). One might say that a civil right is to knowing the origin of the foodstuff, but in the case of Sweden it is not. The transparency in the Swedish food system changed after they joined the EU, as foodstuffs are imported through the EU, the countries of origin are not a part of the import statistics. The result has been unawareness on how or where their imported food has been produced (Johansson, 2008).

Fig. 1 shows the conceptual model developed by Vittersø et al. (2004), which describes the food system as a dual layer. The two horizontal layers are distinguished between food flow and the actors in the food system. Feedback loops are present if the information flows is the circular movement, thus being a part of a transparent food system. This model can be used to describe the coherence between the food flow and the decisions taken by the stakeholders. In an ideal world there would be coherence between the two layers, though this is not always the case. Both horizontal and vertical transparency has to be present in order to have a sustainable system. The vertical transparency can also be called chain-transparency because it is the requirements and legislation from all stakeholders in a specific supply chain that is needed. The horizontal dimension is about each company giving information to other stakeholders and consumers concerning their measures and policies (Wognum et al., 2011), this signifying the relationship between the two layers.

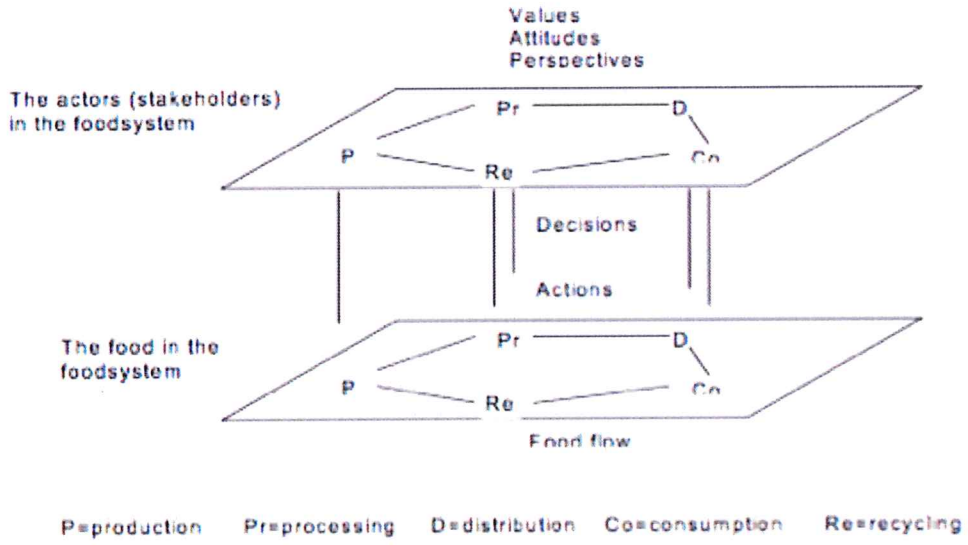

Figure 1: The food system as a double layer consisting of the food flow (lower layer) and an actors layer concerning values, knowledge, information flow (Vitterso et al., 2004).

3. *Agricultural policy*

Food security is on the top of the agenda in the United Nations. In 1996 the World Food summit defined food security as "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life" (Food and Agriculture Organisation, 2006). Because of the growing population worldwide, ensuring food security is high on the agenda for government policy.

The Brundtland commission defined, in 1992, sustainable development as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Since then political strategies and policies have been developed to reach this goal in almost every aspect, and the Norwegian Ministry of Agriculture and Food (LMD) is no exception. In 2012 LMD developed the Norwegian Agricultural and Food Policy Paper which involves four objectives: food security, agriculture in every part of the country, increased value added and sustainable agriculture (Landbruks- og Matdepartementet, 2012). The policy states that the resource management should, as far as possible, be based on Norwegian resources.

The total area of Norway is 323 780 km^2, of which 3 % is agricultural land. Because of limitations in productive land for food production, the government emphasizes the importance of soil protection. There is a policy that limits the conversion of agricultural land to other purposes to less than 600 ha per year. Further the policy emphasizes that the grassland should be conserved through profitable, grass-based food production.

In the interwar period there were established regulations for import because of difficult financial times for the Norwegian farmers. The state took control over the grain import, thus securing the Norwegian farmer a minimum price. In the 1930s, the government also passed two other laws that regulated the food market. One was the turnover-law that would regulate the prices given to the farmers regardless of geographical origin. The other law on import regulations would stop the import of all other foods than those it was a deficit of (Landbruk og Matdepartementet, 2005). In spite of this regulation Norway imported agricultural commodities with the value of 35 billion NOK (Norwegian kroners) in 2010, twice as much as ten years ago (Landbruks- og Matdepartementet, 2012).

After the 2nd world war, almost all the Norwegian agriculture was mechanized and the use of fertilizer and concentrated feed were high. The number of animals and fields had increased accordingly. The amount of farms with over 2 ha almost quadrupled from 1949 to 2004, while smaller farms less than 0.5 ha, decreased from 150 000 to only 7400 (Syverud and Bratberg, 2013). In 1979 Norway had about 125 000 farmers. In 2012 this had been reduced to around 44 500 (Statistics Norway, 2013c). This development is illustrated in fig. 2.

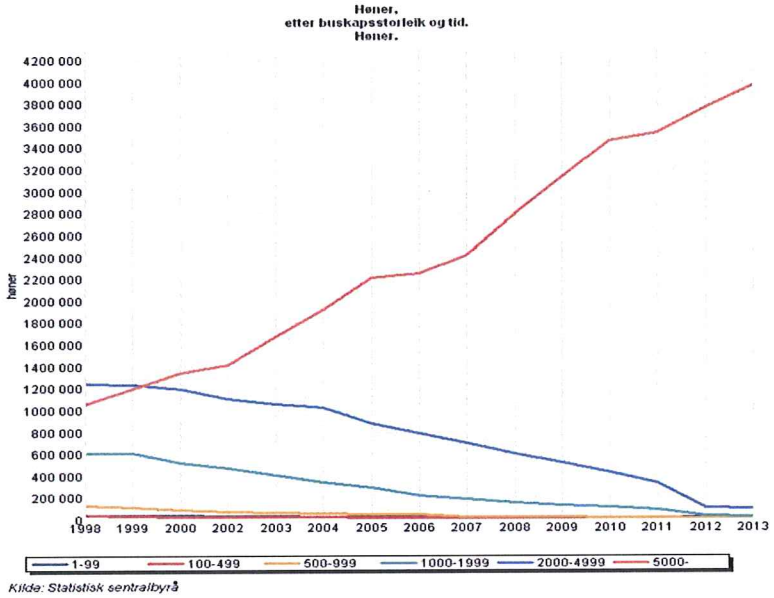

Figure 2: The number of hens per farm over time (SSB 2013, table: 03806)

Purpose and Research questions

The purpose of this study is to explore how industrialisation has influenced the development of agriculture. The study has explored the flow of hen feed and eggs in the Oslo eggshed by answering the question: "*Where* is our food coming from and *how* is it getting to us?" The result will show *who* provide Oslo with eggs, *where* it is produced and to some extent *how* it has been produced. The Oslo eggshed has been analysed with the perspectives of industry, transparency and agricultural policy. The following questions have been answered through a foodshed analysis:

1. To what extent has the production, packaging and distribution of eggs become industrialised in Norway?
2. To what extent is transparency a feature in the Oslo eggshed?
3. To what extent is the current egg system in Norway aligned with the Norwegian agricultural policy?
    a. Food security
    b. Sustainable agriculture

Methodology

A case study approach was adopted since case studies can redraw the essence of complex contexts without the need of any other related cases (Andersen, 2013).

A foodshed is a conceptual framework, developed from the geographic concept of a watershed. The foodshed as a concept is starting to gain recognition (Ilieva, 2012, Johnson, 2008, Kloppenburg et al., 1996, Peters et al., 2009) thus creating foodshed analysis for describing local food systems. The methodologically task of this research using foodshed analysis was to answer Getz`s question: *Where* is our food coming from and *how* is it getting to us, by measuring the flow and direction of eggs together with its quantitative and qualitative transformations (Kloppenburg et al., 1996).

The city of Oslo is the geographic starting point for the foodshed analysis. The analysis has described the sources of egg production beyond its "place" as a commodity, describing the flow of animal feed from the fields abroad, being transformed to an egg-laying hen that provide eggs to the Oslo citizen. Arthur Getz described the foodshed as "the area that is defined by a structure of supply" (Kloppenburg et al., 1996). A regular commodity chain analysis will only map the flow of the commodity itself. In the book by Gereffi and Korzeniewicz (2004) define the commodity chain as "a network of labour and production processes whose end result is a finished commodity". The intention of a foodshed is to map the flow of food, documenting the quantitative and qualitative transformations from the source of production until it ends with the consumer (Johansson, 2008). While some foodshed studies measure how a geographical area is provided with food, this study has explored the eggshed with the aim to find the source of the eggs. By following the eggs I have found the stakeholders involved and gathered the relevant quantitative information. In this research I have not explored anything beyond the actual flow of eggs.

Operational definitions

The three perspectives have been discussed with regard to three questions answered through the exploration of the Oslo eggshed: *Who* provide Oslo with eggs, *where* is it produced and *how* is it produced?

1.Industrialisation

According to Rhodes (1993), Breimyer is said to describe industrialisation as the "swing from an agriculture based on fixed land resources to one based largly on manufactured" ones. The production of animals went to large-scale and there was a

growing relationship between producers and agri-businesses (Rhodes, 1993). This study discusses the results in relation to this definition.

2.Transparency

Transparency literally means see-through and describes the characteristic of a material that lets light pass through it. The term has been adopted in social sciences to emphasize more openness and communication. Transparency is a phrase that can have different meanings depending on the reader and the context. In this research it describes the *availability of information in the Oslo eggshed*. As a customer it is reasonable to get information about the geographical location of the egg production, animal welfare and feed given to the hens. One would expect this information from a farmer, so it is reasonable to expect the same information from the stakeholders in the Oslo eggshed. Wognum et al. (2011) describe transparency as the degree of shared understanding of the access to product-related information and how this information is supplied without noise or delay. This study discusses the result in relation to what extent information about the Oslo eggshed was available or available without access.

3. Agricultural policy

In this study the Oslo eggshed is discussed in relation to the agricultural policy goals in Norway. The goals of food security and sustainable agriculture were chosen because they relate to the purpose of the foodshed analysis of assessing the self-reliance and environmental impacts.

Method

The study uses an explorative and descriptive research method of a case study. As Yin (1989) describes, there are six sources of evidence in case studies: Documentaion, archival records, interviews, direct observations, participant observation and physical artifacts. This study uses documentation and archival records. Methods for obtaining information from the Oslo eggshed include personal correspondence through e-mail and phone as well as online reports, newspapers and official documents.

Stakeholders related to the Oslo eggshed were contacted, such as the six egg packaging facilities (Nortura SA, Cardinal Foods Ski AS, Jonas H. Meling AS, Toten eggpakkeri AS, Jæregg AS and Rias Pakkeri AS), importers of ingredients to concentrated feed (Fiskå Mølle AS, Strand Unikorn AS, Felleskjøpet Agri SA, Felleskjøpet Rogaland SA and Denofa AS) and public institutions (Statistics Norway

(SSB), The Norwegian Agricultural Authority (SLF) and The Norwegian customs authority) in order to receive statistics and reports related to the Oslo eggshed. This was done from February throughout April. Research started by describing the food system in Oslo in order to answer the question: who feeds Oslo? To narrow the topic further research only included eggs from the beginning of March.

This study has gathered information involving eggs sold to the customer in the store. The specific flow of eggs delivered to catering, hotels, restaurants or public kitchens are not explored, as these eggs mainly go through other wholesalers than mentioned in the Oslo eggshed. Eggs sold through farmers markets and other direct supply chains are incorporated in the "direct sales" illustrated in Fig. 3, but have not been explored further.

The egg packaging facilities were asked where they sold their eggs, which brand they produced and for which retailer, how many tons of eggs they received from their farmers each year, how many farmers they received eggs from and the location of the egg farmers. E-mails were sent to all of them and phone calls were used to follow up unreplied e-mails. Because of some miscommunication with the wholesaler, "Den Stolte Hane", information was found through other sources, such as the market share through SLF and the brands produced from the stores.

In order to map the different brands and type of eggs available on the market, a field visit to the food stores in Oslo was conducted. If unknown brands were found, the packaging facilities or farmers producing these eggs were contacted, in order to find their place in the Oslo eggshed.

Which importer that imports what to Norway, is not public information. But because imported carbohydrates are sold in quotas, the importers of these ingredients were defined. Four main importers were identified as well as several small ones importing less than 1 %. The companies are listed in Appendix 1. Through conversations with both SLF and customs authority, I was told that these signify the main importers of fat and proteins as well. The importers, which are also processors of concentrated feed, where asked the following questions. 1) What kind of ingredients do you put in your hen feed? 2) From where do you import the hen feed ingredients? 3) How much of these does your company import? The processors did not answer question 2 and question 3 was not public material. Through a newspaper article written by Ekern (2013a) in the beginning of March, I became aware of the importing company called Denofa that imports soybeans to Norway. They were asked how much of their

import is being used for concentrated feed, which companies they sell their soybeans to and which commodity number they import the soybeans to Norway through. The last two questions were not answered.

The dual layer model (Vittersø et al., 2004) is describing the system perspective in this study, where the food system is described as two layers. The fist level is the flow of food from production, processing, distribution, consumption and recycling while the second layer are the stakeholders involved. The objective was to identify the flow of eggs and explore which stakeholders that were involved in this flow.

Key persons in SSB and SLF were contacted in the start of April in order to get quantitative numbers that could support the quantitative information received from the packaging facilities and importers. The validity of the information could then be controlled (Yin, 1989). Quantitative information was gathered from SLF, SSB, newspaper articles and the research centre called Animalia. The amount of concentrated feed sold to the hens of Norway was calculated using numbers obtained from Animalia. The number of eggs produced in Norway was gathered from SLF, the number of farmers and hens from SSB, the amount of waste from hens and eggs from newspaper articles and Østfoldforskning, the percentage of organic eggs from SLF and the number of eggs consumed in Norway from Animalia. These are all numbers that applies to all of Norway since there was no specific quantitative information only for Oslo. The numbers of eaten eggs in Oslo were therefor calculated to fit the number of citizens in Oslo.

Quantitative information from SLF on concentrated feed ingredients was separated between import and national origin. The document considered the soybean flour as partly Norwegian and partly imported, even though all is imported. The reason was explained by SLF as to distinguish the soybeans being imported as flour and soy imported as whole beans. Denofa imports whole soybeans and "crush" them to flour after the arrival to Fredrikstad, Norway. Since this study explores the origin of ingredients and not its form, the table has been re-calculated as described in Appendix 2. The new numbers were used throughout the study.

At the end of April further inquiry about the origin of hen feed was started. Based on the answer from the processors regarding ingredients in hen feed, four crops were chosen. The amount of imported commodity was gathered from SSB and the statistics table number 08801, "External trade in goods by commodity number and country". Through multiple conversations and e-mail correspondence with the

customs authority, SSB and SLF, commodity numbers were identified. The customs tariff described the type of commodity imported and customs needed to pay for importing it. When knowing the commodity number, SSB could be searched in order to state the amount that had been imported and the countries of origin.

The concentrated feed ingredients could be imported through several commodity numbers, depending on the form and use after arrival. SLF and the Norwegian customs authority were contacted to underpin the choices made regarding commodity numbers.

The following commodity numbers where used for calculating the amount of import and the countries of origin of the four ingredients. Appendix 3 shows the amount imported of each crop.

Commodity	Commodity number
Maize	10.05.9010
	11.03.1310
	23.03.1011
Wheat	23.02.3000
	11.09.0010
Soy	12.01.9010
	12.01.9090
	15.07.1010
	23.04.0010
	23.04.0090
Oats	10.04.9000
	11.04.1200
	11.04.2200

Table 1: Commodity, with its corresponding commodity number (Source: The Norwegian customs service 2012)

The amount of imports found with SSB for each of the commodity numbers, were compared with the document received by Schjøth (2012b) in SLF in order to increase the credibility of the data. The Brazilian Statistics institute (IBGE) was used to calculate the amount of land needed in Brazil to produce the soybeans utilized in Norway.

A program called WorldMapper was used to present the countries of origin for the hen feed (Fig. 4). The cartogram was produced on the basis of the amount of commodities imported (Appendix 4). The geographical map of Norway in fig. 5 was produced in a program called InDesign. A basis map from SSB showing the number of farmers in each county in Norway was utilized as a basis map. Collected material from the importers and the packaging facilities was plotted in this map. The map shows the geographical location of egg farmers, the packaging facilities, Denofa and the hen feed factories in Norway. In order to find out which factories that produce hen feed, the four concentrated feed importers (Fiskå Mølle AS, Felleskjøpet Agri SA, Felleskjøpet Rogaland Agder SA and Strand Unikorn AS) were contacted in the beginning of June. InDesign was also used to illustrate the Oslo eggshed. The description of flow of eggs between the packaging facilities and the consumer was sent to each packaging facility in order to receive feedback. "Cardinal Foods Ski AS" and "Jonas H. Meling AS" did not respond to this e-mail.

Assumptions made about the Oslo eggshed

This study describes where the eggs bought in Oslo come from and how they got there. There are no available numbers on how many eggs the Oslo citizen eat, so I have assumed that they eat the same as the rest of Norway. I have assumed the same for the waste of eggs, since there are only national numbers on how many eggs that are being wasted each year.

The market share for each egg packaging facility was not obtained for Oslo. The packaging facilities didn't have this information easily accessible so it was not received. The market share mentioned in Fig. 3 therefore only applies to the whole country and I have assumed that this percentage also applies to Oslo.

Norway has a quota system for importing carbohydrates for animal feed and this process is public information. For proteins and fat it is not public so there it has not been possibility to contact the importers. I have therefore assumed that the companies that import carbohydrates also import fat and protein for the production of concentrated feed.

Some assumptions have been made considering import of oats. It was not possible to find the exact commodity number for import of oats as animal feed. The commodity can be imported through the three mentioned commodity numbers, but so could other oat variations for non-animal use. Data collected from SLF showed that the

processors used 12 120 tons of imported oats in their animal feed. Data from SSB of the three commodity numbers chosen, showed an import of 35 500 tons. I chose to divide each imported amount by three in order to get a dataset that would match the data of SLF. The calculations are available in Appendix 3. I assume that one third of the amount of imported oats from the selected commodity numbers, is for animal feed.

When calculating the import I have not separated dry matter from the water in the imported commodities even though one commodity might have higher water content than another. I have used the number of tons specified and assumed that all is utilized in the concentrated feed.

Some assumptions were also done considering the import of soybeans. Four commodity numbers were originally used for importing soybeans for animal feed in Norway. Knowing that Denofa imports around 420 000 tons of soybeans each year (Denofa, 2013), the amount in the commodity numbers did not match what was reality. The missing amount was found in a commodity number, not for import of ingredients for animal feed. I have assumed that the commodity number I found was the right one. Denofa has not confirmed that they import soybeans through this specific commodity number. Denofa (2013a) imports soybeans from both Canada and Brazil and exports parts of the import, to Sweden and Denmark. They sell 155 660 tons of soy flour to the factories that produce animal feed in Norway. Since this study was searching for the country of origin of the soybeans and in which quantity utilized in Norway, I did some calculations. I first converted the soy flour to soybeans. Then I knew how much soybeans that were utilized for concentrated feed. Then I calculated which percentage of the total amount that was from Brazil versus Canada. This percentage was then used to define which amount of the Norwegian used soybeans that originated in Canada and Brazil (Appendix 5). In order to find the countries of origin I had to assume that all the soybeans were used in the concentrated feed, even though the soy lecithin were not.

Some further assumptions were made regarding the origin of the hen feed. The hens in Norway eat about 173 500 tons of concentrated feed, calculated by numbers from Hovland et al. (2012). Calculations are described in Appendix 6. Four of the ingredients in this feed were chosen to represent where the feed originates. Vitamins and minerals were not a part of this assessment and the calculation used is based on numbers for all livestock feed, not only hens. One might say that 9 % of the result is for hens, but there are also differences in how much protein, carbohydrates and fat,

which exists in each type of animal feed. This means that there might be more wheat than oats and as a result the country of origin will change. This research has not explored these numbers any further, but assumed that what applies for all livestock, also applies for hens.

Results

Context

In Norway there are 504 farmers that have about 7800 hens each, all-together 4 123 615 hens[1]. Most of these animals don't see daylight and the hens have 1,5 dm^2 each as a free range hen (Lovdata, 2013). There is 4 % mortality among the egg-laying hens meaning 165 000 hens die each year on the production site while 16 000 hens dies under transport (Hovland et al., 2012). Between 1949 and 2011 the hen increased the egg production from 7,3 kg (Almås, 2002) to 20,8 kg (Hovland et al., 2012). In 2013 hens live until they are 76 weeks. Then they produce 15 % less eggs, and are disposed of and thrown away as special waste (Ekern, 2013b).

Description of the Oslo Eggshed

The exploration of the Oslo eggshed is described and visualized in Fig. 3.

(Sources: SLF, SSB, Nofima, Animalia, Jæregg AS, Jonas H.Meling AS, Cardinal Foods, Ski AS, Toten Eggpakkeri AS, Nortura SA, Rias Pakkeri AS)

[1] From table 03806 at SSB
[2] Obtained from table 04415, SSB
[3] Words in *italics* signify retailers

THE OSLO EGGSHED

Countries | Crops | Factories & Importers | Hen feed | Eggs | Egg farmers | Packaging facilities | Brands | Retailers | Consumers

Norway | Europe: 11 523 tons | Europe: 1063 tons | Brazil: 227 153 tons | China: 7066 tons | Europe: 111 903 tons | China: 39 507 tons | Other: 449 tons | Europe: 61 645 tons | China: 31 139 tons | Brazil: 1000 tons | Ivory Coast: 15 624 tons

Wheat: 177 768 tons | Oats: 242 182 tons | Other ingredients | Oats: 12 120 tons | Soy: 210 670 tons | Maize: 134 209 tons | Wheat: 104 939 tons | Other imported ingredients

52 % Norwegian concentrate feed ingredients; 1 002 793 tons

48 % imported concentrate feed ingredients; 853 528 tons

NORWEGIAN 52%

Fiskå Mølle AS 3 factories | Felleskjøpet Agri SA 4 factories | Strand Unikorn AS 8 factories | Felleskjøpet Rogaland Agder SA 1 factory | Denofa AS 1 factory

IMPORTED 48%

4,1 million hens

173 500 tons of hen feed

WASTE 2,3 million hens

1959 egg farmers
61 758 tons of eggs

58 095 tons of eggs
3,5 % organic
470 egg farmers

3663 tons of eggs
Direct sales

17 farmers 1025 tons | 21 farmers 2508 tons | 80 farmers 12 456 tons | 10 farmers 1173 tons | 332 farmers 40 094 tons | 10 farmers 838 tons

Opdal Gård | Ek Gards-pakkeri | Vingulmark | Tjamsland Gård | Holte Gård | Korsvold Gård

2 % | 4 % | 22 % | 2 % | 69 % | 1 %

JÆREGG | JONAS H. MELING A/S | CARDINAL FOODS | TOTEN EGGPAKKERI | nortura | Rias

Økern grossister | Den Stolte Hane

Ek Gardsegg | Tjamsland Egg | Korsvold Økologisk

Solvinge | God Frokost I love eco Farmen | Coop Solskinns-egg | Toten egg | Jacobs økologiske gårdsegg | X-tra | Prior Egg Solegg | Norske Gårdsegg | Vingul-mark | Holte Gårdsegg

Jæregg | Godt kjøp | Den Stolte Hane Gårdsegg | Anglamark | Smak Forskjellen | Go Eco | First Price | Kløver Egg

Catering and Industry | Foreign Shops | Rema 1000 | Hakon-gruppen | Coop | Norges-gruppen | Lime | Bunnpris | Health Food shops | Gutta på Haugen

310 500 eggs are consumed in OSLO per day!

WASTE 4400 eggs per day in OSLO

FIG. 3

The flow of eggs starts in 27 different countries (Appendix 4) and one of the countries Norway import soybeans from is Brazil. For all the countries, see Appendix 4. In Monte Grasso, Brazil, the production of soybeans is almost 3 tons per ha (Brazilian Statistics Institute (IBGE), 2013). Since Norway imports 227 153 tons of soybeans from Brazil, the land used for our consumption of soy in Norway signifies 75 718 ha of land, which equals 8 % of the total Norwegian agricultural land (989 193 ha[2]). Fig. 4 illustrates the countries Norway import concentrated feed ingredients from, resized according to the amount of imported feed from each country. Maize and soybeans are not produced in Norway, so the two crops are 100 % imported. Wheat and oats, on the other hand, is mainly from Norway with some imports from Europe and China.

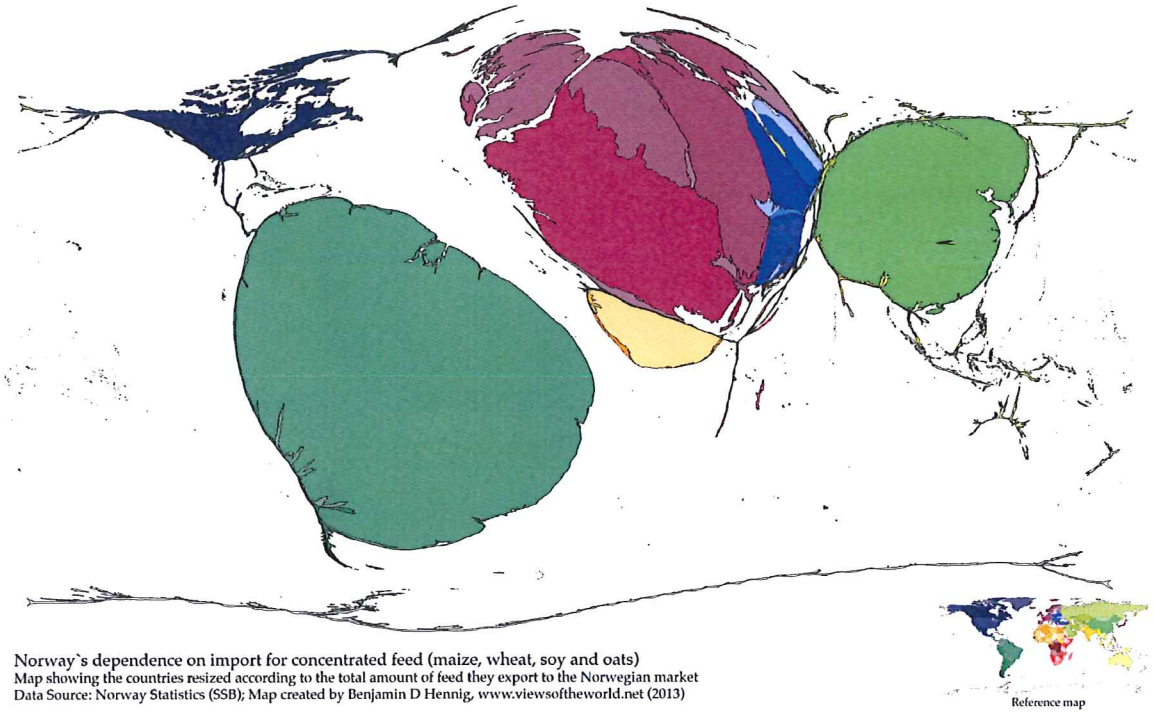

Figure 4: Norway's dependence on import for concentrated feed (maize, wheat, soy and oats) (SSB 2012)

Fig. 4 shows that Norway import the most from Brazil (green), China (light green), France (dark purple), Germany (lighter purple), Canada (dark blue) Poland (blue) and the Ivory Coast (peach).

[2] Obtained from table 04415, SSB

For all the livestock in Norway, the country utilizes 1 944 173 tons (included vitamins and minerals) of ingredients for concentrated feed. Of the total amount 48 % is imported ingredients and 52 % is Norwegian. 68 % of the carbohydrates, 41 % of the fat and 7 % of the proteins used in concentrated feed for livestock are produced in Norway (Schjøth, 2012a) (Appendix 2)

There are mainly 4 importers of carbohydrates used in concentrated feed: Fiskå Mølle AS, Strand, Felleskjøpet Rogaland og Agder SA, Unikorn AS og Felleskjøpet Agri SA. The other companies import less than 1 % (Appendix 1). These companies have hen feed producing factories that deliver animal feed to store chains. These factories are illustrated in fig. 5.

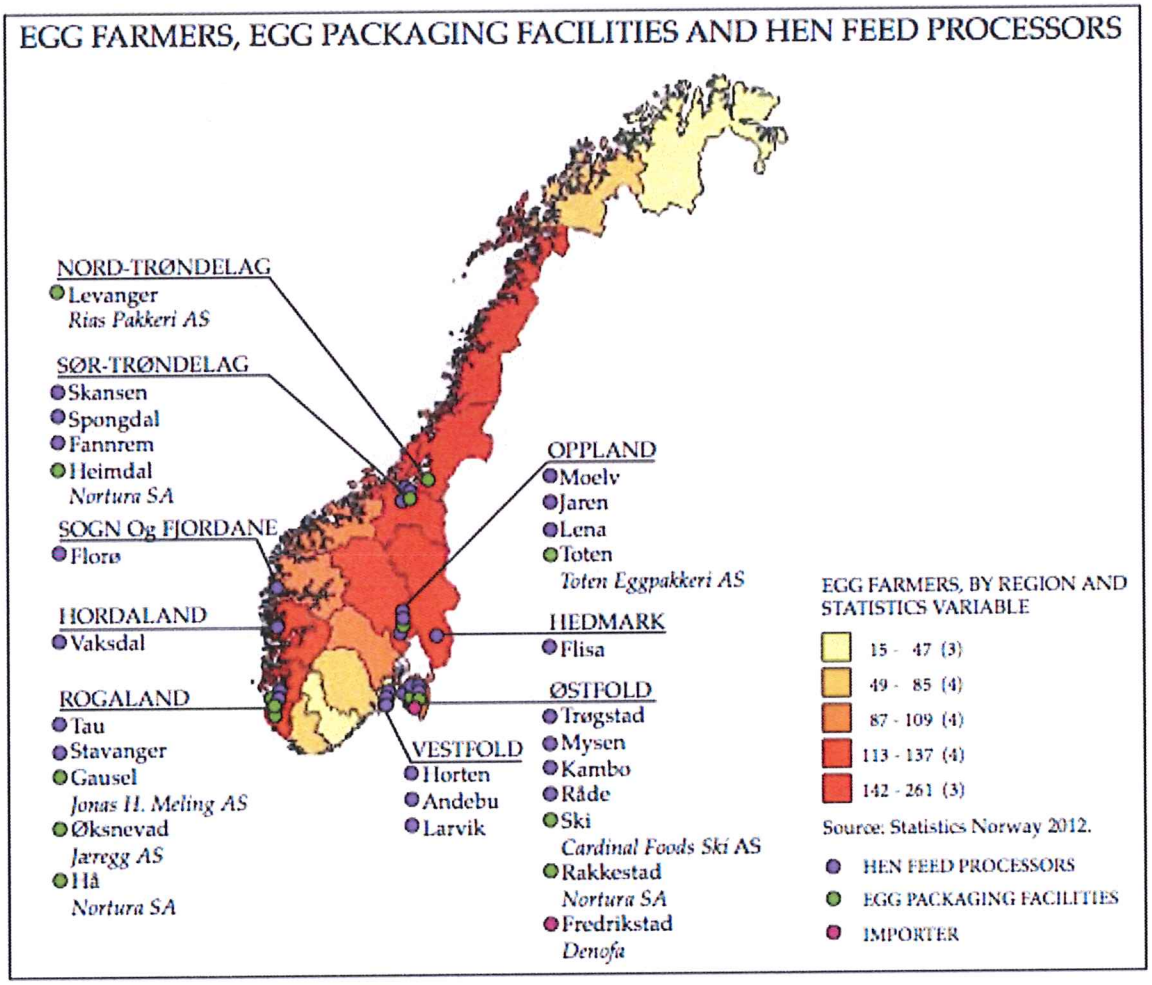

Figure 5: Geographical location of egg farmers, egg packing facilities, hen processing factories of hen feed and Denofa (SSB, collected information)

Fig. 5 also illustrates the geographical location of Denofa, a company that imports most of the soybeans to Norway. They import 420 000 tons of soy each year,

producing 330 000 tons of soy flour, 85 000 crude soya bean oil and 2500 tons of soy lecithin (Denofa, 2013). They also export soy flour to Sweden and Denmark, leaving 155 660 tons of soy flour to Norwegian processors for the production of concentrated feed for animals (Schjøth, 2012a).

The eggs sold in Norway are produced by hens that eat 173 500 tons of concentrated feed each year. This signifies 9 % of the total amount of sold concentrated feed in Norway (Appendix 6) while in total poultry feed is 22 %. Between 1996 and 2012, the amount of sold concentrated feed for poultry increased by 68 % (Schjøth, 2012b, Statistics Norway, 2011).

According to Statistics Norway (2013b) there are 1956 registered egg farmers that receive agricultural subsidies from SLF. Fig. 5 illustrates their location. This figure does not separate between the different sizes of the egg farms, only the number in each country. Fig. 6 below shows that most of the egg farmers have less than 100 hens and around 500 egg farmers have more than 5000 hens.

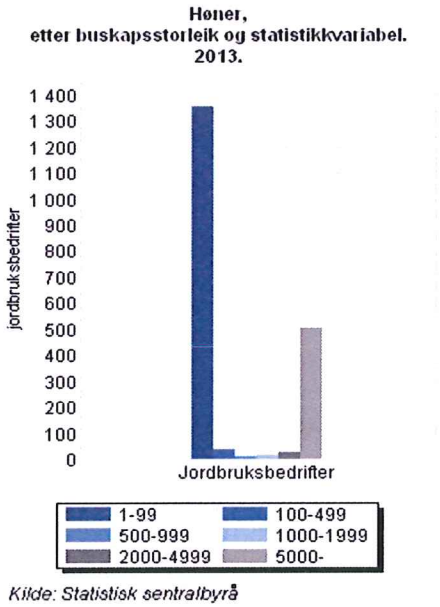

Figure 6: Number of hens related to the number of farms (Source: SSB table 03806)

In total the 1959 egg farmers have 4.1 million hens that produce 61 758 tons of eggs ((Røsnes and Ha, 2012, Statens Landbruksforvaltning, 2012). This number is for the total Norwegian market. Every year 2.3 million hens are wasted on a national basis (Hægermark, 2013) because of decreased production rate as hens age (Ekern, 2013b).

As illustrated in Fig. 3 most of the egg production is delivered to eight egg packaging facilities (three belong to Nortura), whilst local farmers not too far from Oslo produce a smaller part. The eggs from these farms might be packed somewhere else, but are sold directly from the egg farmer to the retailer. The packaging facilities are located in different parts on Norway, as illustrated in Fig. 5. They receive eggs from a total of 470 egg farmers in Norway. The facilities are required to report their production volume to SLF on a monthly basis, which shows that 3.5 % of the 58 095 tons of eggs are organic (Røsnes and Ha, 2012).

The egg packing facilities have different market shares on eggs and Fig. 7 illustrates their distribution. These market shares are based on the amount of received eggs to each facility, registered with SLF.

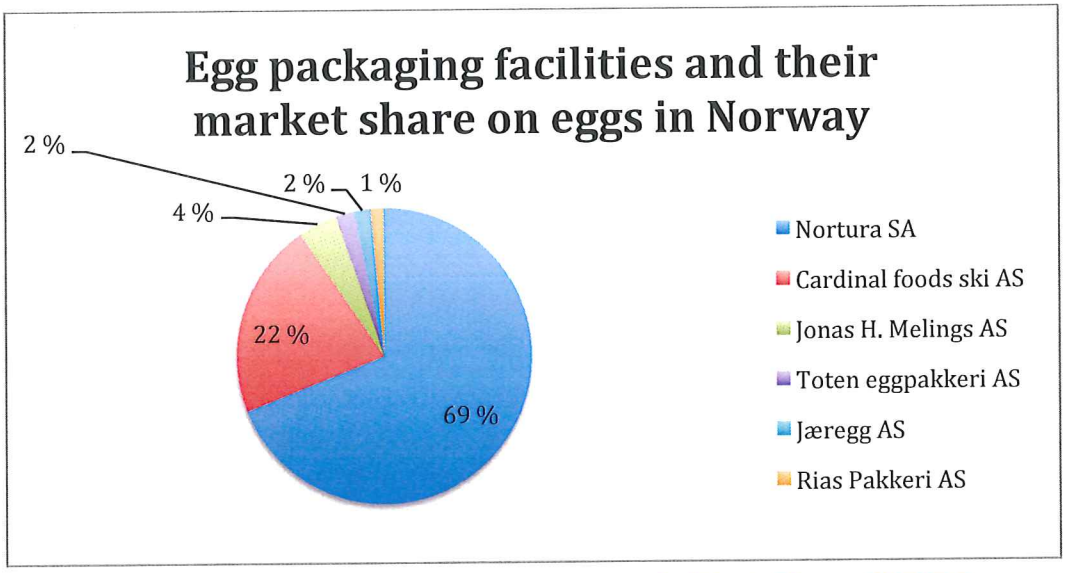

Figure 7: Market share of the 6 registered packaging facilities in Norway (SLF 2012)

The retailers in Oslo receive most of the eggs from six packaging facilities and the distribution company "Den stolte Hane", since only one of the facilities owned by Nortura delivers eggs to Oslo. The eggs are distributed to the retailers as at least 17 different brands, illustrated in Fig. 3. The packaging facilities receive eggs from a total of 470 producers from all over Norway. Five of the facilities are stock companies while one is a cooperative. These companies distribute the eggs directly to retailers or to other wholesalers and are the national distributors of eggs to the Norwegian citizens. Appendix 7 shows the amount of received eggs to each of the egg packaging facilities.

There are 17 egg farmers that deliver 1026 tons of eggs to Jæregg AS, and 21 that deliver 2508 tons to Jonas H. Meling AS. These two facilities deliver most of their eggs to wholesalers for further distribution to foreign shops in Oslo or to catering and industry. Jæregg AS also delivers their eggs to the two retailers *Lime*[3] and *COOP*. Jonas H. Meling had a turnover of 87 million NOK in 2011 whilst Jæregg AS had an annual turnover of 1.5 million NOK. Both of these facilities sell eggs to Cardinal Foods Ski AS and Nortura SA, while Jæregg AS also sells eggs to Jonas H. Meling. Since Nortura SA is the regulator of the egg market, they are obliged to both buy eggs from and sell eggs to the other facilities.

Cardinal Foods Ski AS is the second largest packaging facility in Norway. The company was originally established in 1950 but did not start packaging eggs until 1974. In 2011 the company had an annual turnover of 331 million NOK (Cardinal Foods Ski AS, 2013) and was in 2013 sold into a Nordic investor consortium called "Scandi Standard". There are 80 different egg farmers delivering eggs to Cardinal Foods Ski AS and they produced 12 456 tons in 2012. Cardinal Foods Ski AS produces "Solvinge" and "Godt Kjøp" to *Rema 1000*, "Solvinge" being the own brand of *Rema 1000*. Cardinal Foods Ski AS sells eggs to Den Stolte Hane, the sale and market organisation of Cardinal Foods AS[4], which supplies non-specific retailer eggs to the market. Den Stolte Hane distributes eggs to both *COOP* and retailers in Hakongruppen.

Toten Eggpakkeri AS receive 1173 tons of eggs from 10 egg farmers in the Toten area, and deliver four different brands to the four biggest retailers in Norway as well as to the individual store called *Gutta på Haugen*. Eggs sold directly from farmers are delivered either to the more exclusive retailers in Norgesgruppen, like *Ultra*, *Meny*, *Jacobs* and *Centra*, or for the Health Food shops in Oslo.

Nortura SA is the farmers cooperative in Norway. In 2012 Nortura SA and had an annual turnover of a total 19.2 billion NOK, which also includes different kinds of meat and eggs. Nortura SA produces "Prior eggs" of different styles (organic, free range, environmental cages) that is sold to all the retailers except Reitan gruppen, the health food shops and foreign shops. They also produce "Extra" eggs for their own chain, *COOP*, as well as "First price" eggs, the own brand of *Kiwi*, for

[3] Words in *italics* signify retailers
[4] Cardinal Foods Ski AS and Den Stolte Hane is the subsidiary companies of Cardinal Foods AS, which also have two more subsidiaries running poultry production.

Norgesgruppen. Their eggs are produced by 332 egg farmers and in total their egg laying hens produce 40 094 tons of eggs (Appendix 7).

Rias Pakkeri AS, founded in 2010 in Trøndelag country, distributes one type of brand called "Kløver egg", to the individual retailer *Bunnpris*. They receive 838 tons of eggs from 10 egg farmers and had a turnover of 20 millions NOK in 2011. Fig. 3 shows there are at least 6 egg farmers that deliver their eggs directly to retailers in Oslo. On a national basis direct sales contributed with 6 % of the marked in 2011 (Himle, 2012).

On average a Norwegian citizen eats 185 eggs per year or a half an egg per day (Hovland et al., 2012). In Oslo county this equals 310 500[5] eggs or 19.5 tons per day and around 7100 tons each year. Annually 850 tons are being wasted on a national basis (Bakken, 2011), which signifies 1.4 % of the total production of 61 758 tons of eggs in Norway. In Oslo 4400 eggs are wasted per day. The Oslo eggshed in Fig. 3 shows that producing an egg, which is eventually sold in Oslo, starts in 27 countries, as shown in Fig. 4, and flows from different fields in these countries, through multiple stakeholders illustrated in Fig. 5, to the consumer in Oslo.

Discussion

1. Industrialisation

The Oslo eggshed show how the food system has developed to become a high input system with few stakeholders controlling the supply. There is a commodity specialisation present that could develop because of the separation of the crop and the animal production. The hens have become a machine in the industrialized food system that needs to perform in order to stay alive. They are produced in such a big quantity that their natural behaviour has been neglected and might even forgotten. The hens have been degraded to production units with the mean to produce. When the performance decreases, the hen is thrown away even though the hen itself could turn into 2.3 million dinners annually (Hægermark, 2013). A recent newspaper article referred to Norwegian chicken farmers that didn't recognize themselves as farmers in an industrialised food production (Aadnesen, 2013). The Oslo eggshed show that they are a part of an industry that reaches beyond national borders. The fact that they don`t see it themselves, show how disconnected even the farmers are to the food they eat. When humans become disconnected to the food production the result is ignorance and loss of empathy, not only for the animals, but also for the

[5] 621 332 citizens in Oslo county (table 01222 from SSB) multiplied by 0.5

environmental impact such a production might have. Plants, bees, fungi and bacteria are all parts of an ecosystem that provides services to the ecosystem. Industrialisation has disconnected the producers from the natural "tools" of the ecosystem by offering the more efficient; means of production.

The modern ways of food production have contributed to increased quantities on fewer farms. This developed a need for inputs because of an intensively driven production. The growth of production of soybeans in Brazil has for example been put in relation to the growing demand for animal feed in Europe, which imports 70 % of the Brazilian soybean production (Cavalett and Ortega, 2009). This might increase the risk of being affected by change in the world food market. As of September 2013, the company that imports soybeans to Norway being 49 % Norwegian owned, will be 100 % owned by Grupo André Maggi, Brazil (Hvamstad, 2013). Norway imports 93 % of the protein utilized in animal feed and depends on the import of soybeans from Brazil. Globalisation has indeed brought opportunities, but also challenges.

Norway has 12 300 producers of grain, which is one third of the production in 1989 (Statistics Norway, 2013a). One of the processors of this grain is Fiskå Mølle AS. In 2012 Fiskå Mølle Flisa AS doubled the production to 17 000 tons and hoping to produce 20 000 tons in 2013, in order to cover the increasing demand (Mellem, 2013).

Most hens do not have a life outside of the production area. Hens that produce organic eggs have the possibility to go outside, but this only applies to 3.5 % of the total registered egg production. Moving the hens inside have decreased the use of ecosystem services and increased the use of external inputs. Feed and the bedding are both inputs that previously were available in the farmyard. There is one service that the farms still depend on though, and that is fresh water. But since the use of water increases in production of food (Godfray et al., 2010) it might be the limiting factor on where to produce food in the future (Alcamo et al., 2003). As a by-product of hen farms, manure is produced and sold to manure processors. The production of several commodities on the farm underpins the development of the agro-industry.

As illustrated in Fig. 5, egg farmers are spread in all parts of Norway. This is a result of governmental policies on agriculture and industrial development combined. Industrialisation has brought both transport and infrastructure and connects areas that were previously unreachable. The processors of hen feed and the egg packaging facilities are located mostly in the three counties Rogaland, Sør-Trøndelag and Østfold, which can be called the egg "hot-spots" of Norway. Production wise there is

no reason why egg production should be close to the concentrated feed factories since they distribute the feed to retailers all over the country before it is sold to the egg farmers. But the packaging facilities want to have the farmers as close to the facility as possible because of distribution of fresh and fragile eggs. There are farms that sell their eggs directly to the retailers, thus limiting the physical distance to the retailers and the customer. But this does not necessarily decrease the disconnection between the production of eggs and the consumer.

The growing amount of animals per farm urges resource efficient food production. There is a limited amount of resources available and the production of animals needs to be regulated accordingly. 48 % of the ingredients in animal feed produced in Norway are imported, so in order to produce more animal products a change in resources are necessary. This is possible because of globalisation where trade and international connections have been developed.

2. Transparency

The Oslo eggshed demanded thorough exploration in order to uphold all the information wanted. It was possible to find the countries of origin for the animal feed ingredients because of import statistics, even though the customs tariff in itself was a complex information system. The Norwegian customs authority and SLF knew who the importers were, but this was not public information. During the exploration of the Oslo eggshed the importer Denofa appeared in a newspaper article. Because this company has a direct link to Brazil, the flow of soybeans was explored all the way from the fields in Mato Grasso, Brazil.

Even though the soybeans are imported for animal feed, it is considered a Norwegian product after it has been processed to soy flour. The imported amounts are a part of a public document concerning the self-sufficiency rate for the total production of animal feed in Norway. For the import of proteins the percentage of self-sufficiency changed from 46 % to 7 % after re-calculating. This information can affect the emphasis in the agricultural policy and should be far more transparent than it is today. It shows to what extent Norway depends on other countries in order to produce animal products. This is directly disconnecting the customer to information that might change their food choices.

Information about what the hen eats is not available for the costumer unless the hens have been fed maize that makes a yellow colour on the egg plum. Some of the

organic labels mention that their hens have been pecking in the roots and soil outside, but generally no information about the hens feed can be found.

Customers that buy eggs in Oslo can chose from multiple brands depending on the food store. The label is the direct communication from the production to the customer. All information given to the costumer is either mentioned on the label or on the homepage of the producer, maybe even the processor. At *Rema 1000* the customer can choose from "Solvinge", "Godt Kjøp" or "Toten Egg". The label of "Toten Egg" mention the localisation of the farms (Toten), but this information is not present on all labels. Most labels in the supermarket don`t say anything about the location of the egg production, though there are a number present on some brands that can be searched online for more information about the farmer and the day the eggs were packed. It is mostly local farms that sell their eggs directly to the retailers that give information about localisation through the labels.

If the customers are interested in how the eggs have been produced they can look for the organic certification or "free range" on the label. In order to know exactly what this implies the customer would have to know what the organic certification entails or which environment the "free range" hens have. Eggs from free-range hens only have 1,5 dm^2 to live on, though this is not mentioned on the labels. No labels mention the space each hen has to live on or how much they are outside, unless they have bigger space than normal and can go outside. Labels give information about the positive aspect of the egg-production, this being supported through the interviews in Jackson et al. (2009). A newly published report from the National Institute for Consumer Research (SIFO) in Norway stated that Norwegian consumers are feeling confident that the stores secure the ethical aspect of the egg production (Schjøll et al., 2013). Therefore they will not change their buying habits until there is something negative mentioned on the labels. In order for the consumers to do informed food choices, of eggs, it is necessary to label the eggs with the type of production (Schjøll et al., 2013). But as Kloppenburg et al. (1996) argues, even then they might not be able to because they are physically distant to the land or have no sense of connection to the production. In the EU the eggs produced in cages need to be labelled as such, but the Norwegian government has said no to offer the Norwegian consumers the same (Kulø, 2013).

Three labels in the Oslo eggshed have names that indicate that the hens have been outside in the sun. These are "Solvinge", "Solegg" and "Solskinnsegg" ("sol" equals sun in Norwegian). Hens are sometimes given high carotene feed in order to produce

an extra yellow plum, hence the "sun-names". Even though these names might originally been created for marketing the yellow plum, it is misleading for the customer. Since the eggs are not organic, the hens have never been outside. Norway has a long tradition of having cooperatives; hence *COOP* has many regular, faithful costumers. As a customer wanting to support the farmers in the cooperative, they have to be aware of which packaging facility that has distributed the eggs. When buying "COOP Solskinnsegg" the customer supports "Cardinal Foods Ski AS" and not Nortura AS, which is the packaging facility of the cooperative. Such naming of eggs can be misleading for the customer.

Most retailers sell multiple brands of eggs, several through the same packaging facility. "Smak Forskjellen" sold at *COOP* can for example come from the same hen as eggs sold as "Toten Egg" at *Rema 1000*. The same applies for "I Love Eco" in Hakongruppen and "Anglamark" bought in *COOP*. As a customer going to buy eggs in the store you assume you have a diverse choice in eggs, when actually it is a choice of brands.

If the customer knows that the feed for the hens are partly from Brazil where the production in threatening the amazon forest (Cavalett and Ortega, 2009) that the hen is never outside and that they have 1.5 dm^2 each to live on, one might expect a change in consumer habits.

The assessment of transparency in the Oslo eggshed implies that the feed back loops need to be tightened. As Sundkvist et al. (2005) argues; if there is no direct link between the farmer and the consumer, policies and labels need to be the connecting link. The labels are somewhat misleading or don't show the entire picture of the egg production, showing that the feedback loops are loose. Information given on the labels is not coherent with the production of eggs. In the case of feed there were non-transparent information that can influence the Norwegian food security. In long terms such lack of transparency could make the system unhealthy and unsustainable.

3. Agricultural policy

As the global population grows, countries are encouraged to produce more food (Godfray et al., 2010). Paradoxically, a lot of food is thrown away. Norwegian consumers throw away 300 000 tons of food each year, and in the Oslo eggshed 850 tons of these are eggs (Hanssen and Schakenda, 2010). This amount signifies 12.9 million eggs per year or the annual production for 37 000 hens.

Norway produce all the eggs needed for its citizens, but not all the feed needed for its hens. The Norwegian Directorate of Health recommends light and low-fat meat and it has been an increase in the demand for poultry meat from 1989-2011 (Hovland et al., 2012). In 2009 each consumer ate 8.3 kg of poultry meat per year (Svennerud and Steine, 2011), which is soon bypassing the consumption of cattle (Ruud et al., 2013). Hens have the asset of being a source of eggs and meat, a resource that can feed many people. In the current egg production 2.3 million hens are wasted each year (Hægermark, 2013). This trend is neither aligned with the policy goal about food security nor sustainable food production. With the goal of increasing food production follows a responsibility of utilizing the resource produced. The growing population is often the reason for the mean to increase food production, but as Johansson (2008) concludes, the diets of people might be more important because change in diets changes resource use. Increasing food production in itself doesn't have any value unless it is distributed to the people that need it. The self-sufficiency rate is often discussed in relation to food security, but it doesn´t imply how we utilize the resources produced. The grade of self-reliance should therefore be of more importance in order to truly assess the state of Norway's food security. Positive outcomes of such an analysis may be reducing the dependence on other countries and lead to a more resource effective food system.

One of the sub goals of food security is to increase national production. Eggs sold in Norway are produced within the country`s border, but this would not be possible without the import of feed for the animals. Norway imports about 853 000 tons of ingredients to animal feed which signify 48 % of the total ingredients for all concentrated feed produced in Norway (Schjøth, 2012a). Norway depends on 27 countries for importing the main ingredients to hen feed.

The goal of increasing production of food on national land is specially directed towards grain because it is a nutritious food both for humans and as animal feed. Despite that the need for grain is growing, the trend is fewer grain farmers and less land for producing grain (Hageberg and Smedshaug, 2013). Felleskjøpet concludes that if nothing is done to increase the Norwegian grain production, the need for imported feed will increase (Flø et al., 2012). The land utilized for grain production has decreased with 3500 ha per year since 1991 and in 2012 Norway imported for the first time more grain than they produce themselves (Hageberg and Smedshaug, 2013). Norway import 52 % of the ingredients for animal feed. It is of high political interest to increase this number, but the trend is increasing imports (Norwegian

Agricultural Authority, 2012). Because of high maintenance factor of the animals, the need for high protein feed like rapeseed, soybean and maize gluten is increasing (Statens Landbruksforvaltning, 2011). As Norway produces neither maize nor soybeans the result is import. Fiskå Mølle AS, one of the importers and processor companies, explained how rapeseed or fish flour would be an excellent source for protein in animal feed, but using fish flour is twice as expensive as soybeans, resulting in higher production costs (Fjermedal, 2013).

Importing feed from other countries is needed for the functioning of the Oslo eggshed. Trade is of both national and international interest, but there is no guarantee that Norway has access to foreign food import at all times. In 2011 there were a lack of grain in Russia because of heat waves that produced fires, leading to closed borders for export (Vidal, 2013) and the trend in climate changes show this could easily happen again (Godfray et al., 2010). In order to ensure food security natural resources such as arable land, ecosystem services and freshwater need to be protected (Johansson, 2008)

Long-term perspectives are important for obtaining sustainability. As a means to increase sustainable food production, LMD has set a goal of having 15 % organic production within 2020. In the Oslo eggshed 3.5 % is organic and only 72 % of the total organic egg production were sold as such in 2012 (Røsnes and Ha, 2012). Hens are only served concentrated feed and mostly don´t utilize outside areas, but if the organic production of eggs increases, more hens will walk outside and feed on available resources. This will not only serve the goal of increase organic production, but might decrease the use of imported feed.

As a mean towards sustainable agriculture, LMD emphasizes the importance soil as a carbon storage, making trees relevant for addressing the climate change challenge. Research show that the agricultural production of soybeans in Brazil utilizes high amount of nitrogen and phosphorus, indirectly soil and forests, which is exported to Europe (Nyquist et al., 2013). In Brazil, soybeans are produced at the expense of the Cerrado or Savannah ecosystem, and the expanding production is threatening the southern Amazon forest (Cavalett and Ortega, 2009). The Oslo eggshed is maintained by this production and possibly similar situations in other countries, but one might ask critical questions as to why LMD won`t explore the origin of animal feed further, to protect the natural resources not just in Norway, but in the countries the feed originates from. In order to develop a sustainable egg production the Oslo eggshed need to be more aligned with the agricultural policies, with the exception of

increasing the egg production. There is waste of both hens and eggs, so there is a need for assessing the resource efficiency rather than increasing the production.

Collection of data

In order to describe the Oslo eggshed a big amount of qualitative and quantitative data was gathered from different stakeholders. Since this was an explorative study the links between the stakeholders needed to be explored. Some information that could have been valuable in the analysis might have been missed because of not asking the right questions to the right stakeholders. One of the limitations of using e-mail correspondence is that people may not feel obliged to answer. Some follow up questions through phone calls was done in order to receive the information needed.

The starting point for this research was a customer in Oslo buying an egg. Quantitative information was not available only for Oslo so the waste of eggs and eggs consumed in Oslo were calculated from national numbers. All other numbers is on a national basis. The local farmers and individual retailers are the stakeholders that are related only to Oslo. I could have chosen to explore the Norwegian Eggshed, but that is a more comprehensive investigation that would have needed more time and investigation.

In order to find the different brands of each packaging facility, e-mails were sent and a trip to visit the stores in Oslo was conducted. The different wholesalers could have been contacted and asked what type of brands they sell in their respective stores, but instead data obtained from the packaging facilities was used. There might be some brands that is lacking in the description of the Oslo eggshed because of this. Some farmers may also sell their eggs directly to a shop in Oslo that was not visited and therefore not included in the Oslo eggshed.

Through the data collection of stakeholders four main importers of carbohydrates were identified. I could have asked if they knew other companies that import animal feed ingredients and by doing this obtaining several stakeholders. But conversations with the Norwegian customs authority and SSB implied that these were the most important ones, also for the import of protein and fat.

Even though SSB and Animalia had specific statistics about the hen, gathering information on hen feed remained a challenge. Statistics is mostly published for

poultry or for livestock in general, which means that several assumptions have been made, affecting the results.

I could have chosen other commodity numbers, but through conversations with SLF and the Norwegian customs service I feel confident of the choices done with the available data. If the stakeholders that import ingredients would be public I would have know the exact type and amount of import. Then the calculations would be more specific and the results would be more reliable. The results showing the origin of hen feed have its uncertainties because of choice in article numbers and the assumptions made in some of them. But it gives an idea of which countries Norway rely on to feed the hens.

Further studies

Important studies further would be to address the stakeholders in the Oslo eggshed and assess their values and attitudes towards creating a more transparent and animal friendly food system based on local resources.

Another area of research could be to assess where the food *might* come from or where it *should* come from, as being a part of an extended foodshed analysis. As the Oslo eggshed isn't aligned with the current agricultural policies an analysis of the self-reliance in Oslo could be of interest in the process of making food policies that promote sustainability.

"Food miles" is a term originally described by the organisation Sustain in 1994 (Paxton, 2011). Whereas "food miles" has been a term for discussing carbon footprints, the term also should acknowledge the social and economic aspect of a trade (MacGregor and Vorley, 2006). This could be combined with the presented eggshed in order to assess Oslo's "Egg miles".

Concluding thoughts

This foodshed analysis has clarified how food is produced in 2013. Our food system has developed to an agro-industry with few stakeholders and long supply chains. The specialisation of stakeholders has increased the physical distance in the food system, and the stretched geography in the Oslo eggshed has created disconnection between the consumers and the food.

Industrialisation brought the mechanistic view into the sphere of food. Tools are produced in factories, they function for a while and as they wear out they are replaced. Living animals can't be built but grow and develop over time. It is a natural cycle that can't be controlled, but need to be carefully nurtured. The animals are no longer valued as a living organism, but are simply a product of a profit-optimizing process.

If the consumers do informed food choices by choosing food that is produced ethically and with high transparency, food production will be more aligned with agricultural policies thus developing a healthy eggshed. Then the citizens will have a sustainable food future.

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Appendix

APPENDIX 1

IMPORT OF CARBOHYDRATE INGREDIENTS TO CONCENTRATED FEED PER COMPANY IN TONS (SLF 2011/2012)

Aktør	18.8.11 Tonn	23.11.11 Tonn	28.3.12 Tonn	11.5.12 Tonn	Sum Tonn
ROLF ØYVIND THUNE		140			140
Strand Unikorn AS	28 000	13 071	6 890	15 500	63 461
FK Rogaland Agder	21 200	46 684	17 484	50 000	135 368
Vestfoldmøllene AS	2 500			200	2 700
Fiskå Mølle AS	14 500	20 541	6 500	12 000	53 541
Jensens Curlyhester	10				10
NORMIN AS	200				200
Felleskjøpet Agri BA	39 590	58 542	11 024	31 500	140 656
Per Gunnar Roos		20			20
Vestkorn Milling AS			100		100
Hestesport-Centeret A/S				800	800
Sum	106 000	138 998	41 998	110 000	396 996
Kvote	106 000	139 000	42 000	110 000	397 000
Ubrukt	0	2	2	0	4

Appendix 2

Re-calculated percentage of imported animal feed ingredients from (Schjøth, 2012a)

PROTEIN SOURCE	Total	Import	Norwegian	% Norwegian
Fish flour	9223	1233	7990	87
Mais gluten	41117	41117		
Soy flour	210670	210670		
Rapeseed pellets	100128	100128		
Oil seeds	15717	6937	8780	56
Fish ensilage	3753		3753	100
Urea	2189	2189		
Other protein	11620	6472	5148	44
Total protein	394417	368746	25671	7
Total carbohydrate	1415395	457491	957904	68
Total fat	46508	27291	19218	41
Total vit/min	87852			
Total sum	1944172	853528	1002793	52

APPENDIX 3

DATA ON IMPORTED INGREDIENTS FOR OATS, WHEAT, MAIZE AND SOY (SSB 2012)

Commodity number and commodity	Import	Country	Original import	Re-calculated impc
			2012	
			Mengde 1 (M1)	
10049000 (m1=kg,m2=nei) Oats, not seeds	Import			Divided by three
		DK Danmark	3369051	1123017
		FI Finland	8254609	2751536,333
		IE Irland	1297067	432355,6667
		KZ Kasakhstan	997906	332635,3333
		LT Litauen	3020874	1006958
		SE Sverige	18519644	6173214,667
11041200 (m1=kg, m2=nei) Oats, flakes	Import	BE Belgia	5496	1832
		DK Danmark	45166	15055,33333
		FI Finland	764	254,6666667
		NL Nederland	60	20
		GB Storbritannia	60	20
		SE Sverige	54773	18257,66667
		DE Tyskland	1956	652
11042200 (m1=kg, m2=nei) oats without husk	Import			
		SE Sverige	2142	714
		DE Tyskland	0	
Sum import of oats			**35569568**	**11856522,67**

Commodity number and commodity	Import	Country	Amount of import (kg)
			2012
			Mengde 1 (M1)
11090010 (m1=kg, m2=nei)	Import	BE Belgia	28771392
What gluten, also dried, for animal feed		BR Brasil	1000000
		DK Danmark	479035
		FR Frankrike	5188678
		CN Kina	31139093
		LV Latvia	2000000
		LT Litauen	2000000
		NL Nederland	5400
		GB Storbritannia	21687320
23023000 (m1=kg, m2=nei) Bran, sharps and other residues,	Import	CI Elfenbeinskysten	15623714
whether in the form of pellets,		LV Latvia	1453000
from the sifting, milling etc		SE Sverige	36660
		DE Tyskland	24000
Sum wheat			**109408292**

Commodity number and commodity	Import	Country	Amount in kg
			Mengde 1 (M1)
10059010 (m1=kg, m2=nei) Maize, not seeds, for animals feed	Import	AR Argentina	253294
		BG Bulgaria	0
		CL Chile	0
		DK Danmark	126320
		FR Frankrike	63637512
		IN India	59420
		IT Italia	194980
		PL Polen	6333394
		RU Russland	136740
		UA Ukraina	175980
11031310 (m1=kg, m2=nei) Groats and meal, of maize, animal feed	Import		
		DE Tyskland	33251988
23031011 (m1=kg, m2=nei) Residues of starch manufacture	Import		
and similar residues of maize for animal feed		BG Bulgaria	1518880
		CL Chile	180
		CN Kina	39506776
		NL Nederland	1270088
		SK Slovakia	240000
		DE Tyskland	473465
		HU Ungarn	5153466
Total sum of maize			**152332483**

Commodity number and commodity	Import	Country	Amount in
12019010 (m1=kg,m2=nei) Soya beans, whether or not broken,	Import	CN Kina	41740,0
for animal feed		SE Sverige	92000,0
		DE Tyskland	950,0
15071010 (m1=kg, m2=nei) Soybean oil, crude, whether or	Import	BE Belgia	4700,0
not degummed, but not chemically modified, for animal feed			
23040010 (m1=kg, m2=nei) Oil-cake and other solid residues,	Import	BR Brasil	43696077,0
whether or not ground or in the form of pellets		DK Danmark	173800,0
after the extraction of soyabean oil		FR Frankrike	572,0
		IT Italia	70860,0
		CN Kina	7024548,0
		GB Storbritannia	658106,0
23040090 (m1=kg, m2=nei) Oil-cake and other solid residues,	Import	DK Danmark	61940,0
whether or not ground or in the form of pellets		US USA	260,0
after the extraction of soyabean oil			
12019090 (m1=kg,m2=nei) Soya beans, whether or not broken,		BR Brasil	364325157,0
not for animal feed and seeds		CA Canada	28959680,0
Total amount of imported soy			**445110390,0**

Appendix 4

Imported ingredients for concentrated feed to Norway per crop per country in kg (SSB 2012)

Country	Soy	Maize	Wheat	Oats	Import per country in kg
Argentina	253294				253294
Belgium	4700		28771392	1832	28777924
Brasil	227315077		1000000		228315077
Bulgaria		1518880			1518880
Canada	14674000				14674000
China	7066288	39506776	31139093		77712157
Denmark	235740	126320	479035	1138072	1979167
Finland				2751791	2751791
France	572	63637512	5188678		68826762
Germany	950	33725453	24000	652	33751055
Hungary		5153466			5153466
India		59420			59420
Ireland				432356	432356
Italy	70860	194980			265840
Ivory Coast			15623714		15623714
Kasakhstan				332635	332635
Latvia			3453000		3453000
Lithuania			2000000	1006958	3006958
Netherland		1270088	5400	20	1275508
Norway			177768000	242182000	419950000
Polen		6333394			6333394
Russia		136740			136740
Slovakia		240000			240000
Sweden	92000		36660	6192186	6320846
United Kingdom	658106		21687320	20	22345446
Ukraina		175980			175980
USA	260				260
Total per crop	250371847	152079009	287176292	254038522	

Appendix 5

Re-calculated amount of soy used in concentrated feed in Norway

Country	Total imported kg	%	Used in Norway kg
Brasil	364325157	92,6	183457249
Canada	28959680	7,4	14582751
Total	393284837	100	198040000

Denofa imports about 420 000 tons of whole soybeans. Of this 330 000 turns to flour. This signifies that 78,6 % of imported whole soy turns into flour. According to SLF and Denofa they sell 155 660 tons of flour to concentrated feed, which then signifies (155660/78,6)x100=198040 tons of whole soy. Denofa imports soy from both Brazil and Canada but also export to Sweden and Denmark. Percentage wise 7,4 % is from Canada and 92,6 % from Brazil. This equals 14582751 kg from Canada and 183457249 kg from Brazil.

Appendix 6

Calculated hen feed for the total amount of hens in Norway (Hovland et al., 2012)

Desscription	Quantity
Amount of eggs per hen	331,0
Wheight of the egg in g	63,5
Animal feed in kg/kg egg	2,0
Amount of hens in Norway	4123615,0
Total eggproduction in kg per hen	21,0
Total animal feed for chickens in Norway	***173344***
Percentage of total animal feed	***9***

APPENDIX 7

MARKET SHARE OF THE REGISTERED PACKAGING FACILITIES IN NORWAY WITH ITS CORRESPONDING AMOUNT OF RECEIVED EGGS IN KG (SLF 2012)

Eggpakkeri	Markedsandel	Kg levert egg
Nortura SA	69,01	40094223
Cardinal foods ski AS	21,44	12456093
Jonas H. Melings AS	4,32	2507967
Toten eggpakkeri AS	2,02	1173133
Jæregg AS	1,77	1026339
Rias Pakkeri AS	1,44	837579
Sum levert egg til SLF og markedsandel	100	18001111

APPENDIX 8

ANNOTATED BIBLIOGRAPHY

"Coming into the foodshed" by Kloppenburg et.al. (1996)

Key words: Own-feed, foodshed,

Arthur Getz introduced the term foodshed to facilitate critical thought about where our food is coming from and how it gets to us. His comparison of the food system to a foodshed is very interesting because it connects the cultural (food) to the ecological (shed). Kloppenburg is pointing out that we have developed a global food system that is structured around a marked economy that is enhancing commodities and destroys the local. The commodities are produced with the purpose to feed people, not really to be enjoyed. Ultimately, distancing and long travel disempowers, Kloppenburg says. I will discuss this in my thesis and link it to the results I have after mapping the Oslo foodshed. Then I will see where the food is produced and through who it is being sent in order to reach the eater in Oslo. I will see if Oslo food system is similar to the global food system where food has a long travel distance from grower to the eater.

"Foodshed analysis and its relevance to sustainability" by Peters et.al. (2008)

Key words: world food situation, local food, foodshed analysis

This paper discusses the history of the use of the term foodshed, which is good help for my own use of the term in the thesis. Foodshed is defined as the study of the potential or actual sources of food (growers) and the factors affecting the movement of the food to the eaters. Peters underlines the importance of such an analysis for discussing local food sustainability but also for global food system sustainability. This article supports the need to emphasize such an analysis in making policies within food security and the food system´s ecological impact. Peters et.al. emphasizes the great value of such a foodshed analysis may have and think a foodshed analysis is divided into two parts. 1. The tracing of food from its origin to its ultimate point of consumption. 2. The measurement of different "costs" in the producing and transporting of the products at different locations in the food system (energy consumed, greenhouse gases emitted or prices paid). Evaluation of the geography of the foodshed can then be used to discuss impacts on the environment or vulnerabilities in the system. I see my research doing stage number one in my thesis and discuss the possibility of further research.

"Empowering local food connections for resilient city regions: Planning through foodshed or terroir?" By Rositsa Todorova Ilieva (2012)

Key words: self-reliant, foodshed

This paper discussed if resilient city regions should be planned through foodsheds or terroir. The article describes two food systems that have been analysed with the two different worldviews and conclude with foodsheds being more for urban areas and terroir being more related to rural areas. I will use this article as inspiration for the foodshed analysis and take the advise of not use a too quantitative-oriented approach, because it can "obscure the relationship with the qualitative value of things"

"Stuffed and Starved" by Raj Patel (2007/2012)

Key words: Food globalization, food system

Raj Patel is discussing the history about how we got disconnected to our food through industrialism and globalization. He is arguing that through more choices of different kinds of food products we have been more obese and more people are starving. Patel is discussing the bottleneck of the "middlemen" between growers and eaters, thus creating a power layer that controls the food marked of only a few enterprises and manufacturers. He is arguing how the disconnections have happened through this middle chain and this I will discuss in my paper. I want to explore how many of these "middlemen" there are in Oslo foodshed. Raj Patel focuses on the consumers` power to vote with its wallet when buying food.

"The place of food: mapping out the "Local" in the local food systems" by Robert Feagan (2007)

Key words: locality, place, region, foodshed, comunity

This article discusses the place of the food within the different terms: local, community and place. It concludes that it has been a disconnection between the consumer and producer, thus disconnecting the general public and the social to environmental consequences of the food being grown and eaten. Food chains are turning out more complex in space and there has developed a physical and physiological displacement of production from consumption. The article argues that food chains have been more stretched in complex ways in space, and I will see if I can relate this to the mapping of these "stretchings" in Oslo food system. If the foodshed shows long-distance travel between the grower and producer, I can relate it to what the author calls re-localisation in the food system.

"The Swedish Foodshed: Re-imagining Our support area" by Susanne Johansson (2008)

Key words: Swedish foodshed

The article explains how the Swedish foodshed has developed over time and that they have changed the use of land for food. From depending on the sun and the soil, the dependence is now on external sources like fossil fuels. The author described how a foodshed approach could help people to understand where their food are coming from, and I will use the same method in my research. The article also describes how diet matters for environmental sustainability, and change in diets will changes resource use. Also this article concludes with the fact that consumers and producers need to be reconnected in order to gain food system sustainability. This article expresses characteristics of the food system that I will explore in my research.

"Lost in the supermarked: The corporate-organic Foodscape and the struggle for food democracy" by Josèe Johnston, Andrew Biro and Norah MacKendrick (2009)

Key words: food democracy, corporate foodscape, food choice

This article gives an analysis of food democracy related to what they call corporate-organic foodscape. They assess different brands and how they use strategic narratives such as locality, place and the connection between brands and "real" farmers, though being identified as part of a globalized corporate agribusiness. The article refers to food democracy as the idea of empowering citizens to determine agro-food policies and practices locally, regionally, nationally and globally. The people should not remain passive spectators. In order to have food democracy you need transparency so I will explore transparency further in relation to the Oslo foodshed.

Moral economies of food and geographies of responsibility by Peter Jackson, Neil Ward and Polly Russell (2008)

Key words: Moral economy, space and time, chicken

In this article there are interviews of stakeholders related to sugar and chicken industry. They are asked moral and ethical questions about the food production, related to the dimensions of time (via notions of remembering and forgetting) space (via notions of connecting and disconnecting) and via notions of visibility and invisibility. The results of these interviews will be related to the findings of the Oslo eggshed.

"Systems for Sustainability and transparency of food supply chains. Current status and challenges" by Wognum P.M el.al (2012)

Key words: Transparency, food supply chains

This article describes why transparency is important in food supply chains and how it is necessary in order to use sustainability as added value in the food chain. Transparency is the degree of shared understanding of an access to product-related information and how this information is being supplied without noise or delay. The information applies must be readable and in an appropriate quantity. This definition will be used in the analysis of transparency of the Oslo foodshed.

"On the importance of thightening feedback loops for sustainable development of food systems" by Sundqkvist et.al. (2005)

Key words: Feedback loops, food system, and ecosystem

The article discusses the importance of feedback loops in a food system. It is important to tighten these because the trend in the food system is more industrialisation, specialisation, distancing and concentration. These trends can make it impossible to regard feedback signals from unhealthy ecosystems and weaken communication in the food chain. Increased reliance on local resources give possibilities of increased feedback, but when the distance is too long, the feedback has to go through an overarching level such as policy measures or environmental labelling of products. I will describe the food flow in the Oslo eggshed and see if there is a need for tightening the feedback loops.

APPENDIX 9

REFLECTION PAPER

The work I have done the last 6 months has made me realize that everything is linked to ecology. The ecosystem has a saying in every part of our life. Scientific fields like agroecology, landscape ecology, environmental economics and ecological philosophy are all scientific fields that acknowledge the importance of including the valuable ecosystem in our lives and work. Even though ecology in itself wasn't part of my thesis work, I understood how ecological cycles are connected to the human life.

In order to develop a sustainable food system we have to look at what works: the ecosystem. It is a network of animals, fungi, bacteria and insects that are inter-dependent. The ecosystem runs in cycles. The plants that grow are food for the animals, which again put faeces on the ground, which function as nutrients for new plants. Such cycles depend on and are a part of ecosystem services. Different communities of insects, spiders, animals, fungi and bacteria are running the ecosystem. They rely on each other in order to feed and survive, and by exploiting a resource they depend on, it is themselves that will suffer in the long run.

The ecosystem exists of multiple sub systems that rely on feedback and if such feedback is present, the system is closer to sustainability. In a natural system there is no human ego that can disconnect the loop, but in food systems the ego can be a barrier for the flow of information. The food system needs transparency in order to obtain functioning feed back loops. This made me think about the human body and the constant feedback mechanisms that are occurring at all times. When we eat and the hypothalamus recognise the high glucose in our blood, it sends a message to pancreas that it needs to produce insulin. The insulin opens doors for the glucose to enter the cells, thus lowering the sugar content in our blood. Then hypothalamus sends a message that insulin can be reduced. This feedback loop is directly related to the food system, though in a more complex manner because of human influence. These cycles are affected by the mechanistic approach and it is producing system failure like change in world temperature, increased amount of natural disasters and starving people. The importance of the ecosystem and its cycles are not well understood, so the need for increased ecoliteracy are high!

The understanding of sustainable food systems can be put in relation to the movie called The Lion King. Mufasa (the king) managed the whole kingdom with care and saw that everything in the Savannah was part of an ecosystem and depended on each other. The pack didn't eat more than they needed. In an ecosystem without power relations, politics, communication problems or technology, inter-dependence regulated the lion community. But Scar (Mufasas brother) felt left out of the family (the community). He didn't understand the complexity of the ecosystem and that they were all dependent on each other – he was disconnected to the circle of life! Scar was jealous and developed a need for power. He killed Mufasa and managed the community with great selfishness, eating and killing more than he and his helpers – the hyenas – needed. He did not see the consequences of this before the resources – the animals – he so much dependent on for feed, was scarce (his eco literacy was scarce indeed). Simba (Mufasas son) wanted change and through defeating Scar he managed to rebuild the community by letting the system re-establish itself and again develop diversity, flexibility and partnerships.
Just as Scar was disconnected to the community, the consumers are disconnected to their food. There isn't an understanding of the consequences of their actions. In the food system we need to understand that we are all inter-dependent and that we need to be connected through information flow and feedback loops to create a truly sustainable food system.

The next step is going to Nepal, working with researchers within climate, agriculture and food security. These are complex areas, but I will bring with me three learned lessons.
1. **Planning**: In order to develop knowledge a deeper understanding of a topic is needed. The process from knowledge to wisdom is long and as my sister say: trust the process. There is no need for hurry when working with complex issues. The connections need to be understood.
2. **People**: Every system has communities and actors. They have knowledge and skills that can be utilized and acknowledged in different ways. Every input is valuable and when gathering the information it can be tenfold the value of each part. This paper would not have evolved without discussions and the interactions with other people.
3. **Patience**: Information needed is not always available information and other people's life may run in a different paste than my own. By accepting that the flow of information could run slow, I opened up for new connections. All time is good time and with patience it turned out to be even better.