IIIEE Reports 2003:1

Ecological Modernization of the Swedish Agriculture Industry

Factors Promoting and Hindering the Reduction of Emissions to the Baltic Sea

Steven Archambault

The International Institute for Industrial Environmental Economics
Internationella miljöinstitutet

Published in 2003 by IIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.
Printed by KFS AB, Lund.

ISSN 1650-1675

Acknowledgements

The undertaking of this research has been a very positive experience. I thoroughly enjoyed discussing personal thoughts, ideas, concerns and possibilities with so many different people working with agriculture related issues in Skåne and throughout Sweden. I was met by nothing but kindness and enthusiasm.

Much appreciation goes out to Karl-Erik Grevendahl and the Sustainable Business Hub in Malmö for their generous financial support. Karl-Erik was instrumental in getting the ball rolling for this project, and continued to provide much appreciated insight and discussion throughout the length of the study. I hope to now be included on his long list of contact people.

Much thanks goes to Ruth Archambault and Maxine Stephenson for their assistance in editing the text of this research.

Special appreciation must also be given to Lisa Blix, as she also helped me get started on this project, and continued to answer my questions throughout the research period.

The friendly guidance from Peter Arnfalk was both helpful and educational, for this I am appreciative.

Thanks to Renato Orsato for spending the extra time answering my questions about ecological modernization and political ecology, and for showing an interest in my work.

Additional thanks to Michael Johnson, Roland Zinkernagel, Camelia Tepelus, Helen Nilsson, Zina Fadeeva, Åke Thidell, Don Husingh, Lars Hansson, Åsa and Mikael Backman.

Finally, I give my appreciation to the IIIEE for the opportunity to conduct this research.

Abstract

Nutrient and pesticide pollution accompanying the intensive agriculture activities of the last fifty years has significantly impacted the Baltic Sea ecosystem in northern Europe. This research focused on identifying and describing the factors that may be promoting or inhibiting the implementation of environmental approaches that could reduce the negative impact of agriculture practices on the Baltic Sea. A case study was undertaken of the ecological modernization of the agriculture industry in Skåne, of southern Sweden, an area well known for its large scale and intensive agriculture practices. Studying the environmental contingent factors (eco-factors) has given some insight into why and how the implementation of certain environmental approaches may or may not be further adopted within the agriculture industry. This research has identified several important aspects that may positively encourage the further integration of environmental approaches within the agriculture industry: financial security, expanding knowledge, and local planning. The process of integrating the aspects identified here other identified aspects into the existing agriculture structure that becomes vital for the ecological modernization of the industry.

Executive Summary

Background and rationale for research

The Baltic Sea is often recognized as one of the most polluted seas in the world. Unfortunately, the very rivers and streams that feed the Baltic to give it a unique brackish quality, also bring with them pollution, a mark of the highly industrialized countries of the Baltic catchment area. One of the major sources of pollution going to the Baltic is run-off from agriculture production.

Agriculture related threats to the Baltic are tied to the intense levels of food production seen today. Throughout the Europe Union, including Sweden, agriculture has gone beyond providing adequate supplies of food, to producing large amounts of food that is in excess of what is needed to feed the people who live there. This is a trend not only seen in the EU, but throughout the developed world. High-intensity agriculture production requires large inputs of nutrients, both nitrogen and phosphorus, along with inputs of synthetic chemical pesticides. These inputs generate two key threats to the ecological integrity of the Baltic Sea; unnatural cycles of eutrophication, and damage from toxic substances.

There have been efforts made in Sweden to reduce the environmental impact that agriculture production has on the Baltic Sea. For example, by the end of the 1990s, at least 10% of Swedish agriculture was organic. However, not all efforts to reduce environmental impact have been successful. Sweden failed to meet its goal to reduce by half the amount of nitrogen going into the Sea from 1985-1995. The continued threat of runoff containing synthetic pesticides and excessive nutrients points to the need for further work to reduce these emissions. The Swedish Government has recognized this need. Within the 15 objectives adopted by the Swedish Parliament to make a "Sustainable Sweden" by 2020, there is an aim to reduce the impact of agriculture activities on the Baltic Sea and other important ecosystems.

There are a number of alternatives to the current mode of intensive agriculture production being employed to different degrees in Sweden. One option is the implementation of agriculture techniques that rely on many of the principles found in nature. These ecologically rooted practices include such things as the recycling of nutrients and the reliance on natural or biological pest control. High-tech computer programming can be used to identify the risks of pests as they arise. High-tech equipment can pinpoint the pest and directly apply the needed chemical. These and other modern environmentally-oriented techniques offer the opportunity to reduce or eliminate the input of synthetic fertilizers and chemicals for pest control.

With the availability of less-impacting technology, and the will of the Swedish government to reduce agriculture emissions, the question of "why does agriculture remain an environmental threat in Sweden?" is a good one. It is necessary to look closely at all the forces driving the Swedish agriculture industry, to determine what has promoted environmental improvement, as well as what has hindered it. Identifying and analyzing these various factors is necessary for unlocking clues as to how farming practices that decrease runoff emissions can be further implemented. Making the necessary changes to the social and political structure of the agriculture industry so that environmentally progressive techniques are put to use can be considered the ecological modernization of the agriculture industry.

Research Objective: The objective of this research was to identify and describe various forces that foster or inhibit the Swedish agriculture industry to implement more environmentally-oriented farming activities. A broader goal of the research was to create information that might be useful for initiatives throughout the Baltic Sea region addressing environmental problems related with agriculture. An ecological modernization framework was employed as the main research tool.

The ecological modernization framework identifies seven categories of factors that interact to influence the integration of ecological modern approaches into an organization or industry. The identification and analysis of the factors identified farmers as the key stakeholder.

Factors influencing ecological modernization of the agriculture industry

1) Commitments, Competencies, and Constraints- These are the commitments farmers make towards protecting the environment, and the various competencies and constraints that determine whether or not these commitments can be met. For example, a farmer might be committed to reducing nutrients leakage from his or her farm, however this commitment cannot be met if there is a lack of financial or educational resources to implement the necessary measures.

2) Policies and Programs- This factor considers the governmental policy structure in which an industry functions. These may be regulatory, incentive, or other measures administered by various levels of government (i.e. European Union, national government, or regional and local governments). This factor also includes government-sponsored programs designed to meet specific environmental objectives. A very important example is that of the EU's Common Agriculture Policy, which uses financial subsidies to meet its policy goals.

3) Industrial Ecology Conditions- This eco-factor considers those conditions that may allow industrial ecology to occur between systems within an industry or organization. Industrial ecology allows for the maximum use of resources while minimizing the disruption of the environment. In addition to seemingly win-win situations for the environment and economics, there are often barriers to taking advantage of industrial ecology possibilities. The possibilities for, and the barriers making it difficult to implement industrial ecology between systems are included in this factor. An example is the implementation of bio-energy crops, which may not only give farmers income from producing these valuable crops, but some bio-energy crops will improve soil quality by fixing nitrogen.

4) Related Businesses- This factor includes the numerous supply companies, buyers, retail firms, and research oriented firms that influence the activities of the industry or organization in question. The need for related businesses to be financially successful often give these businesses an interest in the changes of an industry. If a related business has strong influence (i.e. economic or political power), it can drive an industry or organization to change, or to maintain business as usual. This power could impede or encourage the adoption of environmental activities within an industry. An example in the agriculture industry is pesticide companies, which have an interest in the continued use of pesticides by farmers. Pesticide companies have powerful governmental lobbies, giving them some influence on governmental policy. However, pesticide companies must meet societal demands to improve environmental quality. Therefore, integrated pest management is promoted throughout the pesticide industry.

5) Interest Groups and Organizations- This factor includes all the organizations that are not directly associated with government or related businesses. These might be workers unions, non-governmental associations, capacity building organizations (e.g. academic institutions), financial institutions, and others that have some influence on the activities of an industry or organization. An example relevant to the agriculture industry in Sweden is the Federation of Swedish Farmers (LRF), which represents the interests of its members, which are the majority of farmers in Sweden, at a governmental level and throughout Swedish society. LRF also serves a capacity building role by organizing various training programs, some of which aim to address the environmental activities associated with agriculture.

6) Market Demand and Patterns of Utilization- This eco-factor considers the demands of the market, which can generally be divided into industrial (or business) markets and (final) consumer markets. The assumption is that firms will often act as a result of forces in the market. Also considered here are the expectations consumers have about certain products. These expectations may range from the price of products, to how they look, to how the products enable consumers to perform certain activities.

Finally, this factor considers those characteristics that distort market demands. For example, an increased consumer interest in environmentally-oriented products should encourage the agriculture production of these goods. Although this happens to some extent, the presence of stakeholders such as retailers and food processors, may not allow farmers to feel the true demand from consumers.

7) Competitive Forces- This factor considers the competition that exists between firms within an industry. It considers the various competitive positioning of organizations based on the traditional low-cost and differentiation approach. This factor not only looks at competitive positioning through product development, but can also include the low-costs and differentiation of processes. The search for competitive positioning may be a driver of an industry or organization to implement environmental measures. Also included, is the collaboration that occurs within industries or organizations to improve competitive positioning. An example in Sweden is the farmers that are using conventional manure to grow organic products. Conventional manure has more nutrients than organic manure, producing a greater product yield. Using conventional manure lowers the production costs, while maintaining the production of an environmentally-oriented product.

Considerations for the Future of Agriculture

The seven factors give some insight into what is happening within the agriculture industry and why implementing certain environmental technologies may or may not happen as easily as is necessary for major improvements in reducing nutrient and pesticide emissions. Several important aspects were identified through this research that appear to be important for the ecological modernization of the agriculture industry.

Financial security- Farmers may have more freedom to implement various environmental measures if they could be ensured that this implementation will not lead to lower profits. This security might come through increased market demand, but may be more likely to come in the form of government subsidies.

Expanding knowledge- Increasing the capacity of many aspects of the agriculture industry might lead to the implementation of environmental measures. For instance, improvements in the technology available to practice organic farming could lead to further reductions in the use of synthetic pesticides and fertilizers. Improving the farmers' understanding of proper integrated production techniques might accomplish the same task.

Local planning for local needs- Implementing measures appropriate for the unique needs and characteristics of individual farms and local communities might help create solutions to the environmental problems specific to these locations. This could be a farmer prioritizing the needs on his own farm, or a local community that develops goals for sustainable agriculture through stakeholder dialog.

Key Conclusions

Understanding the eco-factors of the agriculture industry not only explains how the identified important aspects might be integrated, but also what barriers might keep them out of the current system. Barriers may be rooted in a number of factors, or through a combination of conditions. Such factors maybe a lack of willingness among farmers to accept change, complex governmental policies that make it difficult to allow changes, strong lobby groups that have the power to resist certain policies that could be beneficial, and a lack of knowledge among consumers.

Further research might expand the marketability of products from an ecologically modern agriculture system on the international level. Another research step could be to determine ways that the Swedish

agriculture industry benefits both economically and environmentally from pollution prevention strategies.

The framework used provided an appropriate tool for organizing, structuring, and analyzing the collected information. However, with such a broad scope, it was not possible to fully explore all of the different factors uncovered during the analysis. Future research that might include looking specifically at certain related businesses, interest groups, organizations, government policies, etc. to better understand how they influence the agriculture industry. Continued market research might be helpful for understanding the evolution of consumer demands. Whether or not the data in this research is useful in a broader perspective is unclear, however, it could serve as a useful approach to understanding the factors that influence agriculture and the integration of environmental measures.

Table of Contents

List of Figures

List of Tables

Table of Boxes

1. Introduction

1.1 Background

The Baltic Sea has the reputation of being one of the most polluted seas in the world. High levels of mercury, DDT, and PCBs that bio-accumulate[1] up the food chain, have caused reproductive disorders in numerous Baltic organisms, from microbes to fish, birds, and marine mammals. Polish cod often contains heavy metals such as zinc, cadmium, lead and mercury, all of which are harmful to human health (Hinrichsen, 1998, p.45-55).

Perhaps the condition of the Baltic Sea, which includes the Danish straits that connect the Baltic to the North Sea, is not surprising, as nine highly industrialized countries surround the sea: Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland, Germany, and Denmark. Over 25 million people live on the coast of the Baltic. More than 88 million people live in the entire catchment[2] area of the Baltic, which covers more than 1.3 million square kilometres of land. In comparison, the surface area of the sea is only 366,000 square kilometres (Hinrichsen, 1998, p.45-55). It is important to consider the entire drainage basin of the Baltic, as many pollutants are generated away from the coastline and then carried to the sea by rivers and streams (Gren, Turner, Wulff, 2000, p. 1).

The agriculture industry is one of the activities that have critically impacted the environmental health of the Baltic Sea ecosystem. Runoff from agriculture is responsible for nutrient pollution and pesticide pollution, which lead to unnatural eutrophication cycles and high levels of water toxicity. Eutrophication and toxicity problems from agriculture do not only impact the sea, but all aquatic ecosystems, including lakes, rivers, and streams that carry or are fed by agriculture runoff. Effects from agricultural runoff, compounded by the impacts from industrial and municipal activities, further explain why the Baltic Sea has such a bad environmental reputation (Hinrichsen, 1998, p. 45).

As in many other areas of the world, intensive agriculture began throughout the Baltic region in the mid-1900s, with the production and use of artificial fertilizers and pesticides. The use of these chemicals intensified agriculture practices, drastically increasing the production of food per area of space (Tuncer, 2001, p. 1). In addition to problems from nutrient and pesticides, there are many other environmental problems associated with intensified agriculture practices, including degradation of habitat, soil erosion, biodiversity losses, loss of soil fertility, air pollution, and other types of water pollution (Miller, 2002, p. 271). The production of food may be considered one of the most important activities for sustaining human life, but the environmental and health impacts accompanying modern agriculture techniques implicate food production as one of the most threatening activities as well.

Not surprisingly, Sweden has followed suit with many other countries by adopting intensified agriculture methods. Consequently, Sweden contributes nutrient and pesticide pollution to the sea via agriculture runoff. A recent Baltic Marine Environment Protection Commission (2002) press release says, "In Sweden, agriculture accounts for an estimated 40% of all the nitrogen from man-made sources entering the Baltic Sea, so reducing nutrient inputs from agriculture remains the biggest long-term challenge." Although pesticide use has decreased some over the last two decades, in 1998, 1688 tonnes of pesticide were used in Swedish Agriculture (Fogelberg, 2001).

---

[1] Bioaccumulate: To increase the conentration of a chemical in specific organs or tissues at a level higher than normally expected (Miller, 2002, p. G2).

[2] Catchment area: The area of land bounded by watersheds draining into a river, basin, or reservoir (Collins, 1999).

Although agriculture runoff is still a major environmental threat, Sweden has not let it go unchecked. For example, by the end of the 1990s, at least 10% of the farming in Sweden was organic. The primary motivation for organic farming was to decrease the environmental impact of synthetic pesticides and fertilizers, as well as to improve the health quality of the agriculture products (Ekolantbruk, 2000). Additionally, Sweden has set a national goal that by 2005, 20% of the arable land should be in organic production. For dairy, beef, and lamb production the goal is for 10% of all animals to be in organic production by 2005 (Steineck, et al 2001, p. 252). A brochure entitled *The Swedish Approach* by the Federation of Swedish Farmers (2001) says, "Comprehensive efforts by Sweden's National Chemicals Inspectorate in the early 1990s made it possible to phase out those pesticides most adverse to health and the environment." These reductions do not mean the threat of pesticides is eliminated. The continued use of pesticides, including newly developed products, maintain the threat to the water system with toxic runoff.

The Swedish government has launched further initiatives to reduce agriculture pollution, which have not been very successful. For example, in 1988 the Swedish Parliament began a program to reduce the amount of nitrogen reaching the Baltic by half during the period of 1985 to 1995, and to significantly reduce the levels of pollution from phosphorous. Six years after the deadline, these goals still had not been reached (Steineck, et al, 2001, p. 251-265).

The continued threat of runoff containing synthetic pesticides and nutrients points to the need for further work in this area. This recognition has been made in Sweden, with the desire of the Swedish Government to see improvements in the environmental performance of agriculture. Within the 15 objectives adopted by the Swedish Parliament to make a "Sustainable Sweden" by 2020, there is an aim to reduce the impact of agriculture on the Baltic Sea and other important ecosystems (Ministry of the Environment, 2001).

There are a number of alternatives to the current mode of intensive agriculture production. One option is the implementation of agriculture techniques that rely on many of the principles found in nature. These ecologically rooted practices are such things as the recycling of nutrients and the reliance on natural or biological pest control. Another opportunity is to use high-tech computer programming to identify the risks of pests as they arise. High tech equipment can pinpoint the pest and directly apply the chemicals needed to eliminate it, without spraying surrounding areas or plants that do not need the chemicals (Husby, 2002). All of these modern day techniques offer the opportunity to reduce the input of synthetic fertilizer, and minimize or eliminate the use of chemical pest control.

With the availability of less-impacting technology, and the will from the Swedish government to reduce agriculture emissions, makes the question of why does agriculture remain a threat in Sweden a good one. There are even indications that the market for less environmentally impacting agriculture products is growing (Wier and Moch, 2001). As pesticide and nutrient runoff pollution continues to remain a threat, it is necessary to look closely at all the forces driving the Swedish agriculture industry, to determine why the environmental improvements have not been implemented to a greater extent than what is seen today.

Government subsidies, the rise of various food sector enterprises, political atmosphere, and the need for competitive positioning in the market place, are further examples of factors that influence the uptake of environmental practices within the agriculture industry. Making the necessary changes to the social and political structure of the agriculture industry so that environmentally progressive techniques are put to use can be considered the ecological modernization of the agriculture industry. Identifying and analyzing the various factors that influence the ecological modernization of the Swedish agriculture industry is necessary for unlocking clues as to how farming practices that decrease runoff emissions can be further implemented throughout the industry. Forces that foster or inhibit

the implementation of more environmentally-oriented farming activities should be found within these factors.

1.2 Objective

The objective of this research was to identify and describe various forces that foster or inhibit the implementation of more environmentally progressive farming activities throughout the Swedish agriculture industry. A broader goal of the research was to create information that might be useful for initiatives throughout the Baltic Sea region addressing environmental problems related with agriculture.

Research questions

Several key questions were chosen to serve as support for meeting the research objective.

What aspects of the agriculture industry in Sweden have led to the environmental impact of nutrient and pesticide pollution reaching the Baltic Sea, and what are the problems associated with this impact?

What are possible measures that could be implemented to assist the agriculture industry in reducing nutrient and pesticide emissions into the Baltic Sea?

What are the relevant forces acting on the agriculture industry that promote or inhibit the further adoption of further measures designed to reduce nutrient and pesticide emissions?

What are some key aspects that may help overcome barriers to implementing emissions reduction measures within the agriculture industry, and how can they be integrated into the organization of the Swedish agriculture industry?

1.3 Scope and Limitations

The problems associated with nutrient and pesticide runoff from agriculture were a starting point for this study. The researcher realizes there are many other environmental problems resulting from the agriculture industry, including air pollution, soil erosion, and inefficient energy use, and other forms of water pollution. Nutrient and pesticide runoff have been identified as two of the most important sources of pollution going into to the Baltic Sea environment, making them relevant for a study that concerning the impacts on the sea. Additionally, the presence of excess nutrients and pesticides are a classic indicator of intensified agriculture practices. Nevertheless, many of the factors influencing the adoption of technologies to reduce nutrient and pesticide emissions from agriculture may be similar to, if not the same factors driving the integration of techniques for avoiding additional agriculture related environmental problems.

Farmers are considered the main stakeholders in this study. All the factors identified are put in context of their influence on farmers. There are additional actors within the agriculture industry that are influenced by the same factors as farmers. Regardless, the additional actors are classified as influential factors impacting farmer behavior. In most cases, factors considered were those that have direct influence on farmers, e.g. machine supply companies providing equipment to farmers. The influence that these additional actors experience is considered only when necessary to further explain the activities of farmers. For example, the shareholders of pesticide companies do not have direct contact with farmers, but their interests are often reflected in the actions of pesticide companies, whose actions have a more direct influence on farmers.

This study primarily addresses the agricultural industry in Skåne, of southern Sweden, which is well known as an important agricultural region. Additionally, the region chosen makes for an interesting case study as the commission responsible for the Helsinki Convention indicated in May 2002, one month prior to the start of this research, that three of the 12 environmental "hotspots" relating to agriculture are located off the coast of Skåne (HELCOM, 2002). When necessary for discussion, examples from other regions within Sweden, and even from outside the national borders, are provided.

It was not possible to fully identify and analyze all the specific factors that determine why certain things within the agriculture industry in southern Sweden occur. To accomplish that task would take more of an insider's perspective, as opposed to an outside investigator (as in this study) who gains insight from a limited number of stakeholders within various sectors of the industry. In order to get the full perspective, it might also be necessary to only study individual sectors, i.e. analyzing the beef sector or sugar beet sector specifically. Although this belongs in the category of further research, the inference is that although there are similarities throughout the entire agriculture industry, each sector does have unique differences. Each sector often has a separate value chain that is completely unrelated to the others, i.e. the beef sector involves a slaughtering process, while the sugar beet sector does not. Obtaining a full insiders perspective of the agriculture industry was unrealistic for this study, however this was not the aim.

This study did aim to garner a very broad understanding of the industry in Skåne, so it was not necessary to discover all the very specific details of the individual factors that were identified as influencing the industry. Although certain companies, policies, interest groups, etc. were identified as influential factors, specific details about each of these were not sought. Therefore, the data collected was generally empirical data. This was also true when collecting data about the actions of individual farmers. Nevertheless, specific details about farmers, various stakeholders, policies, activities etc. were discussed when it was necessary to make further explanations or give examples to better illustrate the general influence these factors have on the industry.

Additionally, it is possible that some factors vary in their degree of influence from one farmer to the next. When this is clear, it is explained. It was typically not considered necessary to know to what extent each factor affects individual farmers, as long as a general understanding could be made about the influence of factors on all farmers, or on types of farmers (e.g. organic farmers or integrated production farmers).

The factors identified were predominantly those originating in Sweden. However, if it was clear that influential factors were situated outside of Sweden, they were also counted as relevant factors (e.g. the international market demand for organic products). Therefore, the limitation for choosing factors was not based on geographical boundaries, but rather on the level of relevance the factors have on farming activities.

The author realizes the opinions of all relevant individuals and organizations associated with the agriculture industry are not represented. Those that are represented are assumed to aide in building a general understanding of the issues and factors promoting and inhibiting improvements in the pesticide and nutrient emissions from the agriculture industry in Sweden.

1.4 Methodology

This section explains the methodology used for accomplishing the research objective and answering the supporting research questions.

1.4.1 Choosing a framework for analysis

To answer the questions posed in the research objective, the agriculture industry in the Skåne region was developed as a case study. The research was exploratory in nature to get an idea of the different factors influencing the agriculture industry. Even by narrowing the scope of the research to one geographical region, the vastness of the agriculture industry makes it difficult to do exploratory research without being overcome by large amounts of data. Therefore, choosing an appropriate framework took on extra importance, as it was not only needed to analyze the data collected, but also to help focus the research towards the most valuable information.

For the present study, an ecological modernization framework was chosen as the primary research tool. The framework, expanded by Renato Orssatto from previous works, provides an outline for identifying and studying the forces driving the movement of an organization or industry away from environmentally destructive activities through the adoption of specific environmental strategies (2001, p. 107-137). The framework identifies seven environmental-contingent factors, or eco-factors, that have the potential to change the decisions and behavior of people in and between organizations, which in turn fosters or inhibits ecological modernization. Eco-factors explain the context in which power to influence, control, or manipulate is embedded within an organization or industry (Orssatto, 2001, p.107-137).

The seven eco-factors are as follows. An explanation of each of the seven categories, as well as a full description of the analytical tool, is presented in chapter 3.

1) Commitments, Competencies, and Constraints
2) Policies and Programs
3) Industrial Ecology Conditions
4) Related Businesses
5) Interest Groups and Organizations
6) Market Demand and Patterns of Utilization
7) Competitive Forces

1.4.2 Information gathering

Background information was collected, primarily through literature review, to explain various aspects of the agriculture industry, including environmental impacts and solutions to these environmental problems. Background information was also used to explain the theoretical concepts used in the study, especially those concepts that helped created a better understanding of the utilized research tool.

As described in the previous section, 1.4.1, the ecological modernization framework was chosen as the primary research tool. Hence, the seven eco-factors described in the ecological modernization framework were used to guide the majority of the information gathering. Typically, this was primary data collected from various actors through e-mail communication, personal meetings, and phone conversations. Contacts were made, and when necessary, literature was reviewed, in order to fill in the blanks and explain and develop the seven eco-factors for the unique characteristics of the agriculture industry in southern Sweden.

It was necessary to acquire information from individuals and organizations with many different connections to the agriculture industry in Skåne. Information was therefore gathered from farmer support organizations, government agencies, environmental researchers, university professors, the European Union, banks, market development groups, supply companies, and agriculture production companies (including individual farmers). Much of the information taken from these sources was garnered through personal interviews, phone calls, or through e-mail exchange.

It was not possible to contact all organizations and businesses related to the Swedish agriculture industry. However, contacts were made to gain a general understanding of the influences on the industry. A more detailed study would further increase the number of organizations contacted and interviews conducted.

The necessity to make contact with new stakeholders was often uncovered as data was collected and put into the framework. Discussion participants often provided names of contacts they thought would be helpful for further data collection. This was an important link to new contacts, and new information. Additionally, contacts were found through literature review and electronic searches.

Discussion was necessary to fully explore the thoughts, ideas, and information from the various stakeholders. As indicated by Peter Arnfalk (2002), meetings that need to be in the form of discussions are ideally carried out through face-to-face, or physical meetings, as opposed to virtual meetings that are most appropriate for short meetings, and those with lesser importance. For this reason, face-to-face meetings were the most preferred method, with phone conversations and e-mail as a second and third alternative. E-mail was useful for making initial contacts with stakeholders, as the purpose of the research could be briefly explained in text. Also, additional follow-up information needed after discussions could be gathered through e-mail exchange.

Appendix 1 shortly describes the various people contacted during this study, and briefly explains the reason they were chosen to provide data to this study. In many cases, the personal contacts were chosen because they could provide insight into the various eco-factors. Appendix 1 also mentions the form of each interview (i.e., e-mail exchange, telephone interview, or face-to-face meeting).

The discussions were carried out in a semi-structured manner allowing the researcher to collect both intrinsic and objective data from the interviewees. When possible, literature was used to support the data collected from the primary research. Data from literature reviews was also used to fill gaps within the data collected through personal contacts. Appendix 2 gives an example of research questions used as a starting point for discussions with various businesses and organizations. These questions were not adhered to strictly, as various topics arose as the meetings progressed. In most cases, different starting questions were chosen based on the nature of the person being interviewed (e.g., farmers or academic researcher).

1.4.3 Data analysis

The analysis of data centered on the information gathered within each of the eco-factors. The analysis was discussed in the context of how the factors promote or inhibit ecological modernization.

The analysis of the different factors allowed the researcher to identify several aspects that appear important for further moving the agriculture industry towards reducing nutrient and pesticide pollution. A discussion explaining the possibilities and difficulties of implementing the chosen aspects illustrates how the various eco-factors can be used to explain what is occurring inside the industry structure.

1.5 Progression of Research

This section presents a visual illustration of the progression of research. See figure 1.

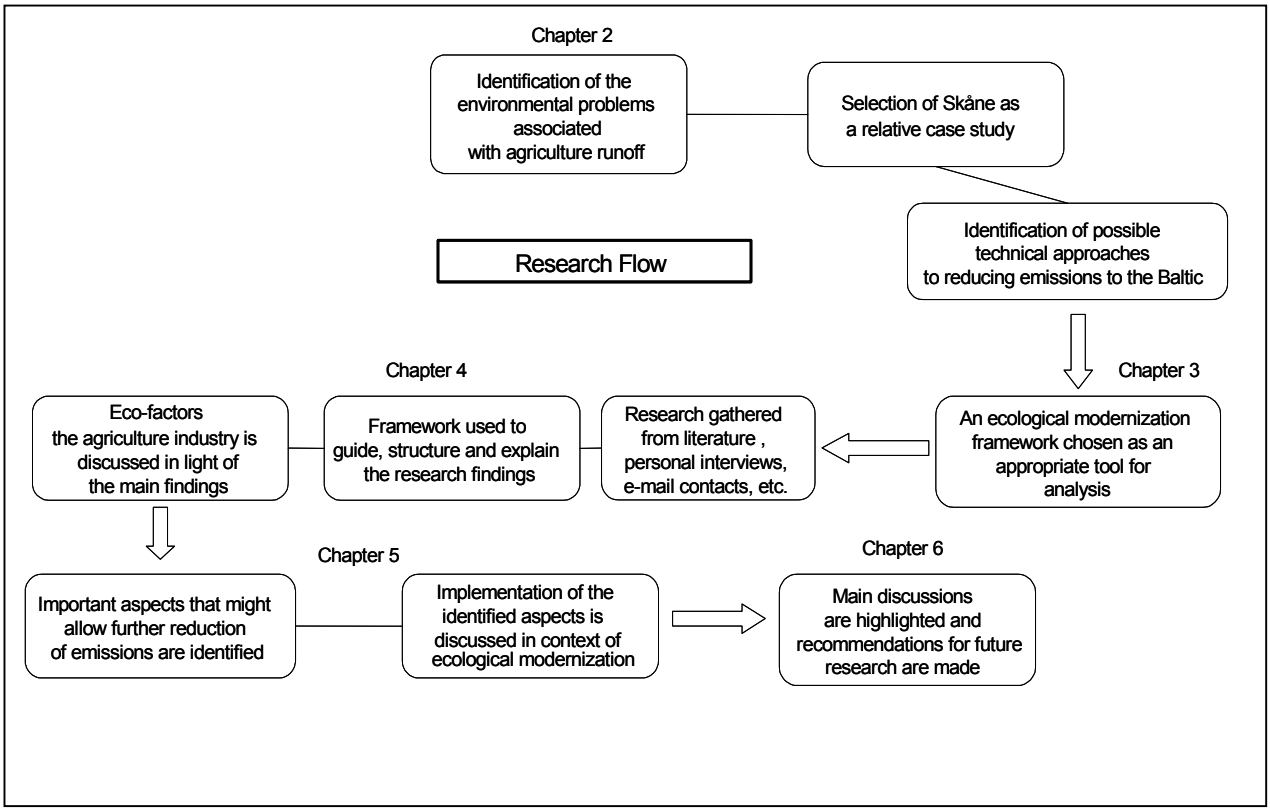

Figure 1 Illustration of research progression.

2. Agriculture and the Baltic Sea

This chapter provides background for a better understanding of the problems associated with nutrient and pesticide pollution, and to identify specific aspects of the agriculture industry in Sweden. It finishes with a presentation of possible techniques that could be implemented in Skåne to reduce the environmental impact on the Baltic Sea.

2.1 Environmental Threats from Nutrient and Pesticide Pollution

Both point source and non-point source pollution produced by various industries are problematic for the Baltic Sea. The agriculture sector is primarily a contributor of non-point source pollution. Unlike point source pollution, which can be easily identified coming from a smoke stake or sewer pipe, non-point source pollution is widely dispersed, making its origin difficult to pinpoint (Miller, 2002, p. 478). Agriculture pollution in the Baltic region originates on many farmlands and gardens, then collects in lakes, streams and rivers before making its way to the sea.

Two of the most serious threats to the Baltic Sea are 1) unnatural eutrophication patterns as a result of nutrient pollution from sewage, fertilizer, and other wastes, and 2) high concentrations of toxic substances such as heavy metals and other hazardous materials. Both of these problems damage and decrease the number of fish and other organisms, as well as threaten human health. There are three main sources for these environmental problems: waste from municipalities, industrial waste, and agricultural runoff. Other contributing sources of pollution include mining and fish farming (Hinrichsen, 1998, p. 45-55).

2.1.1 Eutrophication of the Baltic

Eutrophication does occur naturally. However, problems arise when the eutrophication process is accelerated by the input of excess nutrients, namely nitrogen (N) and phosphorous (P) and potentially potassium (K). Nutrient pollution from fertilizer and animal waste runoff is a primary contributor to the accelerated eutrophication process. During this process, the abundant nutrients act as fertilizer for fast growing algae and other plant life. This plant life dies as part of its natural lifecycle; depleting dissolved oxygen from the water as aerobic bacteria decomposes it. This lack of oxygen can kill fish and other aquatic animals (Miller, 2000, p. 165-167).

It is thought that during the 1900s, nitrogen levels in the Baltic increased fourfold and phosphorous eightfold, in line with intensified agricultural and industrial activities. Over the past fifty years, the deeper waters of the Baltic Sea have been transformed from an oxygenated environment with normal fauna of fish and invertebrates, to waters that are now highly deprived of oxygen. Today, bacteria life forms are all that can be found beyond a 50-meter depth throughout the entire Baltic Sea (Hinrichsen, 1998, p. 45-55).

According to a study of Baltic Sea emissions, throughout most parts of the Baltic, non-point sources made up 70-90% of the total nitrogen load, and 20-40% of the total phosphorous load. The same study pointed out that although it is possible to get accurate data concerning nutrient emissions from certain areas of the Baltic, it is very difficult to make accurate generalizations for the entire Baltic region without proper data from all areas. This is partly due to great variations in land use, soil types, percentage of agricultural land, and population density throughout the Baltic, all of which greatly affects discharge rates (HELCOM, 1998).

2.1.2 Toxic substances in the Baltic

Concentrations of many hazardous substances such as DDT, mercury, lead and other heavy metals have declined in recent years. Regardless, their presence still poses a threat to the integrity of the Baltic Sea. The harmful influence of other as yet unknown contaminants is suspected, since fish in the Baltic are evidently producing two to three times more detoxifying enzymes than they did previously (Helsinki Commission, 2002).

The chemical makeup of some hazardous substances, including some types of pesticides, allows them to bioaccumulate in organisms and then biomagnify throughout the food web. Bioaccumulation is an increase in the concentration of chemicals in organs or tissues of an organism, beyond what would normally be expected. Through biomagnification, the chemicals can be passed from one organism to the next throughout the food web. Organisms higher on the food chain are expected to have higher concentrations of the chemical, as they ingest organisms with toxic substances in their tissues (Miller, 2002, p. 398-399). According to Jens Husby (2002) at Bayer Chemical, a pesticide producing company, pesticides are screened to determine whether they contain bio-accumulating chemicals, and if they do, they are not allowed on the market.

Regardless of the efforts by Bayer, studies have shown that bioaccumulation and biomagnification indeed occur in the Baltic Sea. One study gives an example of Baltic seals and their food source, herring and salmon. The concentration range of a pesticide was found to be higher in the tissue of seals than in herring and salmon (Wilberg, Oehme, Haglund, Karlsson, Olsson, and Rappe 1998). Humans, who are also at the top of the food chain, face a similar to that of seals. Further, chemicals can be passed from women to their babies during pregnancy and through breast milk (Miller, 2002, p. 398-399). Figure 2 illustrates biomagnification in the Baltic upon removing seals from the top of the food chain and putting humans, who also ingest herring and salmon.

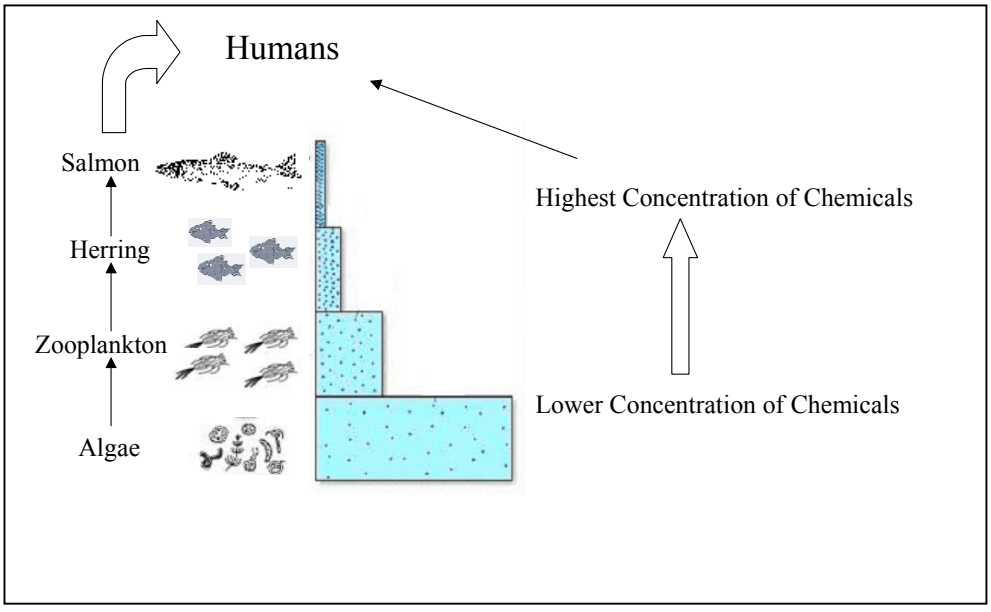

Figure 2 Illustration of Bioaccumulation (based on a diagram in Miller, 2002, p. 399).

2.1.3 Nature of the Baltic

Many of the worst spots for agriculture pollution are not on the coast itself, but along the river systems draining into the Baltic (HELCOM, 1998). Because this sea is somewhat shallow (a mean depth of 60 meters) and almost entirely enclosed by land, it takes about thirty years for the Baltic to completely renew its waters through the Skagerrak, a narrow opening which connects the Baltic to the

North Sea. The North Sea is further connected to the Atlantic Ocean. This naturally slow process makes the sea and the life inside it even more vulnerable to pollution coming from the rivers and streams throughout the Baltic drainage basin (Hinrichsen, 1998, p.45-55).

The Baltic Sea is brackish (condition of seawater with a relatively low salinity) due to the high influx of fresh water from rivers and the limited amount of new seawater. The lowest salinity is in the Bothnian Bay in the north, and the highest salinity is in the south, closer to the influx of seawater. Being brackish, the water is too salty for most freshwater species and too fresh for most marine species. Therefore, naturally there are fewer species inhabiting the Baltic Sea compared to other seas (Jansson and Dahlberg, 1997). Because of the limited number of species, there are fewer organisms to perform all the basic ecosystem functions such as fixing solar energy, clearing the water, decomposing, and recycling wastes. This situation makes the Baltic Sea predisposed to stress (Jansson and Dahlberg, 1997). Therefore, any impact on the Baltic, such as pollution, is of extra concern to the sea.

As is the case in the Baltic, it is hard to determine specifically which environmental impact will trigger a specific type of ecological damage. It is most likely a combination of impacts and ecosystem stress that induces the damage (Ongley, 1996). Box 1 gives a list of different ecological effects from pollution, many of which have been observed in the Baltic.

-Death of organisms

-Cancers, tumors and lesions on fish and animals

-Reproductive inhibition or failure

-Suppression of immune system

-Disruption of endocrine (hormonal) system

-Cellular and DNA damage

-Teratogenic effects (physical deformities such as hooked beaks on birds)

-Poor fish health marked by low red to white blood cell ratio, excessive slime on fish scales and gills, etc

-Intergenerational effects (effects not apparent until subsequent generations of the organism)

-Other physiological effects such as the thinning of the eggshells of sea birds

Box 1 Ecological effects of pollution (Ongley, 1996).

2.2 Intensive Agriculture Practices in Sweden

The intensification of agriculture throughout the second half of the 1900s has been a major contributor to the leakage of nutrients and pesticides into the water system (Hinrichsen, 1998, p. 45-55). Three characteristics of intensive agriculture directly linked to nutrient and pesticide pollution in Sweden are presented in this section, namely fertilizer use, pesticide use, and the drainage of wetlands.

2.2.1 Fertilizer use

In Sweden between 1950 and 1980, there was a big increase in the inputs of nitrogen, phosphorus and potassium in the form of synthetic fertilizer being used in relation to the food being produced (Granstedt, 2000). This means that the amount of nutrients being applied to crops and fed to animals began to exceed the amount of nutrients contained in the food. Today, the input of nitrogen in

artificial fertilizer is more than three times higher than the output of nitrogen in the form of agricultural food products such as bread, grain, milk and meat (Granstedt, 2000). See Figure 3. It is these excess nutrients that make their way into the environment, increasing the risk of eutrophication in the Baltic Sea.

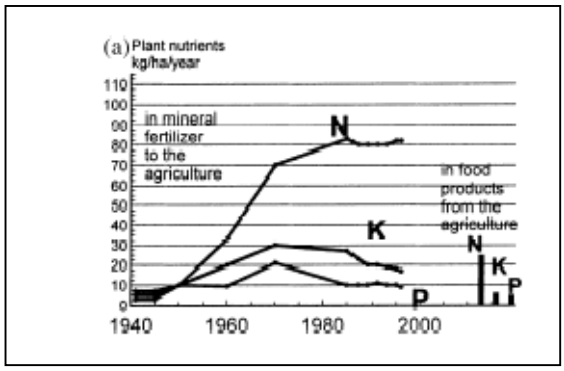

Figure 3 Food nutrients vs. nutrients in fertilizer (Grandstedt, 2000).

When grasslands and forests are cleared, and wetlands are drained to make suitable cropland, thousands of interrelated plant and animal species can be replaced by one crop. These monocultures decrease the overall soil quality, and are partly responsible for the inability of soil to hold nutrients for to be used by the crops. Therefore, it is necessary to apply high amounts of artificial fertilizers (Miller, 2002, p. 219-234).

Another reason for needing high inputs of inorganic fertilizer is the activity of farming crops on farms without any animals. Animal manure can improve the soil structure, add organic nitrogen, and stimulate the growth of beneficial soil bacteria and fungi (Miller, 2002, p. 219-234). Farms without animals depend on artificial fertilizers to bring nutrients back to the soil, since manure is not conveniently available for use. Even if manure is used as fertilizer, there is often a necessity to supplement the manure with artificial fertilizers in order to maintain the high output demanded from industrial agriculture systems (Lindahl, 2002).

Just as there are many farms with a very limited number of animals, there are also many animal farms with a limited number of crops. In Sweden, the overall number of animal producing farms has decreased over the past forty years, although, the number of animals per farm has increased. Disposing of the manure produced on these animal dense farms can become a problem, as the nitrogen and phosphorus nutrients in the manure often leaks into the water system. The nutrients can be incorporated back into the soil if the manure is properly spread onto the cropland. However, in today's systems, there is often much more manure on farms than the soil can properly handle. If large amounts of manure are deposited on the cropland, the soil will not have the opportunity to absorb all the nutrients before the rain carries them away (Grandstedt, 2000). This is a problem not only for conventional farmers, but for organic farmers as well (See section 2.3.7).

A large percentage of the arable land in Sweden is used to produce animal fodder (grazing land and grain crops). According to Granstedt (2000), this percentage may be as high as 80%. This number was similar in the 1950s, however a higher percentage of the fodder used today comes from grain based crops, rather than grazing lands. Conventional crop producing farms require high levels of artificial fertilizer, as these crops are grown in areas where there is insufficient access to nutrients from manure. The grains are then brought to the higher density animal farms where it is used to feed the animals. As described, the nutrients in the animal waste then threaten the water system. Additionally, many animal farmers use feed supplements that have been grown outside Sweden, adding additional nutrients into the system (Andersson, L. and Andersson, T. 2002).

The nutrient loss by way of human waste is another aspect associated with the nutrient problem. The nutrients that end up in the food eaten by humans generally do not get put back onto the fields as fertilizer in Sweden. There is some use of human urine as fertilizer, but this is limited. There are many social and legal restraints regarding the use of sludge from treated municipal waste on agricultural fields. The main concern is heavy metals and other hazardous materials that are added to waste streams that end up in the sludge (Steineck, et. al., 2001, p. 251-265). Therefore, many of these nutrients find their way to the environment after passing through sewage treatment centers.

What has been described here is the flow of nutrients through the agriculture system and to the water system in Sweden. Figure 4 illustrates this open looped system.

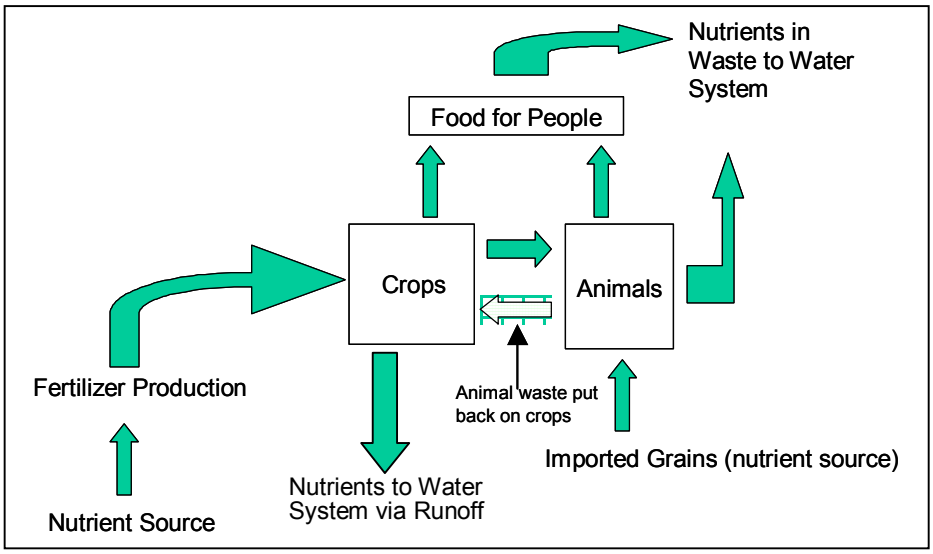

Figure 4 Illustration of Nutrient Flow

HELCOM identifies areas of critical environmental concern, or "hotspots" in the Baltic region. These agricultural hotspots indicate problems with nutrient pollution occurring in those areas. The map in Figure 5 was updated in June 2002. It shows 15 hotspots for agricultural runoff in the Baltic region, with three occurring in and around the Skåne area (HELCOM, 2002).

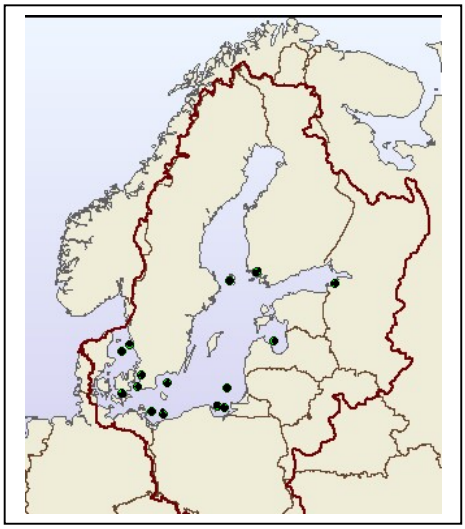

Figure 5 Agriculture Environmental "hotspots" in the Baltic (Dark spots) (UNEP, 2002).

2.2.2 Pesticide use

Increases in pesticide use also signify agriculture intensification. Although there have been some improvements in technology, harmful chemicals have not always been applied in a way that ensures they hit their target. It is these pesticides especially that go directly to the water system that have been a problem (Helsinki Commission, 2002). The disappearance of natural predators through the replacement of native organisms also creates the need for pesticides to control the pests that attack crops.

Measures to reduce pesticide use in Sweden have seen some success over the last two decades. See Figure 6.

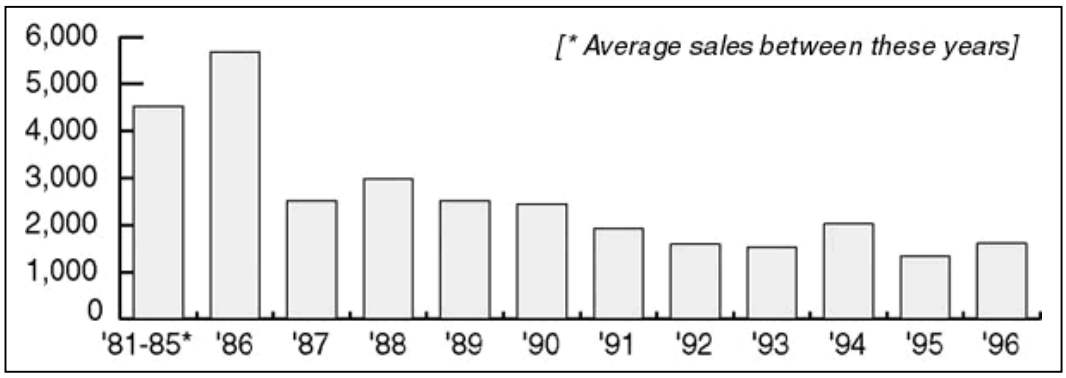

Figure 6 Average sales of pesticides in Sweden from 1981-1996, in metric tons (Pesticide News, 1998).

A brochure entitled *The Swedish Approach* by the Federation of Swedish Farmers (2001) states, "Comprehensive efforts by Sweden's National Chemicals Inspectorate in the early 1990s made it possible to phase out those pesticides most adverse to health and the environment." Although the chemical companies are claiming to test chemicals thoroughly to ensure that precautions are taken in the use of certain chemicals, or that highly dangerous chemicals are removed from use (Husby, 2002), it is possible that further testing will reveal that some of the chemicals being used today are more harmful to the environment than currently thought. The threat of harmful pesticides being developed that are not currently included on the list of the banned substances should also be considered.

2.2.3 Loss of wetlands

According to Ann Åckerman (2002), a wetland specialist at Lund University, the role of wetlands as filters and the impact wetland drainage has had on this function. It is thought by many that wetlands remove nitrogen, phosphorous, and possibly potassium nutrients and pesticides from water that passes through these wetlands before it reaches the sea. The drainage of thousands of square kilometers of wetlands has diminished the natural ecological function of wetlands in many agriculture areas.

Wetlands are lands covered with water all or part of the time, not including lakes, reservoirs, and streams. Some wetlands are very large; some are small. There is an estimated area of 93,000 km^2 of wetlands throughout Sweden. This translates into 20% of the country's total land area being classified as wetland. Therefore, the size of the total area of wetlands in Sweden is approximately three times the size of the country of Belgium (Swedish EPA, 2000).

Throughout the last two centuries, extensive draining of wetlands has taken place to make room for agriculture land. Many were drained by government mandates to make the land more suitable for agriculture. In the last two centuries, approximately 90% of the natural wetlands in southern Sweden

have disappeared (Åckerman, 2002). Gösta Regnell (2002), who works with wetland creation issues in Skåne's regional government office, says 30% of the land in Skåne would be wetlands if this drainage had not occurred, but now, the actual figure is only 3-4%. Figures 7 and 8 illustrate the drainage of wetlands that occurred in one area of Skåne between the early 19th century and the middle of the 20th century. Although the decrease of wetlands has been extensive, Regnell (2002) says, this picture might be a bit exaggerated, as it might be a bit comparing the situation during a rainy time and dry time.

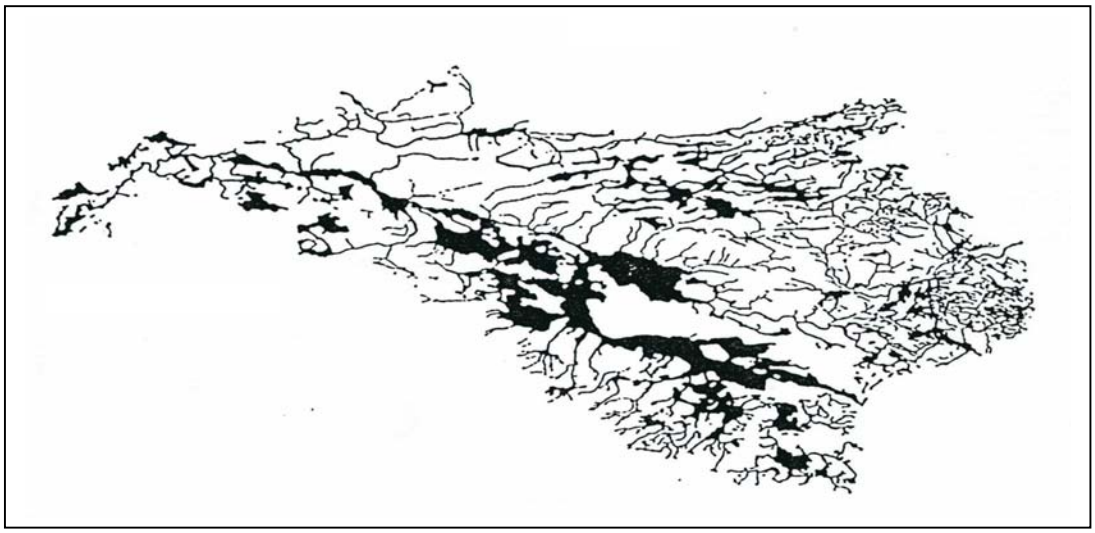

Figure 7 Water system of the Kävlinge River 1812-1820. (from Wolf, 1956) (provided by Blix, 2002)

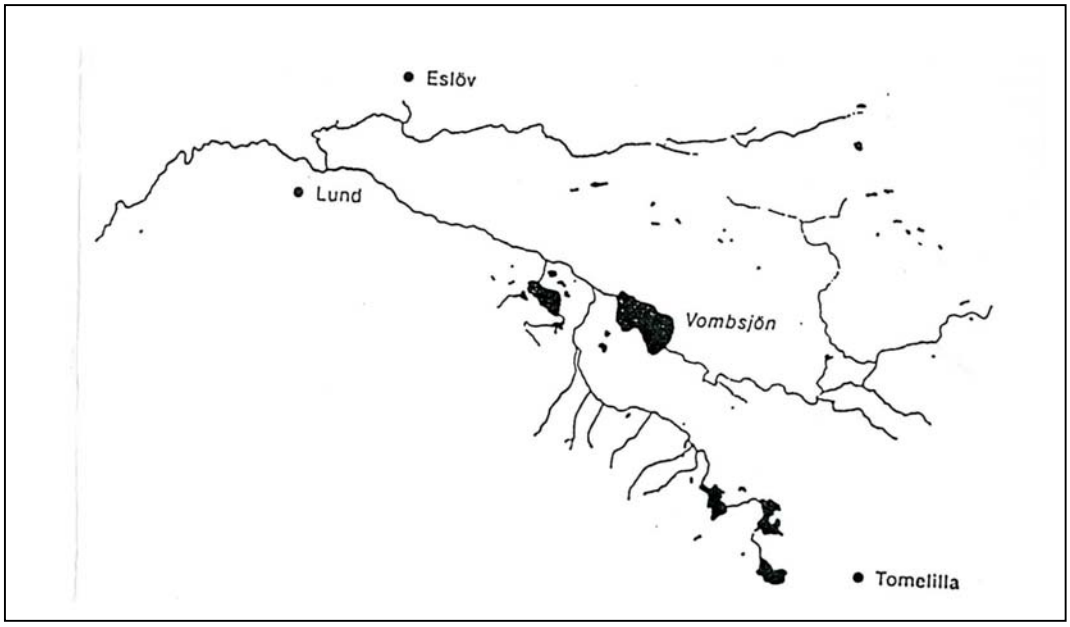

Figure 8 The water system of the Kävlinge River 1950-1953 (from Wolf, 1956) (provided by Blix, 2002).

2.3 Approaches for Lowering Nutrient and Pesticide Emissions

Agriculture does have a great negative impact on the Baltic environment. Nonetheless, this does not mean techniques aimed at reducing this environmental impact of nutrient and pesticide pollution do not exist. There are initiatives throughout Sweden designed to address environmental concerns and increase the prevalence of such methods throughout the industry.

Pollution prevention vs. mitigation

The traditional way to deal with environmental impacts has been to develop means to mitigate the source of environmental damage, such as the purification of wastewater before it enters streams or the sea. An alternative to the so-called *end-of-pipe* solutions is to prevent or minimize these environmental pollutants at their source, using *cleaner technologies*. It has been found in many cases that the prevention of environmental damage is a more efficient way to improve environmental quality than abatement techniques. Prevention can lead to decrease in the use of resources, and often decreases the costs associated with cleaning up pollutants through end-of-pipe techniques.

The agriculture techniques presented in this section primarily follow the theme of preventative environmental measures. However, there are some techniques being utilized in southern Sweden that appear to take on end-of-pipe solutions, or a combination of end-of-pipe and preventative strategies. Although cleaner technologies might be ideal, one cannot forget end-of-pipe methods if they help reach the goal of reducing emissions to the Baltic Sea.

Initiatives in Sweden

There are several initiatives that are specific attempts to reduce the risk of nutrient and pesticide runoff created from agriculture. A new program designed especially for the situation in southern Sweden, "Nutrients in Focus (2002)," is one such example. Also, the Federation of Swedish Farmers provides education and training concerning nutrient and pesticide use (Blix, 2002). Academic research such as that from Grandstedt (2002) also addresses nutrient and pesticide pollution. One could even turn to the objectives of European Union and Swedish regulations to look at attempts to reduce the emissions from agriculture (Steineck, et. al., 2001, p. 251-265).

Based on various initiatives existing throughout Sweden, the following objectives should be met to diminish the impact of agriculture on the Baltic.

- Avoiding inputs of excess nutrients into the agriculture system
- Closing the nutrient loop
- Minimizing the application of pesticides
- Reducing the amount of unclean runoff going into the water system

This section discusses six general approaches that can be used to help the agriculture industry meet the stated objectives. These methods were developed after reviewing the various initiatives being taken in Sweden (mentioned earlier in this section). These six were chosen because they are quite common within the different initiatives, and have the potential to be utilized throughout the agriculture industry in Skåne.

2.3.1 Nutrient recycling

One way to decrease the amount of excess nutrients going into the agriculture system is by utilizing more organic material produced on farms, as sources of nutrients on farms. If nutrients from organic material are used, there should be less reliance on artificial fertilizer.

It is important to realize that the use of organic material and the resulting decrease in artificial fertilizers is not proportional or linear. This is due to the varying degree of quality between different types of organic material. For example, some manure has low nitrogen content. If this manure is applied to the soil, the decrease in need of the artificial fertilizer might be minimal. If the nutrient content of the organic material is matched with the needs of the soil, then the need for artificial fertilizer should be reduced more significantly.

2.3.2 Biological fixation of nitrogen

To reduce the reliance on nutrient inputs to the soil, nitrogen-fixing crops can be utilized. In order to be beneficial for decreasing the amount of nutrients required for agriculture production, these nitrogen-fixing crops should be part of the regular crop rotation of the arable land. Clovers, grasses, and other plants that make up ley[3] are often useful as nitrogen-fixing crops. These can also be used as grazing lands for animals, and as energy crops (Zethraeus, 2002).

2.3.3 Use of technologies that prevent leaching

Another important aspect in reducing nutrient pollution is improving the effectiveness of the nutrients applied to the soil. In an ideal system, there is a balance between the nutrients applied to the soil and the nutrients present in the crops produced. If the inputs and outputs are balanced, then the surplus of nutrients at risk of going into the water system should be minimized. There are proper fertilizer application techniques that take into consideration the type of soil, weather conditions, contours of the land, amount of nutrients necessary, etc. Taking into consideration the characteristics of individual farms when applying fertilizers, should help farmers reduce the threat of pesticides entering the water system.

Technologies that help apply pesticides precisely onto crops should also be employed when these chemicals are applied. There are tractors, computer technologies, and other techniques that ensure pesticides are applied precisely on the pests they are designed to attack. These technologies, and those being developed, should help minimize the loss of pesticides to the water system (Husby, 2002).

2.3.4 Integrated pest management

Integrated Pest Management (IPM) is an increasingly popular system for controlling pests while minimizing the use of synthetic chemical pesticides. Box 2 lists the techniques employed in an IPM system. These techniques are used in both integrated management and organic agriculture. However, organic agriculture would not consider synthetic chemical pesticides as an IPM option.

[3] Ley- arable land that is turned to grassland (Collins, 1999)

- Changing the type of crops grown in one location every season or year (crop rotation).
- Planting rows of hedges or trees around fields to avoid insect invasions, and provide habitats for their natural enemies.
- Adjusting planting times so that major insect pests either starve or get eaten by their natural predators.
- Avoiding growing certain types of crops in locations where pests that the crops are susceptible to are normally found.
- Planting trap crops to lure pests away from the main crop.
- Switching from vulnerable monocultures to intercropping, agro forestry, and polyculture, which use plant diversity to reduce losses to pests.
- Ploughing under or burning diseased or infected plants and stalks and other crop residues harbouring pests remaining in crop fields after harvesting.
- Using plastic that degrades slowly in sunlight to keep weeds from sprouting between crop rows.
- Using vacuum machines to gently remove harmful bugs from plants.

Box 2 Integrated Pest Management (Miller 2002, p. 512).

2.3.5 Wetland creation

As mentioned, wetlands are beneficial tools for mitigating nutrient and pesticide pollution in the water system before it reaches the Baltic. Therefore, increasing the amount of wetlands has the potential to increase the "filtration" of pollution tainted runoff before it meets the sea. Also, the collection of runoff water in reservoirs or large ponds on agriculture land potentially collects many of the pollutants that would normally go directly into the surface water system and to the sea.

There have also been initiatives to introduce wetlands back into the Swedish landscape. There are hopes to create 12,000 hectares of wetlands around Sweden, with 5000 in Skåne alone. So far, there are only 200 hectares in Skåne (Åckerman, 2002).

If wetland implementation is to be effective, it is necessary to situate the wetlands in areas on agriculture fields where they can actually catch the runoff. Constructing a wetland in the most effective location might require the forfeiting of prime arable land. If wetlands are created in a place where minimal runoff from fields does not pass, then the effectiveness of the wetland sharply diminishes (Blix, 2002) (Åckerman, 2002) (Dahlman, 2002) (Lindahl, 2002).

2.3.6 Additional ecological planning and use of eco-tones

Johanna Björkland (2002), a sustainable agriculture researcher pointed out, there are additional eco-tones that can be used to deal with environmental problems. Eco-tones might include such things as planting catch crops around the field to keep nutrients from escaping, making a green zone between the crops and waterways, etc. Also, maintaining high soil quality by such things as avoiding plowing methods that make the soil too compacted, will also help reduce nutrient losses. These and other ecological activities could potentially contribute to decreasing the environmental impact on the sea.

The measures that could be implemented may be different for each farm, depending on their unique characteristics.

2.3.7 Organic and integrated agriculture production

Organic Farming and *Integrated Agriculture Production* are two general categories of agriculture often discussed as solutions to the environmental issues associated with agriculture. Farmers often make commitments to either one of these methods when trying to find ways to minimize their environmental impact. A fundamental difference between these two categories is the use of chemicals in production. Organic farming does not allow for the use of synthetic pesticides or fertilizers. Integrated production (IP) allows the use of chemicals, but the goal is to minimize their use. Despite the main differences between organic and IP agriculture, both approaches have similar environmental goals. However, this greatly depends on the degree to which individual farmers carry out organic or integrated production, and the commitment of these farmers towards environmental improvement.

Organic agriculture is commonly defined in Europe as a farming method that depends on natural ecological processes, where synthetic chemical inputs (namely fertilizers and pesticides) are not used (David, Bernard, Just, 2000, p. 19). Without the use of the chemical inputs, organic farmers must rely heavily on natural ecological services to maintain high animal and soil quality to produce agricultural products. Strategic planning is key, as organic farmers need to be aware of natural conditions and cycles to take full advantage of nature's ability to control pests and recycle nutrients. Heavy reliance on ecological processes does not mean organic farming eliminates the use of very up to date technologies. High-tech equipment could be utilized to mechanically remove weeds, for example.

Integrated agriculture production (IP) also includes techniques that resemble and take advantage of natural ecological services. However, IP farmers have the option of using chemicals. The goal of IP is to minimize the use of synthetic chemicals and pesticides without sacrificing the levels of production yield. IP is seen as the general trend towards a scientific based, low-input high-output farming system (David, et. al. 2000, p. 21). The output, or yield, of organic farms today is typically lower than that of IP and conventional farms.

Organic agriculture is often called *Ecological* farming. The reliance of organic farming on natural ecological processes makes this designation appropriate. However, the same designation might be appropriate for IP systems as well. Neither system escapes environmental problems. For example, nutrient runoff can be just as big an issue for organic and IP farmers, as it would be for conventional farmers (Andersson, G., 2002). Despite not being perfect systems, both farming categories have been referred to as sustainable agriculture. There are ongoing debates and disagreements as to which of these methods is best for the long-term environmental, economic, and social sustainability of the agriculture industry. It might be more appropriate to say each of these methods has elements of sustainability.

There is also discussion concerning the actual products of organic and integrated agriculture production. Generally speaking, integrated products yield the same products as conventional agriculture. The difference is lies primarily in the production methods. Comparing organic products with conventional products, the primary difference also lies in the way conventional and organic products are produced. However, there are some claims that organically produced agriculture is superior in terms of health benefits and taste, in addition to the benefits of environmental production.

A 2001 report in Nature magazine claimed that organic products taste better, citing increased sweetness in organic apples than conventional apples (Reganold, Glover, Andrews, and Hinman, 2001). A scientific paper put out by the Soil Association states that there is evidence supporting the

idea that organically produced foods are superior in terms of food safety, nutritional content and nutritional value (2002).

However, claims can be found that say organic products are not overall more nutritious and tastier than conventional products. The Alabama Cooperative Extension System published an article citing an extension food scientist who says organically grown produce does not have better taste or nutrient content, even though they are grown without the use of chemicals. This scientist also mentions that there is the possibility that dangerous bacteria may be found in some organic produce, as a result of manure used to fertilize the crops (Weese, 2002).

Johanna Björkland (2002), a sustainable agriculture researcher pointed out that there has not been many studies done that compare the pros and cons of both organic and conventional agriculture to determine which gives the best results concerning the environment. More work in this area might better explain the role each mode of production has in today's agriculture industry. Pursing such a discussion was not in the scope of this research.

3. Framework for Analyzing the Factors that Influence the Reduction of Nutrient and Pesticide Emissions

This chapter provides the theoretical background regarding the ecological modernization framework. The seven categories of eco-factors first mentioned in section 1.4 are further defined and explained. Also discussed is how the various eco-factors are theoretically integrated into and affect an industry or organization. This theoretical background is important in order to become more familiar with the ecological modernization framework. The application of this framework in regards to the agriculture industry in Skåne, of southern Sweden, is presented in Chapter 4.

This chapter begins with a look at the concept of rural sociology, and the sociology of agriculture, to further strengthen the argument that the ecological modernization framework is the appropriate tool for identifying and exploring the factors that promote or inhibit the agriculture industry in Skåne to improve its environmental performance in relation to the Baltic Sea.

3.1 Sociology of Agriculture

Rural sociology is defined by the University of Wisconsin Sociology Department (2002) as a "subset of sociological studies which is particularly concerned with rural people and the conditions under which they live and work, and with the natural resource and development issues that are typical of non-metropolitan regions." A topic within rural sociology is the sociology of agriculture. Rural sociology, or the sociology of agriculture, is discussed here to highlight some important issues that should be considered when studying agriculture related issues.

The sociology of agriculture is a discipline designed to scientifically study the role of social factors in the capacity necessary to fully understand agricultural development. It starts from the idea that social factors are a key in explaining the development of agriculture. Agricultural sociology looks at which, why, how, and by whom different agricultural practices come into being.

In many circles, the idea still exists that the classical agricultural sciences, such as plant physiology and cattle breeding, should be the main focus when trying to understand agriculture development, with social factors playing a perimeter role. In addition to the natural laws, agriculture development is often perceived as a process guided by economics (Wiskerke and Oerlemans, 2000, p. 14-20). Failing to recognize the contribution of all social factors disregards many important factors driving the agriculture industry. It also limits the opportunity to intervene within the "structure" to find ways of accomplishing such goals as ecological modernization.

As Steineck, et. al. stated (2001), the local farmer is a central figure in meeting the goals of improving the environmental performance of agriculture. However, in this day and age it makes sense that the farmer is not the only actor involved in the environmental performance of agriculture. Unlike the traditional approach to studying agriculture practices, it is clear that attention must be drawn to the importance of lawmakers, investors, suppliers, consumers, banks, researchers, and other interested parties who influence how farming is carried out. Moreover, it is necessary to look deeper within the structure of laws, natural boundaries, resources, establishments, economics, history, technology, knowledge, and so on, that dictate how farming takes place (Wiskerke and Oerlemans, 2000, p. 14-20).

The idea that agriculture practices are controlled by factors beyond the farmer himself is not a new concept. Based on Koningsveld's (1987) study of practices, agriculture can be divided into two distinct dimensions: 1) technical practices, which define the process of transforming living material

into animal and plant-based products, and 2) social practices, which concern the social co-ordination and implementation of the technical practices. This approach considers agriculture to be a socio-technical practice (Wiskerke and Oerlemans, 2000, p. 14-20).

To understand why certain activities occur in the agriculture industry, it is essential to go beyond the identification of important agencies and structures. It is necessary to try to understand the complexity of such components as the relationship between interest groups, stakeholders, policy makers, and the state in the policy making process. It is necessary to explore the role of different agencies in accordance with certain political agendas and priorities.

Making a broad generalization, there are two mainstream approaches for trying to understand the drivers of socio-technical activities, such as agriculture. The first is a structural approach, which include functionalistic theories, neo-Marxist theories, and modernization theories. The second is the actor-oriented approach, which includes phenomenological theories, ethno methodology and symbolic interactionism (Wiskerke and Oerlemans, 2000, p. 14-20).

The relevant actor approach considers important stakeholders independently. This approach assumes that people are knowledgeable actors, capable of influencing an activity. Wiskerke and Oerlemans (2000, p. 14-20) quote Long and Van der Ploeg (1997) who say, 'Social actors are not simply seen as disembodied social categories or passive recipients of intervention, but active participants who process information and strategize in their dealings with various local actors as well as outside institutions and personnel.' Within this relative actor approach, the activities of stakeholders are inherently considered to occur within a set structure. Taking this approach, the structure is not the focus; it is instead the activities of the individual stakeholders.

The structural approach primarily considers the structure in which an activity occurs as the driver of socio-technical activities. Structural theory considers an activity occurring within certain boundaries. The actions of all relevant actors are considered important to the extent to which they define and shape the structural framework. There is constant modification of structures (Orssatto, 2001). Structural modifications are not only instigated by the actions of specific actors, but also by the goals of organizations, industrial ecological conditions, competition among firms, etc. Structural theory takes into consideration the influences beyond specific actors when explaining the constant modification of the structure in which an activity occurs (Wiskerke and Oerlemans, 2000, p. 14-20).

The objective of this research is to further understand what influences the environmental impact of agriculture activities on the Baltic Sea. The task is an attempt to further understand the "structure" in which these agricultural activities occur. As explained in this section, agriculture is influenced by a multitude of disciplines and factors. It would be therefore be inadequate to try and meet the objective of this research by looking only at technological or economic factors that might influence the industry. To carry out the stated objective, it is therefore appropriate to use the ecological modernization framework.

3.2 Ecological Modernization Framework

Determining how and why activities occur in an organization or industry is important for understanding how to better promote certain changes within the organization or industry. In this case, the goal could be considered the ecological modernization within of the activities within the agriculture industry. As Orsato[4], den Hond, and Clegg discovered, there is not an adequate amount of

[4] Point of clarification: Orssatto is the same author as Orsato, however the spelling of the name was adjusted for publications after 2001.

research that has been done within organizational studies to answer some of the fundamental questions of why or how ecological modernization occurs (2002).

3.2.1 Political Ecology

Orssatto and Clegg say that relationships between organizations and the environment are determined by power and knowledge. Also, they say the ecologically modern actions develop within the political and strategic disputes located within organizations (1999). As a result of a lack of political/power perspectives in environmental research, Orssatto and Clegg devised a strategy to study the political ecology of organizations in order to map out the terrain of political and strategic ecological activities within and around organizations (1999). Modified from Gary Peterson (2000), political ecology is defined as a trans-disciplinary attempt to use natural and social sciences to understand the relationship between human (political) and natural (ecology) systems.

Orssatto and Clegg consider the political ecology of organizations to be those political and strategic actions where "the environmental strategies are embedded." The "actions" by different actors are often able to adjust the current structure of power and decision-making in a way that promotes or inhibits the ecological modernization of an activity or industry (1999). Understanding the political ecology allows for the discovery of the motivations and outcomes such motivations have on the actions and decision making of an industry.

This political ecology of an industry is influenced by the eco-factors. Depending on these eco-factors, an industry's structure of political ecology might enable the integration of a certain amount of ecological modernization within the industry (Orssatto, 2001). This makes a study of the eco-factors a very important key for understanding what is influencing ecological modernization.

In addition to the eco-factors, the political ecology structure of an organization is made up of several other circuits. Each of these circuits is a piece of the puzzle in understanding how or when ecological modernization might occur. Realistically, these circuits do not act separately, but instead overlap and influence each other simultaneously (Orssatto and Clegg 1999). The circuits of political ecology developed by Orssatto and Clegg (1999) are mentioned here.

Circuits of Political Ecology

System Integration: This circuit of political ecology considers all the different processes that make up an organization or industry (Orssatto, 2001). These processes might all be separate systems that integrate to form one system, such as the agricultural system. Orsato, den Hond, and Clegg identify system integration as the material conditions that include the technological means, and associated skills, for controlling the physical and social environment (2002).

An example of system integration within the present day agricultural system is seen in the need for pesticide use within farming practices. If the use of pesticides were eliminated, then the process of producing pesticides would not have to be integrated into the agriculture system. The establishment of different processes, such as the production of pesticides, often has strong ties to financial investment and jobs. Bayer chemical, a supplier of pesticides in Skåne, argues in favor of continued use of pesticides saying, 7-8 million Danish Kroner[5] would be lost in the Danish economy alone if the use of pesticides was discontinued. Bayer also says the pesticide industry provides 16,000 jobs in Denmark (Husby, 2002). This data might be a bit inflated since it comes from a company, which stands to lose business from an elimination of pesticide use. Nevertheless, ties between the agriculture

[5] 1 Euro is approximately 7 Danish Kroner (X.rates.com, 2002)

industry and the economic success of related businesses, such as the pesticide industry, do exist. Due to these ties, completely removing this process from the system is therefore a very difficult task. Dealing with the integration of different processes into the system is one part of moving agriculture towards the reduction of nutrient and pesticide emissions.

Social Integration: This part of the framework has equally as much strength as the integration of systems. This category defines who an actor is and what an actor does through the ways these actors are embedded into rituals and routines. These social attributes are the spoken and unspoken routines by which goals are accomplished (Orssatto, 2001). Additionally, social integration deals with what various parts of an organization mean, often on a symbolic level, and how, based on these meanings, they should be categorized within the organizational system (Orsato, den Hond, and Clegg, 2002).

An example of social integration, as this research will further discuss, is seen with consumers who have grown accustomed to purchasing food at low prices. In order to maintain these low prices, farmers rely on production subsidies from the EU. This allows neither the consumer nor the farmer to realize the true costs of agriculture production. If consumers were willing, and able, to cover the true costs of food production, there might be more incentive for farmers to produce less food, in a more extensive manner. Integrating such an idea as increased prices in food would require some major shifts in thinking. It will take shifts in thinking in order for agriculture in Sweden to truly see the solution to the problems of nutrient and pesticide pollution.

Agency: This circuit is concerned with the strength of organizations or individuals to make changes within a structure (Orsato, den Hond, and Clegg, 2002). Often, the strength to make changes is found within representative organizations or lobbying groups. Companies, environmental organizations, individuals, cooperatives, etc. that have visibility and/or strong financial support, will probably have increased agency, and therefore success in moving forward their own agenda (Orssatto, 2001). An organization of farmers should have an increased ability to push along a specific agenda to the members it has access to. Agency can come from many different directions, and can be used to promote or block ecological modernization. Establishing agency can be very difficult. Established businesses, organizations, etc., are clearly at an advantage over those with new ideas who want to bring forth a particular agenda. This research identifies the European Union and the EU's Common Agriculture Policy as structures with agency that can bring about changes in the agriculture industry, which would allow farmers to decrease their emissions of nutrient and pesticide pollution.

Standing Conditions: Standing conditions describe how an industry or organization is systematically structured. In experimental science, the standing conditions are those preconditions and controlled environmental attributes that are necessary to make an experiment work a certain way. Within an industry or organization, *standing conditions* are the stability within which particular outcomes can be routinely produced (Orssatto, 2001). As long as the standing conditions remain, there is a certain degree of predictability as to how things will play out. If the structure of a system is too inflexible, then it can be difficult to implement new conditions. On the other hand, if the system has too little structure, then new conditions cannot be sustained. It is essential that all the different agencies of a system be coordinated without implementing so much control that the system stops learning. As Orsato, den Hond, and Clegg, describe, the standing conditions that sustain the stable context for which resource use creates routine functions as a means for producing particular outcomes (2002).

An example of standing conditions can be seen in the value chain of the agriculture industry. Farmers or farming companies produce agriculture products. These products are then sold to a buyer, who processes them, or sells them to a food processor. The products are then sold to a retailer who markets the products and sells them to the consumer. The standing conditions of this value chain give each step in the process of production to sales a particular role in bringing food to the consumer.

Obligatory Passage Points: Obligatory passage points are the steps which an innovation or process must go through before it becomes a mainstay within an organization or industry (Orssatto, 2001). These passage points might include the transfer of knowledge to a sufficient number of actors within an industry before something can take place. Orsato, den Hond, and Clegg say that political actors will try to secure their interests by designating what is and is not obligatory within an organizational field (2002).

An example for obligatory passage points for the agriculture industry in Skåne is the necessity for all farmers to realize what they can do on their individual farms to reduce emissions. Passage points might also include securing the necessary financial investment or support to put a new innovation into place within the existing structure.

System integration, social integration, agency, standing conditions, and the obligatory passage points all lead to changes in an organization or industry, such as the agriculture industry in Sweden. As it has been described, it is difficult just to eliminate or alter one aspect of the existing structure of Political Ecology in order to make changes. This is because the structure has evolved in a way that incorporates the elements that are traditional to the structure. However, the inclusion of an innovation is still possible. By going through the necessary passage points, ecological modernization, or specifically the necessary reductions of nutrient and pesticide emissions, can occur.

3.2.2 Environment Contingent Factors

It is quite a difficult task to discover all the details about the circuits of political ecology within a particular organization or industry. To fully understand all the different circuits, one would need an insider's view of the particular industry or organization in question. It was not possible to gain a full understanding of all the political ecology circuits of the agriculture industry in this study. Therefore, the concentration of this research was in developing the various eco-factors.

As mentioned, the eco-factors represent the different forces that promote or inhibit the ecological modernization of an industry or organization. They explain the reasoning behind system and social integration of ecological modernization into the political organization (Orssatto, 2001). These factors, such as regulation, public demand, availability of technologies, natural resource constraints, etc. set the boundaries of the ecological modernization framework. It is these contingent factors that ultimately dictate the creation of agencies and the adoption of innovations of system conditions through obligatory passage points.

The general relationship between the eco-factors and the other circuits of political ecology in the Ecological Modernization Framework is seen in Figure 9.

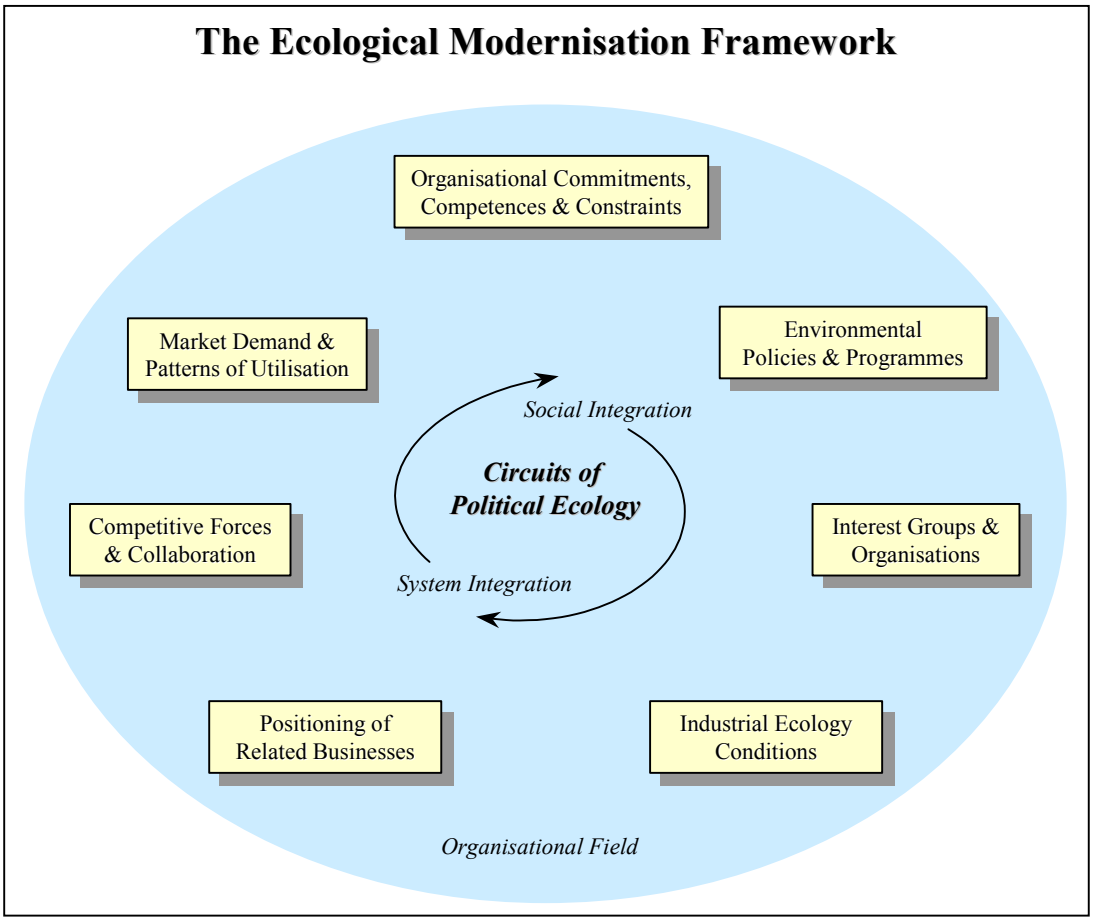

Figure 9 Illustration of the ecological modernization framework (from Orssatto, 2001).

Based on the descriptions given by Orssatto (2001, p. 209-230), each eco-factor is given a brief explanation here.

Organizational Commitments, Competencies, and Constraints

This eco-factor refers to the ethical and moral commitment of the main stakeholders to environmental protection. This factor includes the competencies or abilities of the stakeholder to meet the environmental commitments they have made. The organizational limitations blocking the fulfillment of environmental commitments are also analyzed by this eco-factor.

Environmental Policies and Programs

This eco-factor considers the governmental policy structure in which an industry functions. These may be regulatory, incentive, or other measures administered by various levels of government: European Union, national government, or regional and local governments. This factor also includes government-sponsored programs designed to meet specific environmental objectives.

Industrial Ecology Conditions

This eco-factor considers those conditions that may allow industrial ecology to occur between systems within an industry or organization. Industrial ecology allows for the maximum use of

resources while minimizing the disruption of the environment. In addition to seemingly win-win situations for the environment and economics, there are often barriers to taking advantage of industrial ecology possibilities. The possibilities for, and the barriers making it difficult to implement industrial ecology between systems are included in this factor.

Positioning of Related Businesses

This factor includes the numerous supply companies, buyers, retail firms, and research oriented firms that influence the activities of the industry or organization in question. The need for related businesses to be financially successful often give these businesses an interest in the stability, changes or other happenings within an industry. If a related business has strong influence (i.e. economic or political power), it can drive an industry or organization to change, or to maintain business as usual. This power could impede or encourage the adoption of environmental activities within an industry.

Interest Groups and Organizations

This eco-factor includes all the organizations that are not directly associated with government or related businesses. These might be workers unions, non-governmental associations, capacity building organizations (e.g. academic institutions), financial institutions, and others that have some influence on the activities of an industry or organization.

Market Demands and Patterns of Utilization

This eco-factor considers the demands of the market, which can generally be divided into industrial (or business) markets and (final) consumer markets. The assumption is that firms will often act as a result of forces in the market (Reinhardt, 1998). This eco-factor also considers consumers' expectations about certain products. These expectations may range from the price of products, to what the products look like, to how the products enable consumers to perform certain activities. This factor also considers those characteristics that distort market demands.

Competitive Forces and Collaboration

This eco-factor considers the competition that exists between firms within an industry. It considers the various competitive positioning of organizations based on the traditional low-cost and differentiation approach. This factor not only looks at competitive positioning through product development, but can also include the low-costs and differentiation of processes. The search for competitive positioning may be a driver of an industry or organization to implement environmental measures. Also included, is the collaboration that occurs within industries or organizations to improve competitive-positioning.

4. Analyzing the Factors that Influence Environmental Improvements of Agriculture in Skåne

The major research undertaken during the thesis period is presented in this section. Applying the ecological modernization framework, the main tool for analyzing the factors that influence environmental improvements of agriculture in Skåne are the eco-factors. Chapter 5 uses the analysis presented here to discuss how measures to further reduce nutrients and pesticide pollution (See section 2.3) might further be implemented into the agriculture industry.

4.1 Organizational Commitments, Competencies, and Constraints

This eco-factor attempts to understand the various levels of commitments farmers have made to address the problems of nutrient and pesticide emissions. Commitments may range from very strong concern for the health of natural ecosystems, to a commitment based on the view that farmers have little responsibility to deal with environmental problems. These commitments might be motivated by a variety of things: strong ethical beliefs, the desire to meet Swedish regulations, means to financial success. Competencies and constraints are merely those practical aspects that allow farmers to meet their commitments.

4.1.1 Evolution of farmers' understanding

To comprehend the commitment of farmers towards environmental concerns, it is necessary to analyze how farmers' understand the connection of nutrient and pesticide leakage from agriculture activities to environmental activities. During discussions with several people, including two environmental managers in the Skåne region, Högni Hanson (2002) and Michael Dahlman (2002), it was explained that farmers staunchly disagreed when agriculture activities were first given part of the blame for the pollution problems in the Baltic. As time went on, the farmers began to accept that their farming activities did indeed contribute to the pollution problem. Many people interviewed were of the opinion that now, farmers do indeed care about the impact of agriculture emissions that go into the Baltic Sea, and realize the importance of decreasing the impact (Lindahl, 2002) (Andersson, L. and Andersson, T., 2002) (Andersson, G., 2002) (Eriksson, 2002) (Töner, 2002) (Hanson, 2002) (Dahlman, 2002) (Starck, 2002). These same interviewees agreed there would always be those farmers who do not believe they have a responsibility to the environment.

Per Lindahl, a chicken farmer and board member of LRF (2002) who has implemented environmental measures on his large chicken farm, says there are farmers who still insist farming activities do not have much impact on the environment, thinking discussion about the environment is a waste of time. The Swedish Federation of Farmers (LRF) says there is an interest amongst its members, a large majority of the farmers in Sweden, to maintain a healthy environment (Swedish Federation of Farmers, 2002). Although different stakeholders generally agree upon this statement, environmental managers in the various municipality offices might dispute the extent to which this claim is true, saying farmers do not always take as many steps as they could if they really wanted to maintain a healthy environment. This research did not carry out a survey to measure the environmental interest of farmers, nor were the results of such a survey found. A closer, more quantitative examination of farmers' thoughts might be useful for further research in this area.

Hansson (2002) says, today many farmers realize a responsibility to take care of their pollution emissions, however they do not want to be fully blamed for the environmental problems, as many feel they have no alternative to the way they carryout this activity which society is asking them to do.

4.1.2 Actions and commitment

Regardless of the stated commitment to the environment by farmers and various stakeholders, it is environmental action that demonstrates actual commitment to the environment. One way to track the level of environmental action is to look at the number of organic farmers in Skåne. According to Gunilla Andersson at the Ecological Market Center (2002), 2.3% of farmers in Skåne are committed to organic farming. This number is much less than the Swedish national average of 10% of all farmers being organic (as of the end of the 1990s) (Ekolantbruk, 2000). Anna Björnberg (2002) from the EcoTrade division of Lantmännen, the cooperative of farmers who buy and sell grains, agrees that the implementation of organic production has moved slower in southern Sweden, although she says interest has increased in the last few years.

Organic Production

It is agreed that organic farmers typically have a lower yield than conventional farmers (Andersson, L. 2002) (Andersson, G., 2002) (Björnberg, 2002) (Töner, 2002), which may explain the slow shift to that method of production. In future research, it might be beneficial to compare the differences in yield between organic and conventional farms. Also, farms in the Skåne region have typically been large industrial farms relying on large yield to meet the demand of large sized buyers. Björnberg also says farmers in Skåne have a difficult time changing to new farming methods, because they prefer doing what everybody else in the community is doing, rather than being different.

Based on an interview with Andersson, L., (2002) there are also different levels of commitment among organic farmers. Upon recognizing the environmental problems associated with conventional methods, some farmers who have discontinued the use of synthetic pesticides and fertilizers, vow to leave farming altogether before returning to conventional farming. Some organic farmers who have environmentally-motivated production are only concerned with carrying out organic farming activities on their own farms. For example, these farmers may be willing to use manure on their field that was collected from conventional farming, regardless of the environmental impact on the conventional farm. The manure from conventional crops generally has higher nutrient value based on the non-organic methods of feeding conventional animals. Other "pure" organic farmers take into consideration the whole lifecycle of the inputs coming to their field, and would not use certain inputs such as conventional manure. These farmers would use only organic manure, even though the lower level of nutrients might result in a lower organic yield (Andersson, L., 2002). Although no real statistics were found, it appears that these latter groups of farmers, who take a very holistic approach to the environmental impact of farming, are in the minority.

Andersson, L. (2002) believes that it is unethical to use the manure from conventional farms on organic farms, because many of the grains used to feed those conventional animals are imported from outside Sweden. She says these grains come from Africa, India, and South America, where these grains could be used to feed people. According to her, there are ways meat eating could be adjusted in Sweden so there is not a reliance on these outside grains, which also bring more nutrients into the "loop." She recognizes the inefficiency of the current system to take advantage of nutrients. Her own strong ethical commitment to this issue contributes to her unwillingness of being part of the conventional agriculture system. She relies only on organic manure to fertilize her crops.

Integrated Production

Organic farming is not the only way farmers can demonstrate their commitment to the environment. It is possible to make many environmental improvements to production techniques without completely eliminating the use of synthetic pesticides and fertilizers, which allow farmers to maintain a high product yield (Töner, 2002). Typically farmers who make environmental improvements in this category could be considered integrated production (IP) farmers. They are implementing measures to

improve the retention of nutrients on their farms, and/or reducing the use of synthetic pesticides and fertilizers. As Andersson, G. (2002) mentioned, the Swedish regulations are often more stringent than other countries. Therefore, some people claim that maintaining the Swedish regulations could be considered IP farming. It is clear, though, that there are IP farmers who go beyond the Swedish regulations. Therefore, when classifying the environmental commitment of Swedish farmers, a distinction should be made between those farmers who implement techniques to maintain Swedish regulations, and those who go beyond the regulations in implementing environmental measures.

To summarize the different levels of environmental commitment among farmers, it is possible to categorize farmers into three general groups. The first category includes farmers who meet the minimum environmental standards required by various obligatory regulations. The second group of farmers consists of those who implement environmental measures that go beyond mandatory regulations, with little or no sacrifice of output. The third group of farmers includes those who strive to go well beyond mandatory regulations, often willing to accept a lower level of production in order to maintain high environmental standards. These levels of commitment help explain why certain activities do or do not occur within the agriculture industry.

IP versus Organic

Many of those people in the agriculture industry not involved with organic production believe that integrated production techniques can be a more sustainable method of agriculture production in Sweden than organic production. This is said because there is a feeling the food supply would not be secure if farming in Sweden moved towards being all organic production (Lindahl, 2002) (Ericksson, 2002) (Töner, 2002) (Busby, 2002) (Hultgren, 2002) (Hempel and Hempel, 2002). Many also agree with what was mentioned in Section 2.3.7, that it is possible for organic production to have as high a problem with nutrient pollution as all other methods of farming.

Andersson, L (2002), an organic farmer, also believes that with the current demands for food, and the current production techniques, it is not possible today for all farmers to become organic today. She says such a situation would require shifts in consumer diets. For example, consumers eat chicken, pork, and other types of meat from animals fed on high nutrient grains, often supplemented by grains from outside Sweden, which continues to keep the nutrient loop open. Shifts towards eating grazing cattle and sheep, which are not fed with grains, could reduce the reliance on outside nutrients, therefore helping to close the nutrient loop.

Profitability

Regardless of the farmers' interest in the environment, there is the need for farmers to be profitable (Hempel and Hempel, 2002). This sentiment was shared in every discussion held during this research period. Based on this overwhelming agreement in the discussions, there is a good chance that many environmental farming activities currently in progress would not occur if there were not way to be financially compensated. An example can be seen from the environmental activities on Karin Eriksson's dairy farm in Skåne. Eriksson began to monitor their farming activities more closely through the process of ISO 14000 and 9000 series certification. Certification was undertaken because the dairy company that Eriksson sells her milk to, Skåne Mjeriet, pays several kronor more per liter of milk. Eriksson, K. (2002), says that looking at all of her activities through the ISO certification process has encouraged her to think more about her environmental impact and how she can improve upon it.

4.1.3 Access to knowledge

If a farmer has made a commitment to reduce the emissions of nutrients and pesticide pollution, that farmer must know what techniques can be implemented on his or her farm to accomplish the task. Having the capacity to accomplish the task might also encourage farmers in making an initial commitment to the environment. Starck, A (2002), an environmental agriculture inspector in Kristianstad municipality, says there are many farmers who do not know what should be done to make environmental improvements beyond what is required by Swedish regulations (Starck, 2002). This is exemplified through a question asked in a survey by LRF. The response to the question shows it is clear that farmers do not always know how to improve their environmental performance specifically concerning nutrient application. See Figure 10.

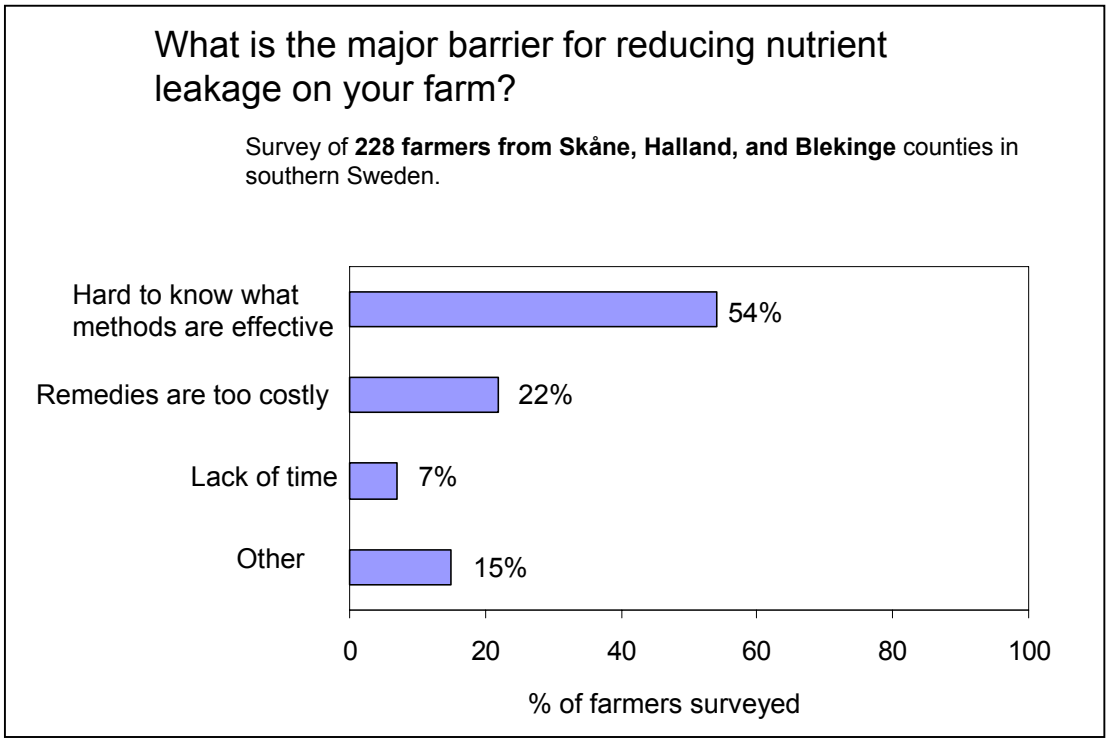

Figure 10 Farmer knowledge about nutrient pollution prevention (Blix, 2002). (translated from Swedish)

Many people, organizations, government, etc., involved with the agriculture industry say broadening the farmers' knowledge is a key component to achieving environmental improvement. There are many capacity-building opportunities that have been developed by the government and various organizations designed to help farmers implement environmental improvement strategies. These opportunities are typically designed to educate farmers on environmental strategies and improvements, providing practical skills for decreasing the emissions into the water system (Blix, 2002) (Wallensteen, 2002).

LRF has spearheaded several environmental educational programs and courses designed to give farmers the practical knowledge and tools to improve the performance of their farms (Hempel, 2002) (Blix, 2002). The Swedish EPA provides literature to farmers so they can become more up to date on environmental issues, objectives, and measures to improve environmental performance (Staaf, 2002).

Information to farmers is one of the main goals of the Swedish Board of Agriculture. They provide an advisory service free of cost for the farmers, with the aim of reducing the loss of nutrients and to reduce the risks connected with the handling of pesticides. One special project, "Nutrients in Focus,"

is administered by the Swedish Board of Agriculture in three counties in southern Sweden, and has a budget of 22 million SEK. The goal of this project, which began in 2001 and will run for three years, is to reduce nitrate leaching (Mejersjö, 2002).

Figure 11 illustrates farmers' thoughts about the effectiveness of training programs.

In addition to the advisors accessible through the Nutrients in Focus program, there are also opportunities for farmers to receive technical advice concerning environmental issues from extension agents. Extension agents have been providing knowledge about various topics to farmers for many years, and are therefore quite trusted by most farmers (Blix, 2002).

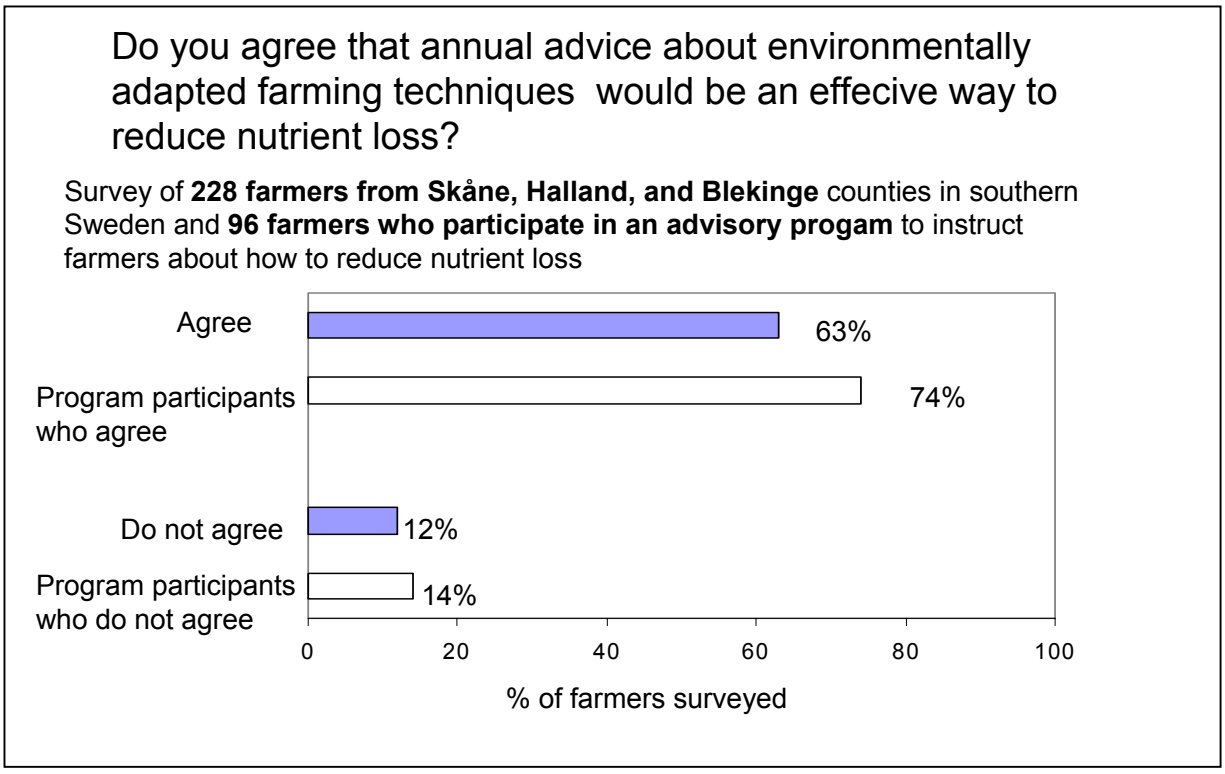

Figure 11 LRF Survey of farmers concerning nutrient loss (Blix, 2002).

Some farmers who have university degrees or have worked in other capacities often go into farming with a more advanced knowledge of environmental issues than traditional farmers. Of course, this is not always the case (Andersson, L., 2002). Many of those who do get a higher education degree work in different aspects of the agriculture industry, such as extension agents (Eriksson, 2002).

4.1.4 Certification status--organic and IP

Another constraint concerning the ability of farmers to meet their ethical commitments might be the way in which organic production and IP farming is organized in Sweden.

It is easy for Swedish farmers to know what they must do to become certified as organic farmers. There are set regulations farmers must follow in their agriculture production that certifies them as organic farmers. However, there is some concern that this approach limits the ability of organic regulators to consider what makes most ecological sense for the unique characteristics of a given farm. For example, the regulations regarding the application of nitrogen for organic farming might not be the best regulation for each farm, as it highly depends on soil type, contours of the land, type

of crops etc. Depending on the conditions of a given organic farm, it is possible that nitrogen leakage can be as much, if not more of a problem than on conventional and IP farms (Andersson, G., 2002).

Globally, IP is vaguely defined *as an agricultural system that contributes to maintaining a productive system with respect to the environment*. Unlike organic farming, there is not one accepted definition of IP throughout Europe. Farmers' unions, industry, policy makers, research and technical institutions, etc., define integrated agriculture differently (David, Bernard, and Just, 2000).

In Sweden, IP takes many forms, and might not even be referred to as IP, but is instead named after the specific program that is implementing IP type initiatives. Some programs which promote IP are Odlings i Balans, Svensk Sigill, and Svensk Odlät. Although this gives different farmers the flexibility to interpret IP regarding the needs on a given farm, it does not state clearly the point at which a farmer becomes an IP farmer. A farmer who recycles only a small bit of animal manure on his farm might be classified as an IP farmer, while a farmer who goes to great lengths to implement often costly measures to minimize environmental impact, will get the same designation. Others might consider IP just to be just meeting the government regulations (Husby, 2002) (Andersson, G., 2002). Since there is no clear definition, it is difficult to quantify and evaluate properly the dissemination of integrated production. It might also be difficult for farmers to get involved with it as extensively as they could if there were more clearly understood definitions of what IP is.

4.1.5 Profitability and access to finances

Finances are another important consideration for farmers planning to undertake environmental initiatives. There are opportunities for farmers to gain financial support for environmentally-oriented endeavors. One example is farmers building wetlands. There is an opportunity for farmers to apply for subsidies from the Swedish government for the creation of certain types of wetlands.

1) If the environmental benefit is good, the landowner will get a subsidy for wetland establishment.

2) Farmers receive subsidies annually for 20 years if the wetland has been created on agricultural land which would have been generating money had there been crops growing on the land.

There is also some money from the EU wetlands program for wetland creation (Regnell, 2002). The difficulty with wetland creation subsidies is that the subsidies often do not cover all the expenses associated with the wetlands. Therefore, if a farmer does want to create a wetland on his farm, he might be constrained by financial limitations (Blix, 2002).

There are also subsidies available from the EU via the Swedish government for activities such as organic farming and other environmental initiatives (Wallenstein, 2002). The issues of government programs and funding will be discussed further in section 4.2.

Hans Wennberg (2002) and Britt-Marie Lundh (2002), working at Forensingsparbanken with agriculture and sustainable investments, say there are also opportunities for non-conventional farmers to receive financial backing from investment banks as long as the banks can determine the applicant for funds has the ability to be profitable. Wennberg and Lundh say there is much discussion between the bank and farmer to consider different techniques, equipment, regulations, etc. to be sure that the investment for the bank is a good one. It is also possible for some farming activities to qualify for sustainable investment funds.

4.1.6 Technology

Scientific data about different atmospheric conditions is collected at over 300 locations throughout Denmark through high-tech computer programming designed to alert Danish farmers when to apply pesticides, how much, and on which crops throughout all farming regions. This data indicates when and where certain pests are appearing, and where they will cause a problem. This allows Danish farmers to spray only when absolutely necessary. Although there are such programs operating on a minimal level in the Skåne region, an advanced system would better help farmers apply pesticides only when absolutely necessary, decreasing their overall use (Husby, 2002).

An important constraint for organic farmers was discussed with Andersson (2002). She said that organic farmers try to use conventional seeds and animals to produce organic products. But, she said these conventional seeds and animals, which have been developed through crossbreeding over the last 40-50 years, are not designed for organic production. Very limited organic seed and animal development has taken place. It is possible that this is a primary reason for a much lower output from organic production than conventional.

Although not clearly stated in any of the discussions, perhaps amongst those farmers unwilling to make environmental improvements, what really exists is a fear of changing from techniques that have been used for so many years, not only by some current farmers themselves, but also by their parents and grandparents.

4.1.7 Key conclusions

Attempts to implement environmental measures indicate a greater environmental commitment than merely stating that an environmental commitment exists. It is recognizable that the progression of farmers' understanding of the environmental issues is significant. If a majority of farmers share a feeling of responsibility to protect the environment, it could be an indication there is willingness among farmers to further discuss the problems of nutrient and pesticide leakage. Holding these discussions are an important step towards developing realistic solutions.

Three general categories of environmental commitment illustrate the various types of environmental activities undertaken by farmers. These categories may indicate the motivation for farmers to implement further environmental measures. It is clear that financial compensation is often a driver for creating motivation, some of which can be instilled by the reception of various government subsidies. It is also possible for farmers to make long-term investments in environmental activities if there is adequate financial backing. Farmers may also realize the possibility to achieve some financial benefit because buyers are willing to purchase products that have been produced using environmentally-oriented techniques.

There are various constraints that keep farmers from meeting their commitments, or keep farmers from making commitments. Some constraints are technological, especially among organic farmers, which keep organic yield at a rather low level. It appears that one of the biggest constraints which keeps farmers from initiating or following through with a commitment to environmental protection is lack of understanding on how to implement such measures. To an extent various programs and initiatives are designed to educate farmers and given them competency to overcome constraints. An even greater constraint might be the unease of farmers to change the techniques they are accustomed to. This is likely due to a lack of security guaranteeing that new techniques will allow farmers to be successful.

4.2 Environmental Policies & Programs

This section looks closer at the EU's influence, especially through the Common Agriculture Policy (CAP), on Swedish agriculture and environmental policy, as well as programs specifically applicable to the Skåne region. Additionally, there is an attempt to develop a further understanding of the role of government officials in all levels of designing and implementing agriculture related policies and programs. The greater aim of this section of research was to better understand how various policies and programs influence activities in the agriculture industry.

From the European Union (EU) to local municipality government offices in Skåne, all levels of government have a role to play in the activities of agriculture and environmental measures regarding nutrient and pesticide emissions. Typically, agriculture legislation is handled in a top down fashion, with policy making occurring at the top levels of government. The responsibility for administering special permits and enforcing policies is given to the regional and local levels of government (Dahlman 2002) (Starck, 2002) (Regnell, 2002) (Wallenstein, 2002). There are also a limited number of education programs and extension services administered by the county (Skåne) administration board. (Gustafsson, 2001) See Figure 12 for an illustration of Swedish Government responsibilities.

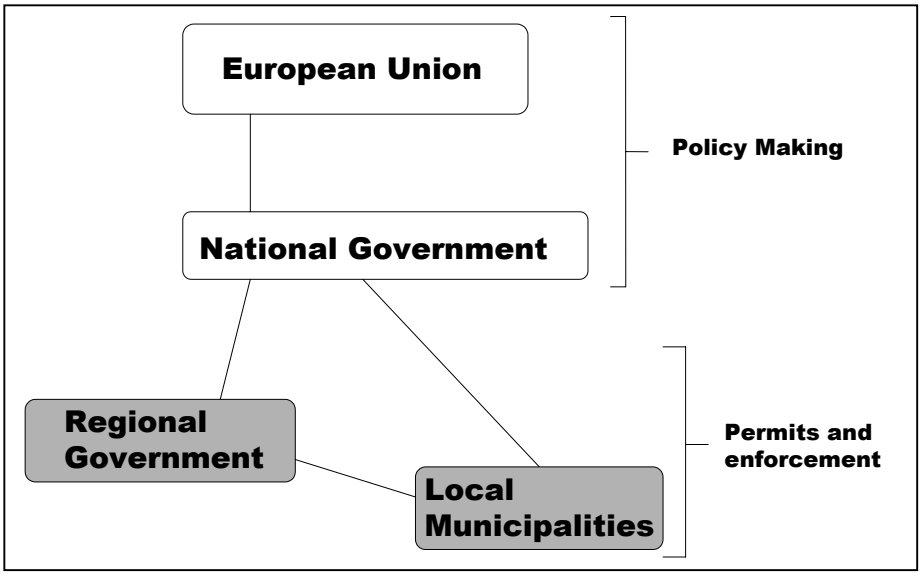

Figure 12 Web of Government Influences Over Agriculture

Karin Wallensteen from the Swedish Ministry of Agriculture (2002) points out that being a member of the EU greatly influences agriculture and environmental policy in Sweden. Some policies are harmonized with general EU policy, while the European Commission must approve other Swedish policy before it is implemented (Wallensteen, 2002). There were national goals and measures for environmental improvement for Sweden by the 1980s, some of which specifically addressed the problems associated with intensified agriculture. With membership to the EU in 1995, the Swedish Parliament introduced a new environmental program with goals to support environmental improvement within the agricultural sector. The program in 1995 included significant increases in funding from the EU for agriculture related environmental projects. One result was a six-fold increase in the total amount of land used for organic agriculture during the first five years of Sweden's existence in the EU (Ekolantbruk, 2002).

4.2.1 Common Agriculture Policy

Perhaps the most important policy influencing agriculture activities is the European Union's Common Agriculture Policy (CAP). The CAP is a set of regulations and mechanisms related to

agriculture production, trade, and processing of agriculture products throughout the EU member states, including Sweden. Almost half the EU budget is used to protect the prices of EU agriculture and create incentives for farmers to have high levels of production (EU Commission, 2001). In 1999, the Swedish agriculture industry received payments of SEK 5,200 million[6] in subsidies from the EU to help meet the objectives of the CAP (Swedish Board of Agriculture, 2002). See the objectives and principles of the CAP in box 3.

Objectives of the Common Agriculture Policy

- Increase agricultural productivity
- Ensure a fair standard of living for the farmers
- Stabilize markets
- Safeguard food supply
- Provide consumers with food at reasonable prices

Principles for achieving the goals

- Ensure a common market with the free movement of goods between member states (there are no duties, import levies and subsidies on products going between EU member states)
- Encourage community preference (to encourage EU consumers to buy EU products, there is a preference and price advantage for goods produced in the EU over low price imports; the internal market is also protected from fluctuations on the world market)
- Financial solidarity (all agriculture expenses and spending come from the EU Community budget, amounting to approximately 50% of the total EU budget)

Box 3 Summary of Common Agriculture Policy (EU Commission, 2001).

There has been success in reaching the goals of the CAP, which were created in 1958 and came into force in 1962. Productivity was and continues to be encouraged, the market place is stable, and overall food security has been established. The set goals reflect the high priority given to creating agriculture security when the Treaty of Rome[7] was signed, as food shortages following World War II were still in memory. It is clear that ensuring adequate production through the CAP has not only been successful, it has led to the production of large food surpluses (EU Commission, 2001).

[6] 1 euro is approximately 9 Swedish Kronor (X.rates.com, 2002).

[7] Treaty of Rome- The treaty that established the European Union after World War II.

Incentive for intensive agriculture production

The International Federation of Organic Agriculture Movements (IFOAM) claims that the CAP has been largely responsible for environmental pollution and unsustainable resource use associated with the agriculture industrialization promoted by the CAP (EU Regional Group, 2002). However, it must be remembered that intensified agriculture existed in Sweden prior to Sweden being in the EU. It might be fair to say though, that the CAP has not adequately addressed the environmental problems associated with intensive agriculture.

Without changing the initial policy goals, the EU has made reforms to the CAP over the last few decades aimed at reducing the burden of agriculture surpluses. Rather than addressing environmental issues, most of these adjustments have addressed decreasing the CAP spending (EU Commission, 2001). Some of the earlier reforms may have actually increased emissions into Baltic Sea by promoting increases in agriculture intensity and use of modern technology. For example, 1968 reforms were geared towards reducing the number of people employed in agriculture and promised greater and more efficient agricultural production (EU Commission, 2001). Environmental issues began to be incorporated into the CAP in 1992, with the EU support of agricultural production methods, which respected the environment and biodiversity introduction of agri-environmental measures (EU Commission, 1999). However, this incorporation in 1992 does not mean that subsidies for intensive agriculture were greatly reduced (if at all).

Agenda 2000 and Rural Development

The most notable inclusion of environmental measures into the CAP came at the end of the 1990s, with the "Agenda 2000" reform proposals. These reforms, set to be in effect from 2000-2006, are considered by the EU to be "the most radical and comprehensive reforms of the CAP since its inception." These reforms are also supposed to serve as a basis for the future development of agriculture in the EU, covering all functions of the CAP: economy, rural development, and the environment. Among other issues, Agenda 2000 includes the integration of more environmental initiatives to make agriculture legislation easier to understand. The improvement of food quality and safety is also part of Agenda 2000 (EU Commission, 2001).

The Rural Development Program discussed during the Agenda 2000 reform meetings became the second pillar of the CAP along with the original CAP objectives. It has, as one of its main objectives, to preserve the environment in rural areas. EU member states are required to identify a series of environment measures farmers can implement that go beyond what would be considered conventional practices. Farmers willing to make a commitment to the environment and implement these agri-environmental measures are eligible to receive a monetary payment (EU Commission, 1999).

In the 2000 report by the EU Commission, approximately 2,551.63 million euros are used in Sweden for the Rural Development program, with 1,130.05 million euros making up the contribution from the EU (EU Commission, 2000). The distribution of agri-environment payments throughout Sweden, and the total amount going to farmers in Skåne was not found in this research.

According to a European Commission paper, the rural development program for Sweden has as its goal to promote "environmentally-sustainable" development. The Swedish program identifies two priority categories:

1) Ecologically sustainable rural development

2) Economically and socially sustainable rural development

Participation in this program is supposed to generate new opportunities for economic growth, as well as provide compensation to farmers through agri-environment payments. Specific environmental initiatives sponsored by this program include organic farming, wetland creation, implementation of catch crops, the cultivation of nitrogen-fixing crops, etc. (EU Commission, 2000).

Even though some programs do exist to incorporate environmental concerns into the CAP, there is still a limited opportunity within the EU to implement environmental measures at farms. Only ten percent of all EU agriculture subsidies going to Sweden are used for environmentally motivated projects (Wallensteen, 2002). As stated in the previous section, farmers and other stakeholders say that current levels of financial support for environmental activities is not always enough compensation to make the activities worthwhile. This is especially true for larger farms in which subsidies for environmental improvement do not constitute a very large percentage of the total income of farming activities (Blix, 2002).

Surplus affecting foreign agriculture production

In addition to the environmental threats, another side effect of agriculture surplus in the EU is the flooding of foreign markets with cheap food products. These inexpensive foods often damage the agriculture infrastructure in developing countries, where purchasing cheap imports is more economical than growing the food locally. This problem will not be discussed further in this research, nevertheless, it illustrates the difficulties of the CAP to go beyond the problems of EU spending and EU environmental concerns.

Many individuals and organizations in Sweden and throughout Europe recognize the need for further reforms and measures to be added to the CAP in order to address agriculture sustainability issues in the EU. A literature search or an internet search locates a tremendous amount of papers and internet sites devoted to modifying the CAP. A paper by IFOAM (2002) is an example of one such paper discussing CAP reform. The IFOAM believes the next reforms should include changing the primary objectives of the CAP, which have stayed the same since the CAP was created. Productivity increases could be removed as a primary goal of the CAP, and new objectives such as the sustainability could be implemented (IFOAM, 2002). Even within the EU, the need to reform the CAP is recognized. It is considered by the EU to be an ongoing process (European Commission, 2001).

4.2.2 Additional EU legislation

The European Union (EU) environmental commission also has some regulations and directives related to agriculture activities that must be implemented by the member states.[8][9] Some of these address environmental issues that are related to nutrient and pesticide pollution. The EU has also developed programs aimed specifically at environmental improvements that impact pollution of the Baltic Sea. One such example is the "wetland programme," which releases some funds for the creation of wetlands in Sweden (EU Commission, 2001).

An example of measures taken by the EU to prevent nutrient pollution from agriculture is the Nitrate Directive implemented in 1991. It requires member states to place mandatory restrictions on agricultural practices that contribute to nitrogen pollution. It also mandates states to develop "Codes of Good Agricultural Practices" that give recommendations about the application of fertilizers, such as the proper time to apply fertilizers. Research can be done that identifies time periods when soils are more vulnerable for leaching nutrients. The directive also requires states to develop regulations

[8] EU Regulation- Specific law set by the EU that member states must follow.

[9] EU Directive- Legislation by the EU that demands member states to design legislation to meet a specified objective.

concerning the use of fertilizers, including the storage of manure and animal density rules (EU Council, 1991).

There are Swedish environmental regulations in agriculture that are a result of what the Nitrate Directive mandated. In addition to legislation, the Swedish government has ongoing efforts to implement economic support and training programs aimed at reducing agriculture emissions. In recent years, farmers have also been offered free advice on how to calculate farm nutrient balances through agricultural extension services. The county administration board administers these training programs (Gustafsson, 2001).

Nutrients in Focus

A new project called "Nutrients in Focus (2002)" is being introduced in Sweden that is designed to encourage farmers in southern Sweden to implement measures that decrease their nutrient emissions. This program is implemented in several steps. See Figure 13.

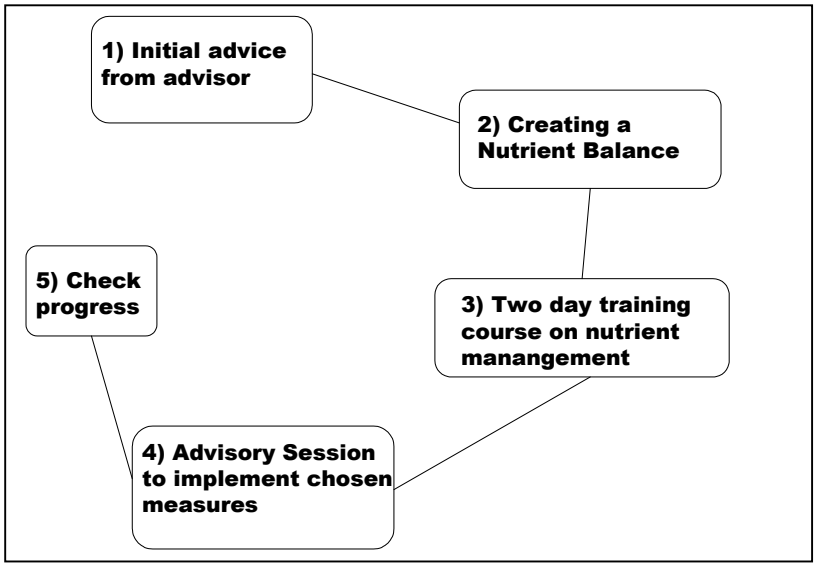

Figure 13 "Nutrients in Focus" Program (2002).

The costs for running the Focus on Nutrients program were 22 million SEK during 2002. The Swedish government pays 78 % of these costs, while the EU covers the rest. In 2003, the cost of the program will be partly funded by the farmers themselves through the Swedish Farmers Association (LRF) (Olofsson, 2002).

Another more recent directive from the EU, is the 'Water Framework Directive.' This directive is an attempt to provide some of the financial and educational tools to deal with water pollution, including nitrogen and pesticide pollution. Several people interviewed in this research believe the water directive could help give some flexibility for farmers and regional authorities to effectively deal with agriculture runoff (Dahlman, 2002) (Regnell, 2002). Box 4 gives a general summary of the objectives of the framework. Sweden will establish regional water authorities to set goals and implement measures to reach the goals throughout Sweden (Blix 2002)

.

- Prevent further deterioration and protect and enhance the status of aquatic ecosystems
- Promote sustainable water use based on long-term protection of available water resources
- Strive for enhanced protection and improvement of the aquatic environment
- Ensure the progressive reduction of pollution of groundwater and prevent its further pollution
- Contribute to mitigating the effects of flooding and drought.

Box 4 Objectives of the EU Water Directive framework.

4.2.3 Helsinki convention

Sweden is also a signatory on several international agreements concerning agriculture and the environment. Perhaps the most influential agreement concerning the Baltic Sea is the Helsinki Convention. The Baltic States worked together to create the Helsinki Convention on the Protection of the Marine Environment, in 1974. This treaty has served as the basis for setting goals and creating action plans to address agriculture and other environmental issues facing the Baltic Sea. It called for all parties to implement "individually or jointly appropriate legislative, administrative, or other necessary measures to prevent and/or reduce pollution to the Baltic." The Baltic Marine Environment Protection Commission, the Helsinki Commission (HELCOM) was developed along with the Convention (Hinrichsen 1998).

Following the break up of the Soviet Union, Sweden and Poland lobbied hard for a revised Helsinki Convention to step up efforts to protect the Baltic. A meeting of all Baltic state prime ministers was held in Ronneby, Sweden in 1990. During this meeting the Baltic Sea Declaration was issued, calling for the "ecological restoration of the Baltic Sea, ensuring the possibility of self restoration of the marine environment and preservation of its ecological balance (Hinrichsen, 1998, p. 45-55)." In a 1992 conference, Environmental ministers from the Baltic States adopted the Declaration and a revised and strengthened Helsinki Convention, which was signed by all Baltic States and the European Economic Community (Hinrichsen, 1998, p. 45-55).

As a result of the 1992 conference, the Baltic Sea Joint Comprehensive Environmental (BSJCE) Action Program was launched in 1993 with the support of HELCOM. The BSJCE Action Program has a specific agenda, a timetable for accomplishing its objectives, and financial mechanisms. See Box 5 for the six main components of the Action Program.

- Policy, legal and regulatory measures
- Strengthening of institutions and human resources development
- Investment Activities
- Special management for coastal lagoons and wetlands
- Applied research
- Public Awareness and Environmental Education

Box 5 Six main components of the BSJCE Action Program (Helsinki Commission 1993).

4.2.4 Swedish government

In addition to the EU directives and participation in such activities as HELCOM, the Swedish government receives additional informational input regarding the creation of laws and policies dealing with nutrient and pesticide problems from several important agencies, including the Swedish Board of Agriculture and the Swedish EPA.

Swedish Board of Agriculture

The Swedish Board of Agriculture (Jordsbruksverket) is the Government's expert authority in the field of agricultural and food policy (Swedish Board of Agriculture, 2002). The Swedish Board of Agriculture is specifically responsible for developing some agriculture related legislation and for developing certain agri-environmental measures (Mejersjö, 2002).

Swedish Environmental Protection Agency

The Swedish Environmental Protection Agency (EPA) is another source of advising for Swedish legislation. The EPA is important for helping set up objectives and national targets for agriculture (Staaf, 2002). The Swedish EPA is discussed further in section 4.5.

A result of measures Sweden has taken which go well beyond command and control policies are seen with the approach towards pesticide reduction in the mid 1980s. Sweden began a government program to reduce the environment and health risks associated with pesticide use in agriculture. The program was successful in reducing the amount of pesticides by 50% within the first five years it was in place. The program was extended into the 1990s, with further reductions achieved (Emmerman, 1996). Table 2 shows the measures used to meet the pesticide reduction goals.

Table 1 Measures to reduce pesticide reduction goals.

Name of Measure Taken	Description of Measure
Mandatory Training	Farmers must obtain a certificate of professional pesticide use.
Regional Plant Protection Centers	Centers to promote IPM among state and local authorities, and commercial pest control extension officers.
Advisory Services for the reduced use of pesticides	Demonstration trials, farm courses, and individual advice.
Voluntary tests on spray machines	Grants given to farmers and companies to complete performance tests and purchase and repair test equipment.
Tax on pesticides	Pesticide tax per kg of pesticide sold. This has been an effective way to decrease use.

4.2.5 Meeting local needs and objectives

Throughout the stakeholder discussions held for this research, there were several issues that seemed to reoccur. The first issue was that the environmental policies and objectives for Swedish agriculture do not always apply directly to the environmental problems in Skåne, or to the needs specific to individual farms. In other words, the policies and objectives are very broad for all of Sweden, and less applicable to the varying characteristics of a regional, local, and individual farm level. The second issue mentioned was, that those people who must work with, and those who enforce the different regulations, do not contribute enough to the establishment of the legislation. Both of these issues relate to the general concern that while farmers are trying to meet the regulations, and municipality offices are trying to enforce the regulations, there is not an opportunity for farmers and the municipality to develop strategies that might indeed solve some of the environmental problems more effectively than legislation designed for such problem solving (Blix, 2002) (Dahlman, 2002) (Lindahl, 2002) (Starck, 2002).

As discussed with Ulrica Hedlund (2002) at the Office of the Environment in Kristianstad municipality, some environmental offices on the municipality level are given the opportunity to work towards developing specific environmental goals and specific objectives for agriculture activities in their municipality. The aim of such work is to involve all stakeholders in the municipality to give input into the municipality goals. However, these types of projects do not receive national government funding. Therefore, these activities can only be implemented if there are sufficient funds within municipalities. Another limitation is often finding adequate expertise to undertake such projects (Hedlund, 2002).

Another important point, as discussed with Dahlman (2002), is that environmental goals and objectives should not be made unless the government has plans to instigate policies and programs that enable these goals to be carried out.

4.2.6 Legislation affecting wetland implementation

The implementation of environmental activities is not always as easy as providing economic incentives. This is illustrated by the creation of wetlands. There is some money from the Swedish government, and a bit from the EU, to cover the costs associated with wetland introduction.

Agreements called *decknings vertargang* regulate the water levels of the water system within the agricultural lands of those farmers that have signed the agreements. It is necessary to change the water levels in order to implement the wetlands on farmlands today. It is difficult to reverse these legal agreements that are still in place (Åckerman, 2002) (Regnell, 2002).

Around 1850 laws regulating the drainage of wetlands began to be created. These laws allowed the creation of cooperative decknings vertargang agreements giving landowners the right to drain certain areas of land. There was no real standard as to the number of farmers that signed these agreements. Sometimes only 3-10 farmers signed them, other times 300 farmers signed them (Regnell, 2002).

Today, if a group of 5 or 10 landowners are in one of these agreements, and 2 or 3 of the people want to build a wetland, they face some legal challenges to get around the still relevant decknings vertargang agreements. There is not an efficient system for negotiating the agreements (Regnell, 2002).

4.2.7 Lobby groups

Government decisions are also influenced by various lobby groups that have specific interests they want to see manifested in various government policies and programs related to agriculture. Many organizations participate in lobbying efforts. This includes various supply companies, organizations, etc. Some lobbying comes through various industry associations. For example, the European Crop Protection Association, a coalition of pesticide companies throughout Europe, represent the ideas and views about environmental and agriculture legislation, especially on the EU Level (Husby, 2002). The Federation of Swedish Farmers (LRF) also has representatives meeting with policy makers on both a national and EU level.

What was not made clear in this research was the extent to which different lobby groups, representing the interests of farmers, suppliers, food processing companies, and other various companies influences decision making at different levels of government.

According to Wallensteen (2002) from the Swedish Board of Agriculture, there are lobby groups that call attention to different environmental issues when legislation is being discussed regarding agriculture and the environment. These include SNF, Greenpeace, Miljöförbundet, Jordens, Vänner, and LRF. It is unclear how influential different interest groups are on the developing government policies.

The existence of such lobbying may be an indication that it can be influential. However, the extent to which this statement is true cannot be verified without further research. The "position" of related businesses and organizations will be discussed in a further section.

4.2.8 Key conclusions

The Common Agriculture Policy (CAP) is the most influential government policy that sets the playing field for the agriculture in Sweden, and throughout Europe. Various subsidy programs have ensured that the CAP meets its objectives. As indicated in the previous section, financial compensation motivates farmers to carry out specific activities. There have been some measures to address the environmental problems within the original objectives of the CAP. This approach has created some success, but it also sends contradictory messages to farmers. One message is that farmers should be concerned primarily with high yield and efficient production. Another message is that farmers should be concerned about the environment, a difficult task if the objective is to produce as much yield as possible. Further calls for reform to include environmental initiatives might lead to changes in the overall objectives of the CAP.

Mandates and directives from the EU are not the only drivers of Swedish environmental and agriculture policy making. International agreements, especially the Helsinki Convention, are important drivers for instituting national environmental policies. The commissions for carrying out such treaties, as well as offices such as the Swedish EPA, help the government create environmental objectives and legislation to meet the objectives. The interests of various companies, industry groups, and organizations influence this process, both on a national and EU level. This lobbying may be either supportive of or opposed to legislation that makes more stringent environmental policies.

Legislation can be an important tool for addressing specific problems, as seen with the programs to reduce pesticide use. With these successes, it is clear that broad policies that apply to all areas of Sweden are not always effective. It is necessary for farmers to have opportunities to implement practical measures that make sense for the unique characteristics for each farm. Local authorities working to enforce legislation feel more effort could be spent developing local strategies for environmental protection.

4.3 Industrial Ecology Conditions

This ecofactor looks at the industrial ecology possibilities that are presented in agriculture inasmuch as the problems associated with agriculture runoff can be minimized. Of course, not all industrial ecology conditions are mentioned here. However, those discussed are real possibilities, and a clear role in the ecological modernization of the Swedish agriculture industry. Although they might exist, those industrial ecology possibilities for other aspects of the agriculture life cycle, such as preparing the land, planting, harvesting, shipping, processing food, and consuming food products have been omitted. In addition to environmental and economic possibilities, this section also mentions the problems associated with the implementation of the various opportunities for industrial ecology. The various problems might explain why the various industrial ecology conditions are not more commonly taken advantage of in Sweden.

4.3.1 Recycling of organic materials

As mentioned in chapter 2, a goal to reduce nutrient pollution should also include eliminating the amount of unnecessary nutrients that come into the agriculture "loop." A very important way this is done is through the recycling of organic material. This could be considered the most common industrial ecology condition in agriculture. The basic principle of recycling nutrients to use organic materials from animals, plants, discarded food products, and even humans as nutrient inputs on fields. This nutrient input allows farmers to minimize the use of artificial fertilizers.

It should not be assumed that using organic material from animal manure, plant debris, discarded food, etc., as a source of nutrients for agriculture fields, poses less risk to the Baltic Sea than using nutrients in the form of artificially produced fertilizer. A study of the entire lifecycle of artificial fertilizers might give a different overall picture of the environmental impact of artificial fertilizers, but when looking specifically at the impact on the sea, it has been indicated in this study that organic sources of nutrients can be just as much a threat of nutrient pollution as artificial fertilizers. In some cases they maybe more of a threat (Andersson, G., 2002).

The true benefits of closing the nutrient loop using organic fertilizer come when the fertilizer is applied in the most environmentally appropriate manner. To minimize leakage, the application of the nutrients onto the fields, whether using organic or artificial fertilizer, must be accomplished in a way that the fertilizer does not overload the soil. The nutrients must be incorporated or be bound into the soil at a fast enough rate that they are not susceptible to being part of runoff when it rains. Optimum plant nutrient utilization incorporates nutrients into the soil as much as possible without the nutrients leaving as runoff (Granstedt, 2000).

The buying and selling of manure as fertilizer was discussed with large-scale animal farmers Per Lindahl and Karin Eriksson (2002). There is a fairly high level of exchange of organic material, especially manure, between farmers. This is the case because many farms have a large number of animals in production that produce more manure than can be used on an animal farmer's cropland. Alternatively, some farmers have very few animals, and are able to utilize the other farmers' animal manure as fertilizer on their land. All indications are that organic fertilizer is typically less expensive than artificial fertilizer, and that those fertilizer buyers would save money by paying less for organic fertilizer than they would if they were to buy the nutrients in the form of artificial fertilizer. Based on these considerations, it would seem that the buying and selling of manure might be driven by the principles of supply and demand. However, this is not always the case.

Even with the ability to move manure from one farm to another, many farms without animals still depend on artificial fertilizers to produce crops. At the same time, it is seen that excess nutrients accumulate near the high levels of animal production. This might be because primarily-animal farms are distributed quite far from primarily-crop farms, making transportation costs higher than the economic benefit of buying and selling manure. It is also common that the level of nitrogen in manure is not high enough to meet the demand of crop plants, and therefore this organic fertilizer is supplemented by artificial nitrogen supplements.

There are no real policy incentives that encourage the recycling of manure from animal farms to crop farms. This is especially true for animal farms that do not exceed the limit of 200 livestock units/HA (Gustafsson, 2002).

Those animal farmers who exceed the 200 livestock unit/ha limit, typically have difficulty keeping the regulation that limits the phosphorus spread in organic material to 22 kg P/ha/year if they spread manure only on their land. This regulation therefore provides an indirect incentive for animal farmers who have limited land area to find buyers who are willing to spread this excess manure. Per Lindahl is a large-scale chicken farmer. Because of the high density of animals he has, by the regulation, he only has the land capacity to utilize half of the manure produced. He needs to locate approximately 200 additional hectares of land in order to dispose of the excess manure. If he cannot find a location to discard this manure, the government can force him to reduce his level of production (Lindahl, 2002). This urgency requires Lindahl to give the manure to the first farmer who is willing to take it off of his hands. Because of this, he does not receive compensation that is equal to what the manure is worth.

There are other organic materials coming from food processing, food waste, and human waste also, which serve as sources of nutrients on farmland, however their use is not widespread. As mentioned in chapter 2, there are currently many fears about the health and safety regarding the use of sludge and urine on croplands.

One company, Ragn-Sells Agro**,** deals with organic (and some inorganic) waste and residual products, such as sludge from sewage treatment plants, breweries and the food industry. The goal of this company is to make money by providing a service that can improve soil quality with material that might otherwise add to nutrient pollution (Ragn-Sells, 2002). There is an opportunity for farmers to take advantage of the services of such a company to help close the "nutrient" loop by using the nutrients such products provide. Although no data has been collected, it is assumed that such businesses are occurring only in a very limited numbers in Skåne.

It should also be mentioned that organic crop farmers, and those trying to achieve some level of environmental certification, have a demand for organic forms of nutrients.

In summary, the infrastructure for recycling manure and other organic farm materials does not seem ideally set up beyond the farm where the materials are actually produced. Several factors might be at play here. One important factor is a lack of legislative incentive to take full advantage of the nutrients

present in organic material. A second factor is the feasibility of storing and transporting organic material to the places where the best advantage of its nutrients could be taken. See Tables 2 and 3 for a summary of these discussions.

Table 2 Using farm manure (animal and green manure) as a source of plant nutrients.

Environmental Benefit	*Economic Benefit*	*Problems*
Encourages the utilization of the nutrients present within the system, as there is less need to use artificial fertilizer on the field. This encourages closing the nutrient loop.	Farmers selling manure gain money, while buyers save the money they would have paid for artificial fertilizers (assuming the cost is less than artificial fertilizers).	There are high transport costs, especially if there is low integration of animal and crop farms in a given region.

Table 3 Using municipal waste (sewage sludge, urine, food waste) and food processing as a source of plant nutrients.

Environmental Benefits	*Economic Benefits*	*Main Problems*
Brings nutrients to the agriculture system that might otherwise leach into the water system or not be utilized. The nutrients in this organic material may have their origin in the agriculture fields. Therefore, utilizing this material increases the soil quality while helping to close the nutrient loop.	The public could have an economical way to deal with so-called wastes. Farmers may save money by using the nutrients in this material while the need for artificial fertilizers is reduced.	There is not an effective system for verifying that sludge from waste treatment centers is free of toxic materials, such as cadmium. Transportation costs could be somewhat high.

4.3.2 Crop rotation with nitrogen fixing crops

Another industrial ecology condition is that of crop rotation to put nitrogen into the soil. Crop rotation is a requirement for organic farmers and for those trying to achieve a certain level of environmental standards, such as KRAV (Andersson, 2002). Table 4 summarizes some of the benefits for using crop rotation, and gives an idea as to why it is not implemented by all farmers.

Table 4 Crop rotation using nitrogen-fixing crops.

Environmental Benefits	*Economic Benefits*	*Main Problems*
Restores nitrogen in the soil, reduces erosion by keeping the ground covered, helps reduce crop losses to insects by presenting them with a changing target (Miller 2002).	Improvement of soil quality and protection from pests decreases the reliance of farmers on artificial fertilizers and chemical pest control, therefore saving economic resources.	In the short term, replacing crops that earn money with nitrogen-fixing crops could decrease the overall income of farmers.

4.3.3 Biological pest control and strategic crop cultivation

These techniques, which are traditionally undertaken only by organic farmers, are being used more and more used by conventional farmers who understand their environmental and economic benefits. Those farmers not looking to become organic farmers, but trying to improve their environmental performance for various reasons, may undertake this strategy. Nevertheless, there are still farmers

who do not implement these techniques (Lindahl, 2002) (Andersson, T. 2002) (Eriksson, 2002). Table 5 summarizes the benefits to implementing biological pest control and strategic crop cultivation techniques.

Table 5 Biological pest control, strategic crop cultivation, and other integrated management techniques.

Environmental Benefits	*Economic Benefits*	*Main Problems*
Decreases the threat of harmful chemicals in the water system, improves biodiversity, increases the integrity of ecological systems.	Decreases the need for farmers to apply as many chemicals, thus saving money.	Manual removal of pests can be very labor intensive. Some farmers might be unwilling to try new techniques, especially if they have limited experience and knowledge of such techniques.

4.3.4 Energy crops

There are opportunities for farmers to grow leys crops for energy production. Sydkraft, a major energy supplier in southern Sweden, relies on bio-energy crops in its mix of energy supplies. There is also great potential for this form of energy to grow in coming years (Johnson, 2001). Björ Zethraeus (2002), bio-energy specialist, verified that many bio-energy crops do indeed replenish the soil with nitrogen. The degree to which this can occur depends on the type of energy crop planted. Table 6 outlines some of the potential benefits and problems associated with the cultivation of energy crops. Appendix 3 is the transcript of an electronic mail written by Zethraeus (unedited), which further discusses some of the issues associated with energy crop production.

Table 6 Growing Energy Crops

Environmental Benefits	*Economic Benefits*	*Main Problems*
Improves the soil quality as many energy crops also contribute to nitrogen fixation. Prevents erosion by keeping arable land covered (Björn 2002).	Supplements the income of farmers by the sale of energy crops. Improving soil quality decreases the need to buy expensive fertilizers and other chemicals.	Growing energy crops decreases the space for other crops that can earn money.

4.3.5 Wetland creation

The environmental benefits of wetlands have been discussed throughout this research. In addition to environmental benefits, there are also some economic benefits. For example, in areas where it is difficult to obtain enough water for irrigation, wetlands can serve as a convenient water source (Hempel and Hempel, 2002). Wetlands have also been shown to increase the biodiversity of an area (Åckerman, 2002), which might lead to greater opportunities for biological control of pests. Data has also been collected that indicates higher populations of fish in wetlands, especially pike. Greater biodiversity might also attract tourists and fishermen, diversifying the income possibilities in farming communities (Hempel, and Hempel, 2002). As wetland implementation is still a fairly new idea, more extensive research must be carried out to prove that the environmental and economic benefits associated with wetlands are real.

The section on policies and programs discussed some of the legal constraints associated with wetland creation. There are also some economic and technical barriers. As mentioned previously, wetlands effective at removing nutrient and pesticide pollution must be situated in an appropriate area, i.e.,

located where they can catch the runoff from the fields. This often requires that the wetland be placed in an area of prime agriculture production. This creates a disincentive for farmers, who are not always fully compensated by government subsidy programs (Åckerman, 2002). The long-term benefits received from wetland implementation may indeed overcome these economic barriers.

Another difficulty is finding the proper expertise to ensure wetlands are created correctly and are positioned in the most effective locations. The technical process of draining wetlands was organized and designed by "water officers." These water officers were hydrology professionals who knew how to drain the land properly to create suitable arable land. The water officer role does not exist today. This has created a limited supply of professionals in the area of hydrology. This type of expertise could be useful in understanding how the wetlands system works, and perhaps it would aide in incorporating wetlands into current agricultural systems (Regnell, 2002). Table 7 summarizes some of the benefits and problems associated with wetland creation.

Table 7 Wetlands Creation

Environmental Benefits	*Economic Benefits*	*Main Problems*
Helps keep nutrients and pesticides in the runoff from reaching the sea by filtering and naturally treating polluted waters. Also increases biodiversity and fish habitat (Åckerman, 2002).	Increased biodiversity may equate the existence of more natural predators. More fishing and wetland recreation should draw visitors who may add to local economy (Åckerman, 2002) (Regnell, 2002) (Hempel, 2002).	The most efficient wetlands take space away from valuable agriculture land, and direct compensation from the government might not make up the costs. There is a lack of expertise for implementing wetlands (Åckerman, 2002) (Regnell, 2002).

4.3.6 Key conclusions

Ideally, industrial ecology conditions give farmers the opportunity to implement measures to improve the environmental performance of their farming practices, while receiving further economic compensation. Of course, if it were as simple as that, all farmers would implement the different industrial ecology techniques. There are obstacles to overcome in each of the industrial ecology techniques presented here. Regardless, there appears to be potential for industrial ecology in Skåne agriculture that has not been fully explored throughout the various sectors of the agriculture industry.

4.4 Positioning of Related Businesses

There are many different businesses that have a role within the agriculture industry. Many of these companies can be considered industries related to the agriculture industry as opposed to being merely related businesses. Further, some of these industries have developed as such because of their role within the agriculture industry. For example, both the pesticide industry and synthetic fertilizer industry have grown into large industrial operations specifically because of their role in the agriculture industry.

There are other related businesses and industries in which certain agriculture activities are part of the value chain. This can be seen with food-processing companies that often appear as industries using agriculture products as their raw material. Large-scale sugar beet production, for example, is a source of raw material for sugar production. The sugar is then used as an ingredient throughout the food-processing industry.

What many of these related businesses or industries have in common is that their success relies heavily on the production methods of modern day agriculture. Such industries could not conduct business as usual if agriculture were to be significantly changed.

This section attempts to illustrate the influence related business has on the reduction of nutrient and pesticide pollution into the Baltic Sea. The pesticide industry is used as a key example to illustrate the role and persuasive strength of some related industries in the agriculture industry. Several other related businesses and industries having important influence on the agriculture industry, including the Swedish co-operative system, are also discussed.

4.4.1 Chemical industry--pesticides

Two divisions of the chemical industry are of major importance to the agriculture industry. These are fertilizer companies and pesticide companies. This section attempts to illustrate the positioning of the chemical industry by looking closer at the business of producing pesticides.

Like all businesses, pesticide companies want to make a profit. However, because of public requests, pesticide companies must balance concerns for the environment while making a profit from pesticide use. During this research, a visit was made to Bayer Chemical to further understand this dual role chemical companies face, and to explain how these types of companies impact the activities of farmers.

A three-hour discussion was held with Jens Husby (2002) at Bayer Chemical company headquarters in Copenhagen, Denmark. One part of the Bayer Company manufactures pesticides, or "plant protection" products as Bayer refers to them. These products are then provided directly to the agriculture industry. Husby works with the sale of pesticides in the region, including Skåne. As of October 2002, he is in charge of the Integrated Agriculture Production at Bayer.

An important part of the pesticide industry is the European and Swedish level associations of pesticide companies. The European level association is the European Crop Protection Association (EUCPA) is made up of all the large pesticide related companies in Europe. There is also a Swedish branch of this association called, Industrin för Växt-och Träskyddsmedel (IVT). It is through this coalition that the needs, demands, etc. of the chemical companies are communicated to various government agencies, including the EU (Husby, 2002).

Husby says that all the major chemical companies that are in EUCPA want to approach integrated crop management scientifically. He said Bayer wants to be responsible in this area, as the company desires to meet society's request for a non-toxic environment. He said it is this push that keeps Bayer from marketing any chemical that it finds to be a credible threat to the environment. When asked if Bayer routinely uses the Pre-cautionary Principle[10] when it comes to deciding whether or not a product will be put on the market or recalled, Husby said Bayer makes all such decisions on a scientific basis. He said the principle is important, but that Bayer does not want to be "rash" in its decision-making. The quick answer is that no, the Pre-cautionary Principle is not always applied.

Although the Pre-cautionary principle is not always used, Husby said Bayer would never knowingly keep an environmentally harmful chemical in the market. Additionally, Bayer makes sure (to the extent possible) that the chemicals designed for the agriculture industry have no known risks. Bayer can screen 15,000 chemicals per day. When asked about bio-accumulating chemicals, Husby said those types of chemicals are not produced. Although non-bio-accumulating chemicals can be a threat

[10] Pre-cautionary Principle- This is the principle that says anything that has the possibility of being a risk to human health, the environment, etc., even before this threat is proved to be a reality, is avoided.

to water systems, the removal of bio-accumulating chemicals is an important step towards eliminating the risk of environmental impact from pesticides pollution.

Regardless of Bayer's stated interest to be environmentally friendly, it is still necessary for the company to make money and sell crop protection products. Husby pointed out the importance of the shareholders and earnings, explaining that the company will not run without money. Husby also mentioned an important point, that the company will not operate if it cannot maintain a good reputation for environmental and health concerns.

Husby said that Bayer must be very careful when it comes to publicity, so high standards in environmental and social reporting must be kept. Any mistake in these issues could easily hurt the reputation of the company, often through the media. This explains part of Bayer's motivation for maintaining high environmental standards. If they were to make some mistake which resulted in environmental or health mishaps, the negative attention would scare off potential investors and customers, who would seek companies with better environmental and social performance.

Bayer, and many of the other chemical companies promote integrated agriculture production, specifically techniques for integrated pest management. Both Bayer and another chemical company called Aventis, have developed literature outlining their integrated pest management programs (Bayer, 2000) (Aventis, 2001). Both companies claim to encourage farmers to use pesticides only when necessary, and even help farmers to institute agriculture techniques to reduce the need for pesticide use.

Additionally, the companies are trying to improve chemicals and application technology, so less amounts of chemicals are needed to get the job done. Improving the application technology includes such things as more direct spray nozzles, precise pest identification using computers, etc. These technologies should make application more precise, removing the need for blanket applications (Husby 2002), which often leads to excess use of chemicals that find their way to the water system without giving any beneficial plant protection.

Husby showed statistics that the total mass of pesticide use has decreased in the last couple of decades. Regardless of the desire to sell plant protection products, Husby says Bayer promotes these efforts to reduce the overall mass of what is applied (2002). Reductions in total mass might come from a combination of improved application techniques, as well as the use of chemicals that are more effective in killing pests.

If it were requested by society that all pesticide production should stop, Husby said Bayer would minimize its focus on crop protection and move resources to different parts of the company (like medical research). But, he said that is not the case, and that farmers, and society overall continue to demand the production of chemicals.

Husby did present figures that estimate how much money and jobs the economy would lose, if pesticides were no longer used. When asked if jobs in the economy could be shifted elsewhere, to organic production for example, the response was that the figure of the net loss already considered that shift. Making such a forecast does not seem possible; however, he said it was based on the findings in the "Bichel Report," which discusses this issue along with other environmental and economic questions. The Danish Environmental Protection Agency (EPA) released the Bichel Report in 1999. It was the result of a task to assess the overall consequences of phasing out pesticides. The Danish EPA appointed several committees made up of stakeholders from various academic fields (economists, scientists, etc.) and industry groups to carry out the study (Bichel Committee, 1999).

When asked if Bayer communicates with the government on the EU or Swedish level, Husby said that type of communication occurs between EUCPA and the government. The views of Bayer are contained in this umbrella. A report such as the Bichel report provides the EUCPA much leverage for promoting the interests of the chemical company. The strength of the industry gives it the opportunity to maintain policies and structures that allow its business to remain as profitable as possible, while maintaining the necessary environmental responsibility to retain a good image. It appears that environmental initiatives beyond what would make the pesticide industry profitable would be unacceptable to the members of EUCPA.

The National Chemicals Inspectorate is also an important part of the chemical industry, as it decides whether a pesticide is approved for use in Sweden or not. Its decision is based solely on the physical and chemical properties of the pesticide and not the possible need of the product in Swedish agriculture (Fogelberg, 2001).

4.4.2 Seed development companies

The major seed development company in Sweden, and throughout the world, is Svalöf Weibull. Its company headquarters is in Svalöv, Skåne. They coordinate and conduct breeding, trials, marketing and sales of seeds from many different crops, including rape oilseed, peas, cereals, vegetables, and potatoes.

Lisabeth Andersson (2002), an organic dairy farmer), pointed out that the majority of the seed development projects taking place are in a 40:1 ratio in favor conventional seed projects. This means that only one project out of forty works towards developing organic seeds. Andersson (2002) pointed out the need for organic seeds to be developed by large companies like Svalöf, as they have the financial resources to improve organic seeds. According to Andersson, organic farming will never be as effective if conventional seeds, which have been designed considering the inputs of fertilizers, are not replaced by seeds developed to be effective in organic conditions. Andersson says different companies own Svalöf, including a major fertilizer supply company. She believes these companies consider improvements in organic production a threat, as it might decrease the demand for such products as synthetic fertilizer. For this reason they are unwilling to encourage Svalöf Weibull to develop organic seeds (Andersson, L. 2002).

Svalöf was not contacted during this company. Regardless, the claim by Andersson illustrates the reliance certain aspects of farming have on related businesses. Without seed development research, the agriculture industry would not be as effective as it could be in growing food products. Further, seed development companies have developed as a result of access to the financial resources invested to develop the agriculture tools that can produce efficiently based on the available conditions, such as access to fertilizers and pesticides. Shifting that investment towards the development of other products (organic seed) appears difficult.

4.4.3 Machinery suppliers

Although it was not considered extensively in this research, the machinery supply companies could be considered important players in dictating how farming is carried out. It is often assumed that machinery supply companies will lose jobs and money if agriculture shifted away from intense production. This is because people often associate less impacting agriculture with less use of equipment and technology. Although, it might be the case in some instances, a shift towards a reduction in use of synthetic pesticides and fertilizers will not necessarily mean the reduction in use of the technologies provided by machinery and supply companies. For example, as Andersson, L. (2002) pointed out, the mechanical removal of weeds and pests in an organic field should not mean a decrease in the use of technology. She said it would be much more effective to use machinery that can recognize pests (perhaps through computers), which are then mechanically remove the pest.

There might also be some concern that machinery decreases the ability to maintain optimal soil quality, as machinery often compacts the soil. As Ericksson (2002) said, this issue also relies on the weather conditions, and how the moisture in the soils. Poor soil quality could lead to increased nutrient leakage. Regardless of the situation, it would appear obvious that the machinery supply companies want to see continued use of their equipment.

This sector should be considered a factor influencing the ecological modernization of the agriculture industry. The extent to which this is true requires further research.

4.4.4 Farmers' co-operatives

There are specialized institutions designed to market Swedish products on behalf of the farmers. Typically, these specialized institutions are farmer co-operatives. The co-operatives were established to improve the price of the products by increasing the bargaining power of the farmers, and by introducing measures to maintain higher food quality. The unique characteristic of co-operatives is their ownership structure. The farmers who use the services of the co-operatives also own the cooperatives (Heidenmark, 2000).

One of the most important co-operatives in Sweden is Svenska Lantmännen--the Swedish Farmers Supply and Crop Marketing Cooperative. The aim of the co-operative is to, "provide conditions for profitable arable farming and livestock production and find a market for our members' products (Lantmännen, 2001)." Lantmännen is owned and governed by approximately 56,000 Swedish farmers, and has an annual turnover of SEK 25 billion (EURO 2.7 billion). The group has 10,000 employees in thirteen countries, although most work in Sweden (Lantmännen, 2001). The size of Lantmännen indicates the strength and potential influence this co-operative has over the agriculture industry.

Lantmännen is involved in many different aspects of agriculture production, marketing, and sales, in Sweden, as well as outside the Swedish borders. According to the Lantmännen internet site, this cooperative markets farming commodities such as seed, fertilizers, plant protection products and feed for animal production. Following harvest, Lantmännen also has the facilities to store and refine the agriculture products before they are sold to processors such as flourmills, feed industries, and distilleries (Lantmännen, 2002).

Another important business for Lantmänen is its machinery sales. Lantmännen serves as a retailer of machines for farming and forestry. The co-operative also operates an extensive chain of about 140 hardware stores throughout Sweden. Furthermore, Lantmännen is a complete supplier of agricultural construction equipment. Lantmännen also carries out research and development in cooperation with universities and other companies (Lantmänen, 2002).

It is important to get an idea of all the different activities a co-operative such as Lantmännen is involved in. If they are indeed a voice of their members, as they claim, their actions represent those of the farmers. If there are any shifts in the thinking of farmers about how farming should be carried out, this should be reflected in the activities of the various co-operatives. Additionally, if there is a demand from food companies and consumers for products that take environmental concerns into consideration, the co-operative should figure out how to meet the demand in a way that is most economically feasible. This might mean importing a certain type of product, or it could mean passing the demand on to its members, who would then try to provide products that meet the demand.

EcoTrade is a division of the Läntmannen co-operative that deals with the buying and selling of organic grain. It also addresses some integrated production issues. As Anna Björnberg (2002) said, this is a very small part of Läntmannen's operations. She also said that southern Sweden is not moving as much environmentally-oriented grain as other parts of Sweden. She did say that interest has increased in recent years as farmers start to recognize the demand. Having EcoTrade gives

Läntmannen the opportunity to make some money from its sales in this sector. It is the thought of this research that having some business in organic sales gives Läntmannen the necessary capacity to deal further in environmentally-oriented products if there is further future demand.

As Gunilla Andersson (2002) mentioned, these co-operatives are made up of all types of farmers, including organic farmers. So, a small part of all these types of these co-operatives are influenced by the interests of organic and other environmentally motivated farming. However, because the main control of these groups is by people more directed towards conventional farming, the organizations cannot fully embrace such ideas as organic farming. Although no data was gathered specifically about this issue, there is a possibility that the production of environmentally-oriented products could be a conflict of interest for a group like Läntmannen. This is because Läntmannen also generates so much business in the sales of non-organic products, for example, sales of imported grains and synthetic fertilizers. There might also be some conflicts with other sectors of Läntmannen, like machinery sales.

4.4.5 Food processing companies

These companies are an important factor in the activities of the agriculture industry, as they are buying products from farmers or through co-operatives. The processing companies have the opportunity to demand from the farming industry products that have met various levels of environmentally-oriented production.

An example of this was mentioned in section 4.1, as the dairy farmer, Eriksson, was told by Skåne Mejeriet, that they will pay more for her milk if she is ISO-14000 certified. As pointed out by Björnberg from EcoTrade (2002), farmers in Skåne often have contracts with companies to produce large volumes of products. Because of the incentive to meet these quotas designed by large buyers, there is not much room to implement environmental activities, or alternatives to conventional farming, that risk decreasing the yield. With this in mind, buyers have the opportunity to push farmers to implement environmental measures.

There are some difficulties and costs associated with food processing that often act as a barrier to companies as they attempt to fully integrate environmentally-oriented products into their production line. If there is not enough incentive for these companies to figure out a solution to reducing costs, further implementation of environmentally-oriented products may be limited (Andersson, G., 2002).

4.4.6 Retailers

This category considers all those businesses designed to sell agriculture products to the consumer. Supermarkets, farmers' markets, convenience stores, restaurants, food stands, and others are being considered food retailers. The retailers are the primary interface with consumers. Presumably, many of the consumer demands are felt first hand by the retailer, who then must relay the demand to food suppliers, food processors, and farmers.

Andersson, G. (2002), pointed out that the presentation of food products to consumers on the retail level contributes to determining how consumers are going to act, and what they will demand. She explained that retailers are in a good position to take on some of this knowledge transfer to consumers, but they rarely accomplish this task efficiently. Andersson says, without a clear explanation of what organic products are, and why they cost as much as they do, it is difficult for consumers to learn about the benefits of environmentally-oriented products.

Konsum is a Co-operative supermarket owned by the consumers that attempts to have a large selection of environmentally motivated products. According to an interview with Gunilla Andersson (2002), who works with the EcoMarket in Malmö to further develop the organic food market, Konsum has been successful in promoting the idea of ecological foods to the consumer.

Nevertheless, Andersson says, Konsum and other chains are not fully educating customers about the purpose, behind environmentally-oriented products.

Andersson also says retailers have the responsibility to make environmentally beneficial products available on their shelves. She says Konsum claims to make an effort to stock more of their shelves with environmentally-oriented products. However, Andersson is critical about Konsum's claim that the reason their shelves are not full of environmentally-oriented products is because they cannot find enough suppliers of these products. Andersson agrees that it would be difficult for Konsum to fully stock their shelves with these products, but she believes Konsum, and other retail stores, have not done enough to search for suppliers of these products.

Andersson also believes there is potential within the restaurant industry to provide consumers with organic products. This will be further discussed in the section on market demand.

4.4.7 Key conclusions

Considering their size, it is clear that related industries, and businesses associated with agriculture, have a very large influence on farming activities and the entire agriculture industry. These related businesses have developed success based on current agriculture practices. It is easy to understand that these businesses are weary of any changes in agriculture that could jeopardize their financial success. In some cases, like the pesticide industry, there have been some attempts to satisfy society's call for improved environmental awareness regarding pesticide use. It is clear, though, that such an industry is resistant to a drastic shift in the way agriculture is carried out, say completely eliminating pesticide use. This adds a sense of rigidity to the agriculture industry, making it difficult to implement new techniques that do not fit the traditional paradigm. Seed development is a good example. It is difficult to persuade seed development companies that have strong know-how and financial resources to develop seeds that will help improve the yield from organic crops. Part of this resistance may be that it is not in the interest of fertilizer and other companies that have ownership in seed development companies to promote success in organic agriculture, for the obvious reason that they stand to lose revenue if less fertilizer is sold.

Another important influence on the agriculture industry in Skåne is farmer owned co-operatives. Co-operatives give a loud voice to farmers, typically representing the interests of the majority of farmers. This is especially true of the important co-operative in Sweden, Läntmannen. Although there are some attempts to represent environmental issues at Läntmannen, theoretically, any major shifts in thinking must come from a majority of the members. Practically however, the direction of a co-operative might follow the initiatives, and decisions, of appointed representatives who are running the co-operative and making operational decisions on a daily basis. Also, in the case of Läntmannen, it might be difficult to promote many changes, because conflicts of interest might arise. For example, if there is a demand from buyers for Läntmannen to sale more organic grains, they would lose business from the sales of synthetic fertilizer.

Although they may be a minority, there are related businesses that are demanding that farmers implement environmental measures into the way they produce agriculture. If the stakeholders of the businesses related to the agriculture industry demand environmentally-oriented products, this demand can be passed on to farmers. The farmers must then implement the necessary measures to meet the demands of contracts with buyers. It is thought that this is an underdeveloped potential for promoting environmental agriculture techniques. The reasons for this underdevelopment are likely related to costs associated with fully integrating environmentally-oriented products into the value chain of various processing companies (this is discussed further .in section 4.6). Although it is being assumed here, it is not clear from the data gathered if the environmental demands from related

businesses specifically address the issues of pesticide and nutrient pollution. Instead, they may be more focused on other environmental issues. This should be considered in further research.

4.5 Interest Groups and Organizations

This section attempts to explain the important role of organizations regarding the agriculture sector in Skåne. Based on the research collected, five categories of interest groups and organizations influencing farming activities have been identified. This is not an exhaustive set of categories, as further research might uncover additional types of groups and organizations that are equally or more influential than the ones described here. Further, each category gives some examples of specific interest groups and the influence they have on farming activities. Again, this is not an exhaustive set of examples.

4.5.1 Farmers' associations and special interest groups

Two important examples of farmers' associations and special interest groups are discussed in this section. The first is the Swedish Federation of Farmers (Lantbrukarnas Riksförbund, LRF). Second is Swedish Ecological Farmers Association (EFA), a group similar to LRF but holding only organic farmers as its members. These groups are important as they represent the various interests of their respective members to the government and to society as a whole. They also serve as important information banks for their various members.

Swedish Federation of Farmers (Lantbrukarnas Riksförbund, LRF)

This is an association for farmers throughout Sweden that takes on the task of creating "the conditions for efficient, market oriented and competitive companies (LRF 2002). " Jan Hultgren, (2002) a board member of LRF says, to carry out this task, LRF is located in every municipality to answer farmers' questions, listen to their needs, and to deliver information to the farmers.

An English summary of LRF's mission statement posted on the LRF homepage (2002) reads as follows.

LRF is the interest and industry organisation for Swedish farmers, forest owners and the agricultural co-operative movement. By advancing the economic interest of farmers and developing rural communities, the conditions are also created for promoting and satisfying social and cultural interests. Membership in LRF is designed to provide influence, profitability and fellowship.

LRF consists of approximately 140,000 individual members, along with 50 incorporated associations that make up the agricultural co-operative movement and 13 industry organizations. Including the members via association with the different co-operatives and organizations, there are approximately 300,000 members of LRF. This is a large majority of the people involved in the Swedish agriculture industry (LRF, 2002).

LRF holds as its members a large majority of the farmers in Skåne, and throughout Sweden. It could be considered one of the most influential groups regarding all aspects of the agriculture industry and the activities of farmers. For many years, LRF has promoted the interests of farmers in government and throughout society (Hultgren, 2002). LRF is also represented in the EU. Rolf Eriksson is the current LRF representative to the European Union in Brussels. LRF also plays an active role in passing knowledge to farmers, with the goal of enabling farmers to be more successful.

In recent years, as an organization, LRF has realized the importance of promoting environmental improvement amongst farmers. This has become one of the stated priorities of LRF. Although not all members agree with the need to address environmental issues, LRF promotes the "Swedish

Approach" to agriculture (Blix, 2002). See Box 6 for a summary of the different aspects of the Swedish Approach to agriculture that regard pesticide and nutrient pollution.

- Water systems should be free of pesticide residue
- Minimized risk of pesticides on cultivated land and surrounding ecosystems
- Reduction of dependence on synthetic pesticides
- Recycling plant nutrients that leave farms as food products
- Organic waste returning to farms should be free of unwanted heavy metals and other toxic substances

Box 6 Summary of LRF's "Swedish Approach." (LRF, 2001)

The "Swedish Approach" can be considered an integrated production approach. LRF promotes organic production to the extent that it is profitable business for farmers (Hempel, 2002). As Eva-Karin Hempel, a board member for LRF, pointed out, in some cases it is felt that organic production does not make good economic sense for Swedish farmers. It was Hempel's (2002) opinion that in these cases, organic production should not be promoted. This is an example of the thinking that organic farming is not the solution to the environmental problems associated with agriculture.

Both Blix (2002) and Hempel (2002) mentioned that access to education and training are the primary ways LRF tries to build capacity among farmers. Through educational programs, LRF feels it can mobilize its members to improve their environmental performance and maintain profitable farming businesses.

Due to its high level of influence, LRF has the ability to lead farmers towards more environmentally friendly techniques. This role could expand if there are big changes in the EU's approach to the Common Agriculture Policy, and other legislation, that favor strong environmental techniques. Although this happens to some extent already, LRF could serve as an important support tool to assist Swedish farmers in making a transition to more environmentally concerned techniques. Considering that LRF is well known in society and has access to government leaders, it seems LRF could also be in a position to lobby for such legislation and programs that assist farmers in improving their environmental performance. However, this would require the necessary interest amongst LRF members.

Swedish Ecological Farmers Association (Ekologiska Lantbrukarna)

Taking on a similar role as LRF, The Ecological Farmers Association (EFA) is a group that has managed to unite organic farmers into one strong umbrella organization. Founded in 1985, by 2001 it had grown to about 2300 members. Most of the members are active farmers, but advisors, teachers and others supportive of organic agriculture are invited to join. The EFA is a non-profit organization, and religiously and politically independent. The goals of EFA are addressed through three primary activities: policy work, creating information, and organizational development (Ecological Farmers Association, 2001).

The overall goals of EFA are to promote organic agriculture and to work for the interests of organic farmers. Its focus is to suggest and work for initiatives to advance organic farming's development.

Development addresses both the amount of organic production produced as well as the quality of organic products. Also, EFA considers one of its tasks to be the safeguarding and strengthening of the values of organic production and to make them known and understood so that the trust of consumers of organic products is maintained (Ecological Farmers Association, 2001).

Since it was founded, EFA appears to have been successful in putting the topic of organic farming on the government's agenda. It also has had a role in encouraging new organic farmers, and providing such things as advice for organic techniques. What is not clear through this research is its level of power in government, throughout the farming industry, and elsewhere when compared to a group like LRF. It is likely that the size and strength of LRF is much more influential than EFA. Looking at the relationship between EFA and LRF, perhaps the collaboration between the two groups is an area for further research.

4.5.2 Extension agents

Extension agents are those who translate science and technical information regarding agriculture into something that can be practically applied by farmers. Generally, there are three main categories of extension agents.

The first group of extension agents might be best situated as a factor within "related business," as the companies that employ these extension agents benefit from the profitability of the farmers. For example, there are extension agents in the companies that have contracts to buy agriculture products from farmers. These extension agents will guide the farmer on what he or she must do in order to properly meet the requirements of the contract (Törner, 2002).

The second category of extension agents includes those from different agriculture societies or organizations such as LRF, EFA, and other organizations that help farmers meet goals set out by different programs, or to give advice about new techniques (Törner, 2002).

Finally, there are extension agents provided through different government offices, involved with government programs (Törner, 2002). It might be possible to associate this group of extension agents with the policy and programs section.

Although the different types of extension agents could have been mentioned along with several different eco-factors, they are included within the Interest Groups and Organizations to emphasize their importance as entities of knowledge transfer, as they are a primary source of new knowledge and practical skills for farmers. Farmers typically trust the advice of extension agents. Therefore, farmers are probably willing to listen if they are able to provide good advice about environmental measures. However, it appears that most extension agents are trained more in conventional measures than those that are environmentally oriented (Blix, 2002).

4.5.3 Academic institutions

The Centre for Sustainable Agriculture - CUL – claims to be a focal point for researchers and institutions interested in research, development, education and information related to ecological agriculture. CUL co-ordinates activities and promotes co-operation, claiming to take an active part in the work of developing interdisciplinary research methods (Center for Sustainable Agriculture, 2002).

It is important to discuss the evolution of research and education within agriculture related academic institutions over the last decade. The academic and educational focus in these institutions is important because this is the arena in which many people who will work in the agriculture field are trained. There is also the potential to transfer knowledge gained during research directly to those who will deal with the problems of nutrient and pesticide pollution. To further understand this issue, a discussion was held with Johanna Björklund (2002), a researcher in sustainable agriculture at CUL.

Björklund said the funding available for sustainability related research has increased in the last few years. She said it is common for researchers to change small parts of their "conventional" agriculture research to make it eligible for sustainability related funds. She believes this could slow the process of moving forward in the field.

Another issue discussed with Björklund was the transfer of knowledge from research to the farmers and other stakeholders who could find some value in it. She said the first problem is that some of the research is for an academic audience, as researchers must publish academic papers to move up in their own fields, and do not have the intent from the beginning to share the knowledge with the most important stakeholders—those working with the practical issues. Eriksson (2002) (the dairy farmer interviewed in this study), said she has been aware of this problem, and consequently has been working diligently over the past decade to improve the situation by discussing the issue with researchers. Eriksson believes this situation has improved in recent times, although not all academic research that could be relevant is reaching farmers (2002).

Related to this is the fact that the research does not always involve the practical problems and real life situations of farmers. To remedy this, Björkland (2002) said there must be more "participatory research." This type of research allows farmers and others working directly with the issues to interject their rich knowledge of many of the topics into the research. Ultimately, this could improve the quality of the research. She indicated if the participatory approach was given priority for funding, it could be beneficial in increasing its prevalence in the agriculture research area.

Finally, Björkland said that educational programs related to agriculture are generally still geared towards conventional agriculture education. Within certain subject areas environmental problems are addressed. However, the problems are explained in relation to how they pertain to that specific subject. Björkland sees the need for a more interdisciplinary approach to solving the agriculture related environmental problems. If such people as future extension agents are to understand environmental solutions, it is necessary to properly educate agriculture students about environmentally-oriented techniques.

4.5.4 Certifications and eco-labels: KRAV, Svensk Odlat, etc.

Organizations exist which have the objective of certifying farmers based on their agriculture production. These organizations are important, because they provide farmers with practical measures to meet certain standards. The organizations also provide labeling for the agriculture products. Eco-labels are important tools for communicating environmental information and raising consumer awareness (Mont, 2002).

The Control Board for Alternative Farming (Kontrollföreningen för Alternativ Odling, KRAV) is the standard for certifying organic production. It is a third party organization designated by the government to develop standards and a certification system for all types of farmers. Once certified, KRAV farmers can put the KRAV eco-label on their product (Wall-Ellström, 2002). Although it is necessary for farmers to know how to become organically certified, there has been some indication that setting regulations for all of Sweden does not give an individual farmer the opportunity to implement measures that are appropriate for the characteristics of his or her particular farm.

There is not simply one organization in Sweden that creates standards for all integrated agriculture production. Certification systems have been set up to certify different sectors of the agriculture industry. Svensk Odlät sets the integrated production standards and provides the label for fruits, vegetables, ornamental flowers, berries, and potatoes. An auditing company is designated to do the actual certification of the farmers following the Svensk Odlät standards (Goransson, 2002). Not having a set standard for all IP production does give producers some flexibility, however, it can be

quite confusing for producers and consumers if there is no set standard describing exactly the requirements for IP agriculture.

4.5.5 Financial institutions

Financial support is of vital importance to any business, including those in the agriculture industry. In this section, an attempt is made to explain the role of banks in providing financial support through investment loans. Förensingsparbanken (a bank) was chosen as an appropriate example, as it is one of the major banks in Sweden dealing with investments towards agriculture firms and related businesses. The market share of Förensinsparbanken is 50-60% of the investments, loans, and financing volume of agriculture. This amounts to about 80% of all the farms in Sweden (Wennberg, 2002).

Interviews were held with two people working in various parts of Förensingsparbanken in Sweden. The first was Marie Lundh who works in a department of Förensingsparbanken called Swedbank. Swedbank deals with sustainable investment funds, some of which are earmarked for sustainable agriculture projects (Lundh, 2002). The second was Hans Wennberg, who oversees agriculture related funding projects throughout Förensingsparbanken.

Nearly 200 people working at the bank are involved with agriculture related projects, further illustrating the importance of business at the bank from the agriculture sector. Employees are economists and bankers specializing in agriculture. Some employees have practical experience working as farmers or in other agriculture related activities. Other employees have other types of experiences, such as background in the companies that are suppliers to the farmers (Wennberg, 2002).

Wennberg (2002) says the bank does not have a preference for financing any specific farm based on its environmental performance. Wennberg says part of the job of the bank, is to check to be sure the farmers meet the mandatory environmental regulations. He says the bank could lose money on its investment if the farmer becomes subject to paying fines.

The most important aspect for the bank, when deciding whether or not to give funding to an individual, is to predict how financially successful that farmer will be. It is the entrepreneurship of farmers is important. It doesn't matter so much what kind of farming it is. Education programs are good from the point of view of the bank. It is important for farmers to make decisions to which they have given thorough consideration. Education offers this opportunity for thinking about the business decisions that must be made (Wennberg, 2002).

Suppliers to farmers, such as pesticide and fertilizer suppliers, are also receiving services from the bank. Services to farmers and to suppliers are administered out of two different departments at the bank. The question was asked if there could be a conflict of interest between some related businesses and some agriculture projects. This was asked to determine if there are any problems for the bank in financing both organic farmers and companies such as pesticide supply companies. According to Wennberg (2002), currently, there seems to be no conflict of interest between the success of farmers and success of suppliers. The question was asked with the suspicion that demand for artificial fertilizers and pesticides is lower because of organic farming, so the profits of these suppliers would be decreasing. This could damage the investments made in the supply companies. If further investments are made in environmentally oriented agriculture, this might be something to keep track of.

The sustainable investments, with which Förensingsparbanken deals through its Swedbank department, have more requirements for farmers. Investors have given money to a specific fund so that the bank can use that money to invest in sustainability projects. If any agriculture project meets the particular requirements to be a sustainable investment project, that project might be earmarked to receive funding from the sustainability source (Lundh, 2002).

This researcher understands that sustainable investments do not persuade farmers to produce in a certain way, as there is plenty of investment money available to farmers for any profitable farming activity. If, in the future, a much larger percent of funds were designated by investors to be used only for sustainability projects, then banks like Förensingsparbanken may have to adjust their manner of designating eligibility for funding projects. If there were more stringent environmental requirements, it is likely that farmers would indeed implement environmental measures to become eligible for certain funds. Today, investment money does not appear to influence farmers to improve environmental performance beyond meeting environmental regulations.

4.5.6 Capacity building organizations (non-academic)

Nutrients in Balance (Odling i Balans)

This is an organization promoting integrated agriculture production around Sweden. Its aim has been to develop integrated production "pilot" farms throughout different areas of Sweden. These farms are used to demonstrate, to other farmers, different integrated techniques for all types of farming. The idea is that farmers will see that certain techniques of integrated production can indeed be successful, without damaging the financial success of farming activities (Töner, 2002).

Ecological Market (Ekologist Marknadscentrum)

This is an organization receiving a large part of its funding from the Swedish government to help develop the market for organic agriculture products (Andersson, G., 2002). Coverage of this project will be included in the market demand and utilization section.

Rural Economy and Agriculture Society (Hushållningssällskapet)

The Rural Economy and Agricultural Society is an independent members' organization dedicated to enhancing an enterprising spirit in rural areas and promoting a healthy environment in the country as well as in the cities.

Hushållningssällskapet has approximately 75,000 members throughout Sweden. Their members claim to be the most important resource, providing vital feedback and information to their various projects. The society employees 800 staff members.

Environmental Protection Agency

The Swedish Environmental Protection Agency (EPA) is a very important capacity building organization. An interview was held with Hakan Staff from the EPA who explained the role of the EPA concerning the environment, and specifically the problems related to agriculture.

There is no direct contact between the EPA and farmers. Contact is primarily with the Swedish Board of Agriculture (SJV) and the Federation of Swedish Farmers (LRF). EPA gives suggestions directly to the Government or through the SJV regarding environmental issues. The EPA has no authorization to issue legal instruments, except for the protection of soils. But, all legislative issues are sent to the EPA for review and feedback. There is little opportunity for the EPA to work on its own initiatives, as the Swedish government pays commissions to the EPA to carry out the projects it deems necessary (Staff, 2002).

Within this role, the EPA also has the opportunity to influence the Swedish Government, and to some extent the EU, in changing the agriculture subsidy system in the CAP to favor more

environmentally motivated agriculture techniques. Staff says this has been somewhat successful thus far, as Sweden directs a large share of the EU subsidies towards environmental programs.

The EPA is also responsible for setting and following tracking various environmental targets. "Zero Eutrophication" is an example of one such objective. The EPA supports active participation of farmers in the discussions about issues before goals are set.

It was commented that taking part in meetings with farmers on a local level would be helpful, as well as cooperation with environmental NGOs and consumer organizations, which happens very little today (Staff, 2002). This would allow the EPA to receive input from those involved firsthand with farming and related issues, when targets are established and legislation is being reviewed. It would also be an opportunity to try to convince farmers that environmentalists are not against agriculture, something Staff mentioned as important. Blix (2002) also pointed out the conflict that often arises between farmers and environmental experts. One reason that meeting with various stakeholders is difficult is that the EPA has a fairly small staff working on agriculture projects (Staff, 2002).

Additionally, the EPA builds capacity through raising environmental awareness in the general public. This is accomplished through books and other publications.

4.5.7 Key conclusions

It is important to recognize the influence from interest groups and organizations that are not government or related businesses. Many of the organizations have as their objective to improve, advance, and provide assistance, knowledge, and resources to farmers. Within these organizations, some take a more active role in promoting environmental related issues among farmers, through training courses, technical assistance, investments, and research. The ability to influence the industry often depends on how visible the organization is to farmers, government, consumers, etc. An organization's visibility may depend on size, financial resources, access to government offices, etc.

Within farmers' groups and associations, the infrastructure is established to communicate to all of the members of the organization. The organization itself has to decide if promoting environmental issues is in the interest of the members. Other organizations, like financial institutions, have access to farmers because farmers, who need investment loans, etc., must follow the demands of the banks. If the banks chose, they could encourage certain levels of environmental performance. However, because investment banks need to make a profit, they are most likely acting in the interest of investors. As explained, there are some investors who do wish to invest only in sustainable projects, but these investors do not appear to have the power to persuade the agriculture industry to improve environmental performance. This situation could change if more investors are interested in sustainability investments.

Academic institutions and other organizations involved with researching agriculture sustainability issues, only influence the agriculture industry if there is success in passing the knowledge gained through research on to the people within the industry. This is not always done as effectively as it should be in order to pass along important information.

Additionally, if groups prioritize research and communication about conventional agriculture over environmentally-oriented techniques, new knowledge being passed along may be continuing to build capacity in conventional farming, without making the required strides in environmentally-oriented farming techniques.

Finally, the line between private interest groups and organizations, government, related businesses, and consumer organizations is quite thin. This is because many of the interest groups and organizations have an agenda that works towards meeting some governmental, consumer, and

business objectives, all of which provide a source of funding for the organizations. Included in this discussion are all the different groups that have an affiliation with agriculture, but are not government bodies, consumers, or businesses related to agriculture.

4.6 Market Demand & Patterns of Utilization

Within the market society of today, it is clear that products are produced to meet the demands of consumers. Generally, it is assumed here that consumer demand for environmentally-oriented agriculture products would promote an increase in the production of such products. Without such demand, the justification for producing such products is very weak. Additionally, it is being assumed that environmentally-oriented products must meet the normal expectations consumers have developed concerning the purchasing and use of food products, or the patterns of utilization. Otherwise, the demand for these products will be low. If environmentally oriented products cannot meet the demands of consumers, an unlikely successful alternative to increase demand, would be to adjust consumer expectations to match those that the organic products meet.

The assumptions made about consumer demand translating into production of the products demanded, are not always safe assumptions to make when considering the agriculture industry. This is because the farmers are often meeting quotas set by food-processing companies, or reacting to the buying and selling of agriculture commodities to other third parties. Also, the financial success of farmers is greatly subsidized, producing agriculture products that award them payments from the EU, through the CAP program. This issue of farmers not being in direct contact with consumer demand will be further discussed in section 4.6.4.

It was a bit difficult to find information regarding the market demand for IP products. This may be because IP products are not standardized in the way that organic products are. For this reason, analysis of market demand is concerned primarily with the demand for organic products. It is being assumed that generalizations about consumer demand for environmentally-oriented products can be gathered through data that pertains specifically to organic production.

4.6.1 Consumer demand

This section looks at statistics for the demand of organic agriculture products within Sweden, Europe, and throughout the world. Figure 14 shows that Swedish consumers' demand for agriculture products is one of the highest in relation to the overall production in Sweden. Figure 15 shows that Swedish consumers spend one of the highest amounts per capita on organic products when compared to other European countries and countries throughout the world.

Overall, Sweden had a total market share of organic products at two percent of the total market of agriculture products in 1998. However, some products were shown to have up to 10% of the market share (Grolink, 1998).

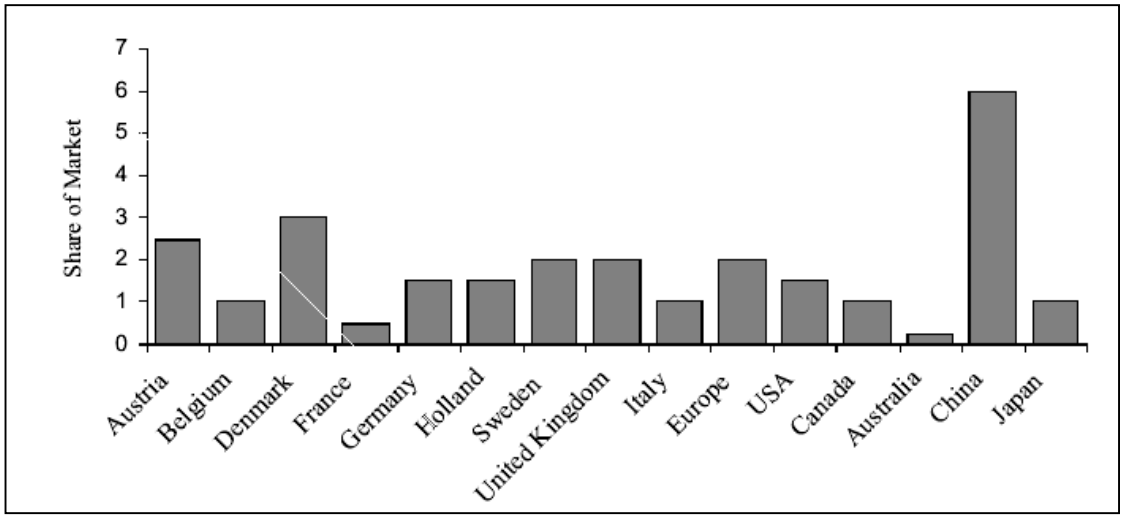

Figure 14 Percentage of total agriculture products that is organic, by country (Sylander and Widel, 2000).

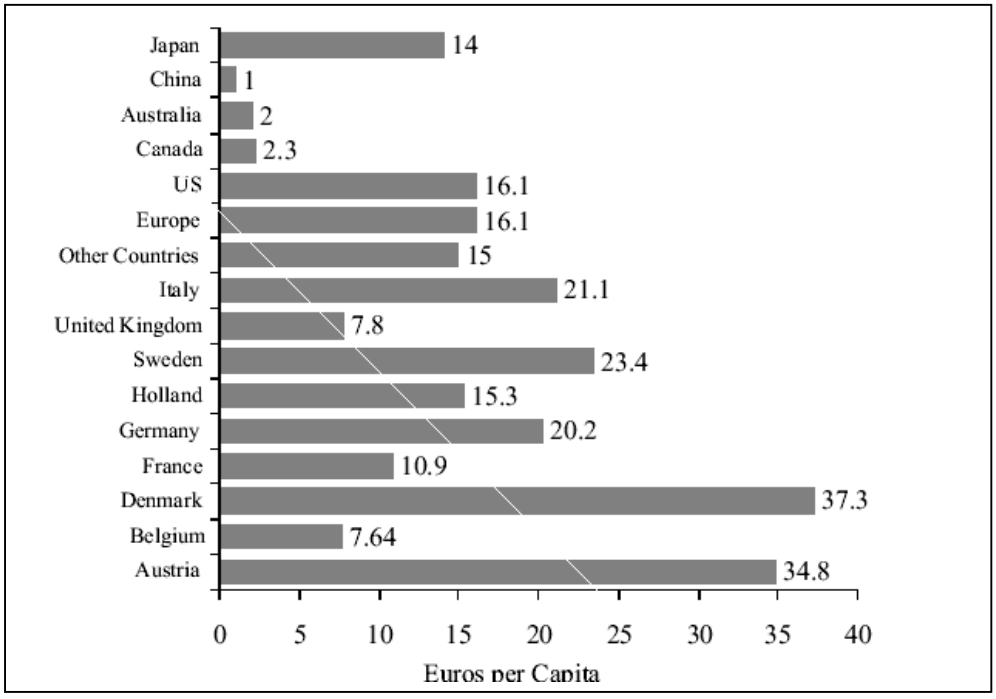

Figure 15 Euros spent per capita on organic products per year by country (Sylvander and Widel, 2000).

4.6.2 Foreign markets

Consumers of both environmentally-oriented and conventional Swedish agriculture products are not limited to the Skåne region, as these products are exported around Sweden and beyond the national borders. It is unclear what percentage of environmentally-oriented Swedish agriculture products are exported now, but the overall volume of exported products in 2000 was SEK 21.1 billion. This was

over a fifty percent increase in exports since Sweden joined the EU (which gave Swedish agriculture more access to the EU market). As of 1999, the market for organic products in the EU is the highest worldwide, having around 43% of the global market. Approximate shares of the market in other regions are USA 32%, Japan 13%, and China 9% (Sylvander and Widel, 2000).

Perhaps the demand for organic and other environmentally-oriented products throughout Europe is a driver for the production of these agriculture products. This research did not look specifically at the impact of foreign markets on the Swedish agriculture industry, but the share of environmentally-oriented products from Sweden, which penetrate foreign markets, is an important area for further research.

4.6.3 Swedish consumer expectations

It was assumed that there is a range of consumers, from those who do not demand more than the environmental quality of today's conventional products, to those who want products with environmental standards beyond those of conventional products. To an extent, this assumption can be verified through casual observations of the various yogurt products available at ICA and Konsum supermarkets in Skåne. Typically, one can find many different products, with and without various environmental labels and statements, which indicate that different levels of environmental considerations were taken into account during the production of the products.

In order to get an idea of the consumer demand for environmentally-oriented products, a survey of Swedish consumers is analyzed. LRF and other associations carried out the study, "The Way to Market," to strengthen the competitiveness of Swedish food production. The study was conducted to help Swedish farmers know consumers' values, attitudes and behavior regarding organic food (Ekologiska Lantbrukarna, 2000). Although this research is concerned with environmentally-oriented products beyond only organic products, it should give an understanding of the demands of consumers for all environmentally-oriented products. It might be helpful to undertake further research to determine the demand of consumers for all environmentally-oriented products.

The study showed that the concept of "organic orientation" is a factor that increases the confidence of consumers that farmers are carrying out work that takes the health of the environment into consideration. In other words, organic farming improves the environmental image of farmers in the eyes of the consumers. It was discovered that organic production is an important area for increasing the quality of Swedish food production, in order to meet and surpass the expectations of the consumer. According to the study, consumers consider it most important for products to be Swedish, regardless of whether the product is organic. However, there are some groups of consumers who express a high priority for organic products. One such group is the environmentally conscience group, representing 15-20% of all consumers (Lockeretz, 2000).

The survey did not track consumer thoughts or behavior on the specific issue of nutrient or pesticide emissions from agriculture. This raises the question of whether or not those consumers traditionally demanding environmentally-oriented products, consider nutrient and pesticide emissions are of specific concern. There is a possibility that this group of consumers is more concerned about other environmental concerns such as energy use. Regardless, consumer interest in environmentally-oriented production techniques could be an indication of how consumers would respond if asked a question specifically about nutrient or pesticide emissions pollution.

Often times, consumers can misinterpret the definition of organic agriculture production. In the survey, consumers were asked to describe what they believe should be included in organic production. Those considerations that relate to nutrient and pesticide pollution are presented here. They were

asked to rank a number of considerations on a scale of 1 (lowest importance) to 10 (highest importance).

Organic products should:

-not use synthetic pesticides (8.6)

-pay great attention to the environment in their production (8.3)

-give animals feeds that are produced organically (7.6)

-do not use commercial fertilizer (7.3)

The study also showed a lack of knowledge amongst consumers about organic production. This was seen in the study as a large proportion of consumers not agreeing (~20%) or not knowing (~40%) that certain aspects were part of organic production (Lockeretz, 2000).

Demand for low-cost agriculture products

Although it was not discovered through the survey, it can be assumed that consumers have grown accustomed to food that is low cost. Part of this reason for this might be the success of the CAP objectives to keep food prices low. Further research should uncover the willingness of consumers to pay for environmentally-oriented products. It is very likely that high prices of organic products prohibit many consumers who are interested in purchasing environmentally-oriented products from doing so.

4.6.4 Farmers' realization of demand

It is also important to discuss how the agriculture industry realizes that demand. There are several reasons why farmers in Sweden might not directly feel the true or direct demand from consumers for products. This phenomenon may be traced back to a few different causes. This research did not specifically focus on this issue; however, it became apparent that this issue may be an important determinant of agriculture's response to market demand. Further research concentrating on the farmer's response to the market is needed.

It is assumed that in many cases the farmers, who often grow crops just to meet certain quotas or contracts, do not directly feel the demand from the consumers. This is seen with the presence of organizations like Läntmannen (2002), which buy directly from the farmers at an agreed-upon price, and then sell to various buyers who may in turn sell further to food processors and, finally, to retailers. The impact of such commodity trading might show that farmers are not impacted directly by what the consumers want. If consumers demand environmentally-oriented agriculture products, farmers dealing with commodities might not have the ability to respond until other actors in the food chain respond to that market demand.

This is because the demand of certain agriculture commodities often depends on how much money has been invested in those specific commodities. The influence of commodities on the production of environmentally-oriented agriculture goods is an important issue for further research.

The retailers are the stakeholders who often realize certain demands from consumers. These demands then must be passed on to the suppliers (processing companies or farmers themselves). According to Caroline Göransson (2002), Svensk Odlät is a label indicating environmental and health safety, an example of retailers demanding farmers to improve their environmental performance per the

concerns and demands of consumers. Göransson, who works at Svensk Odlät (2002), discussed that retailers want to sell products that meet the environmental and health demands of the consumers.

Andersson, G. (2002) believes that there are some problems in the link between processing companies and consumers. She said that processing companies know there is a demand for environmentally-oriented products, but have not figured out the best way to meet this demand. One problem might be the difficulties associated with processing both conventional and environmentally-oriented products simultaneously.

Today, environmentally-oriented products are considered "special." They are not always part of the regular process chain. For example, when organic products are processed, they must carry any extra costs in production. These costs include the costs of shifting a line of production between conventional and organic products. An alternative would be to allow the costs of organic products to be absorbed into the normal costs of a processing plant (Andersson, G., 2002). The current situation may be a contributor to the typically high prices of organic products.

There are also some food processing companies that process only organic products. Andersson, G. (2002), says this reduces the time, hassle, and problems associated with shifting the production line between organic and conventional raw material.

If processing companies were able to better meet the demands of consumers for environmentally-oriented products, there would be more pressure on farmers to supply products that meet the environmental expectations.

4.6.5 Promotion of environmentally-oriented products in the marketplace

Andersson (2002) says that for successful promotion of the ecological market,

1) Consumers must have access to products.

2) Stores must try seriously to sell ecological products, not just put them on the shelf for a few weeks and not explain why the products are higher quality, or worthwhile purchasing.

3) Consumers must ask stores to sell the ecological products.

One technique of the EcoMarket to expand the interest in organic products is to convince those people responsible for feeding large numbers of people, such as schools and hospitals, that organic production is beneficial. A switch to the use of organic products in these kitchens brings organic products to all the people eating in the cafeterias. Although some of these cafeterias are on a limited budget and might not be able to afford organic products, the campaign has been successful. Not only are the health and environmental benefits explained to people operating these cafeterias, but the greater enjoyment employees have when preparing meals with organic raw materials over pre-prepared conventional meals (Andersson, G. 2002), is also pointed out.

Another attempt at increasing the organic market has been to approach cooks in restaurants who are interested in using ecological products in their kitchens. The Ecological Market Center has been successful in facilitating a network of interested cooks who see the benefits of using Swedish organic products in their kitchens. These cooks recognize it as increasing the food quality, as well as being a potential marketing tool (Andersson, G. 2002).

4.6.6 Key conclusions

There is a clear demand for environmentally-oriented products in Sweden, throughout the EU and beyond. Since a national goal in Sweden is to further increase the % of organic agriculture production, there is a need for further growth in the demand for these types of products. There is some discussion as to the transfer of the consumer demand to farmers, as farmers are not always directly in contact with consumers. It is not always straightforward as to what agency is most able to directly respond to the demand of consumers. Regardless, there is correlation between the demand of consumers and the level of ecological products that are being produced.

Although there are certain demands for organically oriented products that relate to the problems of nutrient and pesticide pollution, it is unclear whether consumers are actually demanding agriculture products that have taken into consideration the problems of nutrient and pesticide emissions. Ensuring that the demand is for environmentally-oriented products includes nutrient and pesticide pollution might be accomplished through further education of consumers.

It is uncertain if IP products will suffice to meet consumers' demand for organic products. Although not clear through this research, the more consumers know about IP, the more they might be willing to accept these products as meeting their demand for environmentally-oriented products. If IP products are communicated as environmentally-oriented, and their price of production remains low (see section 4.7), consumers who normally do not have the willingness to pay high prices for organic products but want to purchase environmentally-oriented products, may find that purchasing IP products is a favorable alternative.

4.7 Competitive Forces & Collaboration

Factors in this category include the degree to which competition between farmers within the agriculture industry contributes to promoting or inhibiting agriculture to improve its environmental performance in relation to the Baltic Sea. It may be said that establishing and maintaining competitive positioning will influence the behavior of farmers, which may explain why certain environmental measures are undertaken, or why they are not. The competitive positioning of farmers can be discussed in the traditional sense of low costs and differentiation of products. In addition to products, a dimension of competitive positioning that considers processes is considered here. This is appropriate for agriculture, as it is a very process oriented activity.

4.7.1 Low costs and differentiation

As pointed out by Orssatto (2001), work by Michael Porter is often used to explain the competitive positioning of firms in an industry. Porter defines two crucial types of competitive advantage that firms can possess: low costs and differentiation. Orssatto (2001) presents a way to map the competitive positioning of firms based on the low costs and differentiation not only of products themselves, but also their production. Figure 16 illustrates the various competitive positions of the different agriculture production techniques. The rationale for these positions is explained further in this section.

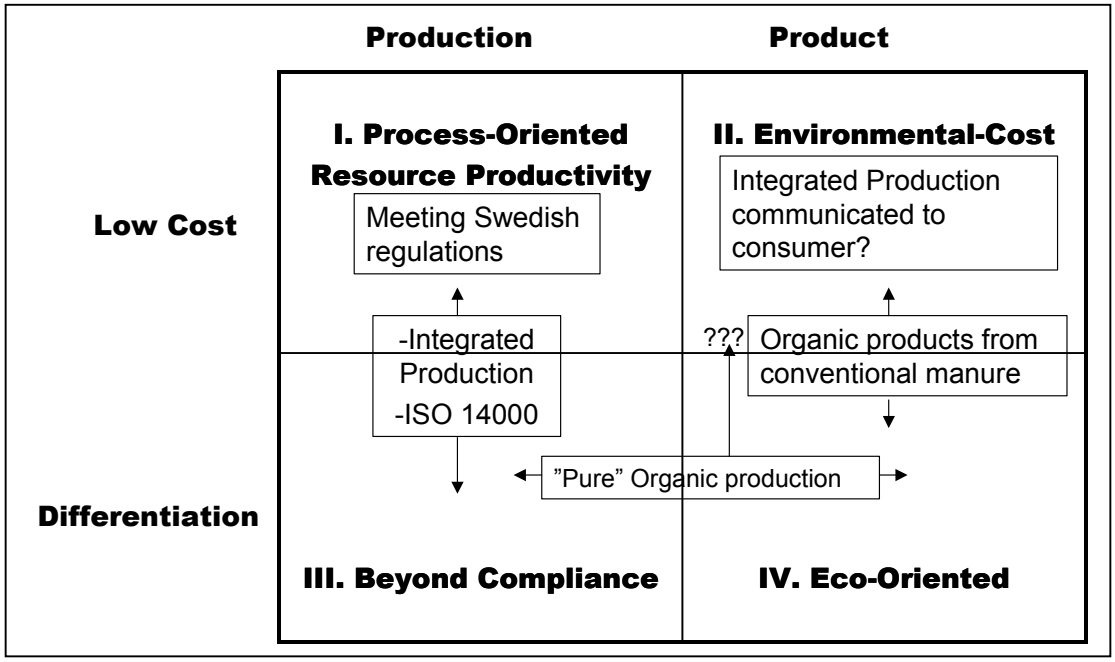

Figure 16 Competitive positioning of different agriculture processes and products.

Low cost competitiveness results from a producer being able to produce high volumes at the lowest possible cost. These cost savings achieved by the producer are then passed onto the consumer in the form of lower retail prices (Orssatto, 2001). Low cost competitiveness can be seen in the conventional production of agriculture. Highly subsidized agriculture uses synthetic fertilizers and pesticides to increase production and lower the costs of agriculture products. Conventional farmers rely on the ability to have a high output in order to be financially successful.

Differentiation allows a producer to meet a niche demand for a product. Typically, production to reach a niche market has a higher production cost, unlike the first of Porter's competitive advantage positions. Price-premiums are obtained through this differentiation, assuming consumers are willing to pay more for these products than conventional products (Orssatto, 2001). A differentiation competitive advantage can be likened to the development of organic products. Organic products are demanded by a small part of the population. A niche market for organic products has developed. Those who can meet this niche demand with high quality organic products will secure a share of the market.

Generally speaking, organic products serve the same function as conventional products. Although, as mentioned in 2.3.7, there may be some perceived differences between organic and non-organic products. These differences may be increased health security, better taste, and improved nutritional content. From that point of view, organic products could be considered a differentiated product with environmental benefits. However, it might be argued that the main difference between conventional and organic products, and other environmentally-oriented products, is the method of production.

The goal for many integrated agriculture producers is to instigate agriculture techniques that improve environmental performance, but do not sacrifice a high level of production (Töner, 2002). These farmers have the opportunity to address the environmental concerns of consumers, without reducing the yield, as occurs in organic production. As mentioned in the previous section, an important further concern is whether integrated production satisfies consumer concerns about environmental quality. This is a debate that is still occurring, and may develop as time goes on. If in the current situation it

does meet the environmental demands of consumers, it could be considered an environmental product that competes at low cost.

Another factor in this situation is the introduction of subsidies in Sweden that aim to encourage farmers to implement environmental measures by reducing the costs of doing so (see section 4.2.1). This could make organic and other environmentally friendly agriculture practices more competitive on costs, as the costs of production are offset by the subsidies. This is illustrated by the ??? connected to organic production on the competitive positioning map in Figure 16.

Preventative measures and increased competitiveness

Additionally, as mentioned in section 2.3, preventative environmental strategies may help avoid the costs associated with implementing end-of-pipe technologies. Increase in cost efficiency would theoretically lead to agriculture production that is more competitive. For example, several farmers pointed out that putting organic waste from animals onto crops as fertilizer minimizes the cost associated with purchasing synthetic fertilizers (Hempel, E.K., Hempel, I., and Lindahl, P. 2002). Knowing that costs could be further reduced could be a driving factor for further closing the nutrient loop, ensuring that animal wastes in addition to what are used today, are recycled onto agricultural crops.

4.7.2 Competition among organic producers

Due to the presence of organic producers using conventional manure as fertilizer, there is the occurrence of interesting, perhaps unfair, competition between those organic farmers utilizing conventional manure and those who do not. Conventional manure is manure from animals on a conventional farm that were raised using conventional methods. The grains used to feed these animals contain a much higher level of nutrients. Therefore, the resulting conventional manure has more nutrients than does manure from animals fed feed from organic crops. When conventional manure is used to grow organic products, the organic products have higher yield with lower costs than organic crops grown with organic manure. Some organic producers feel that using any conventional manure as fertilizer would make their product not "truly" organic. KRAV, the organic control organization, does have some limits to the amount of manure that can be used to fertilize organic crops (Andersson, L., 2002).

This competition has been seen with the price of vegetables. Organic farmers using non-conventional organic manure cannot lower their production costs enough to be competitive with those organic vegetable growers using conventional manure (Andersson, L., 2002). See figure 16.

It appears that some conventional farmers grow a section of their farm as organic. This allows them easy access to the organic market by using readily available conventional manure from the conventional production. If organic farmers stay within the regulatory limits of using conventional manure, then they can market their products the same way as the non-conventional manure organic farmers.

4.7.3 Collaboration among Swedish farmers

Collaboration within an industry normally refers to the alliance of firms in order to block the threat of new entrants into the market place. This study did not observe this situation as such. However, within the various co-operatives and associations in Sweden, there is collaboration among a large majority of farmers to bargain for the best prices throughout Sweden, and internationally (Läntmannen, 2001). These forms of collaboration also enable favorable lobby power and other benefits that have been mentioned throughout this paper.

4.7.4 Key conclusions

Most farming occurring in Sweden has competitive positioning based on low costs of production. There is also organic production that meets the needs of one sector of the society, typically at higher costs. However, defining the competitive positioning within the agriculture industry can become complex when considering the presence of different IP agriculture methods, ISO certification, and even various levels of competition among organic farmers.

The competitive positioning of farmers has been described here through an expansion of the traditional model of low costs and differentiation of products. As differences in agriculture products are highly dependent on the process of production, it is appropriate to further explain the competitive positioning of agriculture through low costs and differentiation of processes.

Different forms of integrated production can be put into different competitive positions. This may depend on the level of communication with the consumer about the environmental qualities of the product. Ideally, farmers have the best competitive positioning when they are able to maintain low costs and yield a product that meets environmental demands of consumers.

There is an interesting variety of competitive positioning among organic farmers. Some organic farmers are able to compete on the cost level because they use nutritious conventional manure for their crops. Pure organic farmers avoid using conventional manure. It is possible that in the future, through subsidies or improved technologies, the cost of production for environmentally-oriented products, especially organic production, will decline. If this happens, organic products may move from differentiation positioning to low-cost positioning. This is already observed, to a degree, in the competition among organic farmers.

Currently, there is collaboration among Swedish farmers through the various co-operatives, which, try to bargain for the best prices for Swedish farmers. Collaboration among Swedish farmers might be useful if Sweden wants to compete with other nations, using the claim that Swedish agricultural products are produced with a high level of environmental and health concerns. Such collaboration could allow Swedish agriculture to differentiate and to be very competitive on the European and International markets.

5. Integrating Environmental Methods into the Agriculture Industry

Analyzing the various eco-factors has created a general understanding of what is happening within the agriculture industry, especially highlighting the various degrees to which environmental concerns are incorporated within agriculture production. Considering the eco-factors and their interaction with the other circuits of political ecology introduced in **section 3.1**, can give some insight into the process of integrating further environmental measures, like those proposed in **section 2.3**, toward the ecological modernization of the agriculture industry. A discussion of the integration possibilities and constraints are discussed in this chapter. To have this discussion, several important aspects are identified which potentially, upon system and social integration into the current agriculture industry paradigm, may lead to further implementation of the environmentally-oriented agriculture techniques.

The aspects discussed here highlight those eco-factors that may be the most influential in bringing about further ecological modernization of the agriculture industry in southern Sweden. Perhaps these are not the only aspects that may lead to further reductions in emissions, but this researcher feels they have emerged as important parts of the effort to do so.

5.1 Financial Security

The first aspect identified is that it is necessary for farmers to feel financially secure in order to implement environmentally-oriented techniques. This is especially important for farmers uneasy about making shifts in production techniques to new environmentally-oriented techniques. This is to say that financial security can act as a safety net in which new methods can be used without the worry of decreased profits, or simply, making ends meet. Farmer profitability was first discussed in **section 4.1.2**.

5.1.1 Adjustments in the CAP

Based on the eco-factors analysis, there are several levels of system and social integration that could bring about financial security. The first is to integrate an increase in support from the EU that encourages environmentally-oriented production. The subsidies of the Common Agriculture Policy (CAP) had the proper agency to meet the original objectives of the CAP. Perhaps more than just implementing an increase in funds earmarked for environmental production, it is necessary to integrate the goals of environmentally-oriented agriculture into the overall objectives of the CAP. This could serve as an opportunity to remove the mixed signals that the current subsidy system creates. Merely increasing the amount of funds for environmental projects without changing the objectives of the CAP, may lead to decreased clarity of the goals of the CAP. The CAP was first discussed in **section 4.2.1.**

Pressure to change aspects of the CAP will most likely continue to come from various lobbying groups such as farmers associations, the environmental protection agency, related businesses, the national government, and others trying to influence the EU to adjust the CAP to meet the interests of these organizations.

In response to an increasing market demand, more farmers might see the opportunity to improve their competitive positioning if they produce more environmentally-oriented products. Therefore, these farmers would have an interest in CAP policies favorable for environmental production. These interests could then be expressed through lobbying to the EU through various farmers' groups, such as LRF and the ecological farmers association.

The Swedish government, LRF, other farmers' groups, and even individual farmers may continue to realize the benefit of positioning the entire Swedish farming industry to compete with other nations, using the claim that Swedish agricultural products are produced with a high level of environmental and health concerns. Therefore, many stakeholders might lobby for an increase in CAP support for environmental measures (see **section 4.7**). This is especially true if an increase in market demand for environmentally-oriented products continues (see **section 4.6**). If food-processing businesses were able to improve their ability to meet consumer demand, they would have an interest in measures that decrease the costs of environmentally-oriented agriculture products. Other related businesses might be resistant to such change, including the pesticide industry (**section 4.4.1**), if there are further increases in organic farming production. They are likely to continue lobbying for integrated production measures within the CAP. Lobbying was discussed in **section 4.2.6.**

It is also likely that changes in the CAP have to be made because of the expansion of the EU. The current subsidy structure could not afford to pay farmers in countries with strong agriculture sectors, such as Poland.

5.1.2 Increases in market demand

It is also proposed that farmers would have more freedom to implement environmentally-oriented agriculture techniques if there were increased financial security resulting from significant increases in market demand. A larger market demand would ensure farmers that their investments towards implementing environmental measures would be profitable. In order for market demand to be successful, there must be increased consumer awareness of the environmental and health benefits of various environmentally-oriented products. This could be accomplished by the way retail businesses present products, and through communicative labeling. Market demand was first discussed in **section 4.6.**

There must also be greater consumer access to these products, and the costs of these products should be reduced so they are attractive to consumers. Food processing companies might be able to meet both of these goals by improving the integration of environmentally-oriented food production with conventional production. The additional costs of processing environmentally-oriented food should be born by the environmental and conventional products being processed. Changes in the CAP subsidy system and improvements in technologies might also bring down the costs of environmental-oriented agriculture production. Those savings could then be transferred to the consumer.

Of course any additional costs incurred by retailers and food processors must be justified, or lead to increased profitability in both these sectors. The positioning of related businesses could create a strong barrier for the implementation of the important aspects being discussed in this chapter.

5.1.3 Industrial ecology

Farmers will also feel more financial security if they can realize the economic benefits from industrial ecology conditions. As mentioned in **section 4.3** there are various industrial ecology opportunities; however, certain difficulties can hinder the implementation of these opportunities. These barriers might be results of community and farm planning issues, need for capital investment, or certain regulatory conditions. Of course, many of these difficulties are not easy to overcome. But, there are several things that could happen to possibly improve the chances that these opportunities and associated benefits are realized.

It might be possible for collaboration to happen between farmers and related businesses that might create the financial ability and know-how to help farmers take advantage of industrial ecology conditions. These could be energy companies that help with the implementation of bio-energy crops, or manure-handling companies designed to manage the buying and selling and exchanging of manure between farms. These related businesses would also have a business interest in seeing such industrial

ecology conditions put in place. As will be discussed further in section 5.3, it may be possible to better coordinate the planning of some farms to make the realization of some industrial ecology possibilities, such as recycling nutrients, more practical. Another possibility might be the adjustment of certain legislative restrictions to encourage the establishment of industrial ecology conditions, such as the decknings vertargang, which would enable the creation of more wetlands (See **section 4.2.5**).

5.1.4 Increases in Competitiveness

As presented in **section 4.7**, the implementation of certain environmental techniques can give farmers an edge of competitiveness in the agriculture market. This marriage of improvements in environmental quality and increases in competitiveness may help provide the financial security necessary as the ecological modernization of agriculture takes place.

Preventative measures and cost-effectiveness

Improved cost effectiveness coupled with environmental improvement is the theme behind preventative environmental strategies through the implementation of cleaner technologies. This theme of increased efficiency might be easily seen with integrated production, which tries to minimize the application of synthetic pesticides and fertilizers through more efficient and precise application techniques. These techniques aim to avoid extreme overuse of synthetic fertilizers and pesticides, as these substances stress the environment. (**See section 2.3**)

Although typically considered more costly, organic production should be included in the discussion of the increased competitiveness associated with cleaner technologies. A study at Washington State University in the northwestern US found organic apple production to be more cost effective, and give overall better environmental impact results than apples grown using integrated or conventional production techniques. The main reasons for economic success in organic production, and to a lesser extent in integrated production, had to do with resource input, labor costs, and the increases in price achieved through the sale of environmentally friendly apples. Organic apple trees had better soil quality which could hold more water, resist surface degradation, and required less labor. Apples from organic trees were also being sold at a higher price (Reganold, Glover, Andrews, Hinman, 2001).

5.2 Expanding knowledge

The second aspect considered important is improving the technical expertise concerning agriculture and environmental measures, and passing that expertise to farmers and those working with farmers. The goal here is to improve the overall capacity of agriculture to implement successful environmental techniques while simultaneously meeting the prescribed goals of agriculture production. Capacity building can be accomplished on many levels, from developing improved technology (see **section 4.1.6**), to learning more about natural systems, and creating practical data that is useful for those directly working directly with agriculture (See **section 4.1.3**).

5.2.1 Academic research

The funding of "sustainable" agriculture research in academia should be administered to ensure sufficient educational opportunities to address the specific problems of nutrient and pesticide runoff from both integrated and organic production. The difficulty here is that traditional researchers are established with research projects that deal with more conventional issues. Research monies might be earmarked for conventional research, making it difficult to change the structure for funding environmentally-oriented research. Although no data was found, some of the funding of academic research in this field might come from related businesses that make their profit from increased capacity in more conventional methods. Research should be done in a way that its results are practical

and can be delivered back to the farmers themselves, using participatory research when feasible. Some people in the academic field might not like this style because it could slow down the paper-writing process, and adjustments would have to be made to ensure such technicalities as paper submission deadlines are considered. Academic research is further discussed in **section 4.5.3.**

5.2.2 Development of organic seed and animals

There should also be research programs that properly develop seed and animals for organic production. It is difficult for this type of research to occur more than it does in existing seed development companies, as they are concentrating on conventional seed development. Also, synthetic fertilizer and pesticide companies own a large part of the largest seed development company. This illustrates the direction in which the ownership might drive the research of such an organization (See **section 4.4.2**) towards conventional seed development.

Organic animal and seed development could be accomplished in separate companies or organizations that deal specifically with increasing the capacity of this organic "technology." With a smaller number of farmers, it may be difficult to ensure the proper infrastructure to develop seed and animal technology at the same level of success as conventional seed developers. Unless it is clear that organic seed and animal development is something worthwhile, with potential profit, it could be difficult to find the necessary research funding. To deal with this problem, forming community, regional, and national coalitions for organic seed and animal development might help make these development efforts realistic.

5.2.3 Appropriate integrated production techniques

Other important research programs come from small organizations and businesses that have a stake in the methods of agriculture production. Organizations like Odlings i Balans are important for improving the overall knowledge of technologies for integrated agriculture production (IP) techniques and demonstrating these techniques so farmers learn what is useful and effective for certain farm characteristics (See **section 4.5.6**). Perhaps in an attempt to prove a certain level of dedication to the environment, and perhaps to sell new technologies, related businesses are also important for building capacity in farmers to improve environmental performance. An example is the IP training manual of Bayer chemical. The important question to ask is what is the real aim of such a program, as it is one of the company goals to continue selling pesticides.

Farmers should also learn why it is necessary to implement environmental agriculture techniques. Courses, training, farming associations, extension agents, written material, participatory research, etc., are all appropriate avenues for passing along not only the knowledge of what can be done, but the reasons why the innovations are important. This dissemination of knowledge could promote further social integration of environmental agriculture techniques into the agriculture industry.

5.2.4 Expertise of farming support

It could be beneficial, in order to ensure the expertise of people who work as extension agents, in farming associations, etc., that they be given appropriate education so they are prepared to deal with the environmental issues from a multi-disciplinary approach. This may be difficult to accomplish adequately without the proper adjustment of higher education, as it needs to be less concerned with conventional agriculture issues, and more focused on educating people to be knowledgeable about implementing techniques that deal with the problems of nutrient and pesticide pollution in the greater context of all environmental and social issues of farming (see **section 4.5.3**).

5.3 Local Planning for Local Needs

Agriculture planning is the third aspect considered of vital importance for reducing the environmental impact of agriculture. The goal of this aspect is to design agriculture techniques to ensure activities and goals match the unique needs of municipalities, communities, and farms. This idea was first discussed in **section 4.2.5**.

Planning related aspects that could potentially increase the implementation of environmentally-oriented agriculture techniques making the most sense for the unique characteristics and needs of individual farms, local communities, and perhaps even specific regions could be very beneficial. A greater degree of freedom may be given to individual farmers and local areas to assess their specific needs, and based on those needs to design specific environmental objectives and measures to meet the objectives. Objectives and measures for a community should be developed through a multi-stakeholder process.

Several barriers are quickly brought to mind when discussing the idea of more localized planning. Distributing such authority to local levels would require integration of new policies on the national level. As mentioned, the European Commission might approve such an approach if it were to be used to meet some of the directives administered by the EU. Also, financial resources and expertise must be in place to assess local conditions, design objectives, and implement action plans. Funding could be partly directed from the EU or other government funds (see **section 4.2.1**). Some of the funding could come from the buyers of agricultural products who have an interest in improved environmental planning at the farm level. This interest might be directed toward an integrated environmental management system, or the marketing of a product in a specific way (see **section 4.4.6**).

Expertise could come from organizations responsible for developing environmental techniques that are based on the unique needs and conditions of farms, like Odlings i Balans. It might also be the auditing organizations that deal with certifications like ISO 14000. It might be even better to develop specific organizations whose task it is to investigate the conditions on farms, and be able to give advice like extension agents (see **section 4.5.2**), to help individual farms and communities develop strategies and action plans.

Better planning of agriculture activities would also allow farmers to take further take advantage of industrial ecology conditions (see **sections 4.3** and **5.1.3**). For example, it is much easier for manure to be used to fertilize cropland if that cropland is near the source of the manure. This could be a matter of better integrating animals and plants on one farm, or it could mean the collaboration among farmers in a community or municipality. It could be very difficult to coordinate such collaboration without the assistance of the municipalities or LRF. Such coordination could be included in regional or local farm plans, if such planning occurred.

6. Conclusions and Recommendations for Future Research

This chapter considers the various discussions that have taken place in the presentation of this research and analysis, and attempts to draw conclusions based on the information provided. As it is sometimes difficult to make final conclusions from a study based largely on quantitative information (Wolcott, 1990, p. 55-57), the researcher has chosen to make conclusions by re-visiting the research objective and supporting research questions presented in Chapter 1. Finally, this chapter ends with comments on the analytical tool employed for this study and gives some recommendations for further research.

6.1 Re-visiting the Research Objective and Questions

As stated in section 1.2, the research objective being considered in this study was to identify and describe various forces that foster or inhibit the Swedish agriculture industry's implementation of more ecologically modern farming activities, with the broader goal to create information that might be useful in initiatives throughout the Baltic Sea region for addressing environmental problems related to agriculture. The extent to which the objective was accomplished will be considered by returning to the supporting research questions.

6.1.1 Agriculture and the Baltic Sea

Question #1 What aspects of the agriculture industry in Sweden have led to the environmental impact of nutrient and pesticide pollution reaching the Baltic Sea, and what are the problems associated with this impact?

Agriculture related threats to the Baltic are tied to the intense levels of food production seen not only in Sweden, but also throughout the Europe Union and the rest of the developed world. Agriculture has gone beyond safeguarding food supplies, one of the objectives of the CAP, to producing large amounts in excess. This intensity requires large inputs of nutrients, both nitrogen and phosphorus, along with inputs of synthetic chemical pesticides. These inputs generate two key threats to the ecological integrity of the Baltic Sea: unnatural cycles of eutrophication, and damage from toxic substances. Additionally, the drainage of wetlands throughout Sweden, including Skåne, has added to the pollution problem. Wetlands serve as natural filtration systems, slowing the flow of runoff to the sea, and absorbing some of the pollutants before the runoff reaches the sea. There is even current thinking that biological processes in the wetlands can partly purify the runoff.

Agriculture emissions are a non-point source form pollution, so it is often difficult to determine exactly where the emissions originate. It is clear that the unnatural eutrophication and the input of toxic chemicals threaten the integrity of the Baltic Sea, and potentially human health, as the Baltic is an important source of food.

Only three main aspects were discussed in answering the first question. There is much more to learn about the specific characteristics of agriculture in Sweden, such as animal densities, types of crops produced, etc. With a more exhaustive search, it is likely that other aspects of agriculture in Sweden will be found to have influenced the increase in nutrient and pesticide pollution. There may even be trends more specific than the intensification of agriculture in the mid-1900s that indicate details about nutrient and pesticide pollution.

6.1.2 Environmental measures

Question #2 What are possible measures that could be implemented to assist the agriculture industry in reducing nutrient and pesticide emissions into the Baltic Sea?

The information found as a result of answering question #1 helped formulate possible answers for #2. There is a tremendous amount of attention paid to addressing nutrient pollution, and to a lesser extent pesticide pollution, from agriculture. Therefore, it was impossible in this study to discuss in detail, all, or even many, of the different possible measures. Upon reading information and discussing this question with several people, four general objectives were identified to diminish the impact of agriculture on the Baltic. From these four objectives, a variety of measures were discussed as possible solutions to runoff pollution.

6.1.3 Eco-factors

Question #3 What are the relevant forces acting on the agriculture industry that promote or inhibit the further adoption of measures designed to reduce nutrient and pesticide emissions?

Even though conclusions for each of the seven eco-factors were drawn in chapter 4, it is clear that the story in all cases is not finished. A difficulty when using such a framework is that it is necessary to freeze time and put information into a rigid form. In reality, many aspects of the agriculture industry are fluid. Of course there is some rigidity to the industry, i.e. the standing conditions, but the eco-factors do not always present the view that parts of the industry may be constantly adjusting, or the fact that there are interactions between the different eco-factor categories.

With such a general study, it is clear that not all the opinions of all relevant individuals and organizations associated with the agriculture industry are represented. It is likely, that through the exploratory nature research, certain factors within the eco-factors were indeed overlooked. Future studies devoted to each eco-factor individually may be a way to create a better understanding of what is taking place in the industry.

Finally, the approach taken with the eco-factors was to get a general perspective of the factors at play within the Swedish agriculture industry. To accomplish this task, the scope attempted to build a case study of Skåne. To an extent, this study rather became a more a general study for all of southern Sweden, or perhaps even all of Sweden, rather than specifically the Skåne region. Of course, many insights were gathered from stakeholders in Sweden, but the likelihood that they are applicable to the rest of Sweden is probably very high. Whether this was a natural process of first getting to know an industry on a general level before being able to get a narrower perspective, is unclear. It is possible that what was included in the eco-factors covered more general issues, or, it might indicate that agriculture in Skåne is more driven by forces that drive the entire industry in Sweden, rather than by local forces. What is most likely is that each factor must be looked at more specifically, in order to get an understanding of what unique characteristics are influencing Skåne.

6.1.4 Overcoming barriers

Question #4 What are some key aspects that may help overcome barriers to implementing emissions reduction measures within the agriculture industry, and how can these aids be integrated into the system?

Studying the eco-factors within the context of the ecological modernization framework has given some insight into formulating an understanding of why and how the implementation of certain environmental approaches may or may not occur. Additionally, several important aspects were identified through this research that appear to be of usefulness to the integration of environmental approaches within the industry. These are financial security, expanding knowledge, and local planning.

The extent to which each of the aspects is essential for reducing agriculture emissions can be debated; however, it is the process of integrating these or other identified aspects into the existing agriculture structure that becomes vital for the ecological modernization of the industry.

Additionally, the study of ecological modernization does not only give insight into how broad themes might be accepted into the current industry structure (i.e. financial security, expanding knowledge, and local planning), it also gives insight as to how specific projects (i.e. wetland implementation), companies (i.e. manure trading business), policy proposals (i.e. revisions of the CAP), market strategies (i.e. branding Swedish agriculture as environmentally friendly), and others might be incorporated into the agriculture industry.

6.1.5 Broader perspective

As stated in the objective, it was hopeful this research would also serve useful for the broader agriculture industry outside of Skåne. This objective might have been met. Issues similar to those in Skåne are being faced throughout Sweden, the Baltic region, Europe, and beyond. This research gives some indication of what is driving the general agriculture industry; however, there are many local conditions and aspects that vary from region to region. Therefore, perhaps a more beneficial result of this research is the methodology that may be a successful approach for looking further into the specific factors influencing agriculture within different regional or local contexts.

6.2 Recommendations for Further Research

Several examples of the areas for further research were mentioned in the text, but will be highlighted again here.

6.2.1 Specific influence of key eco-factors

The aim of this research was to get a general idea of all the different eco-factors presented in the ecological modernization framework. There are several areas that could provide useful insight upon closer examination. First, a more quantitative approach to discovering the thoughts of farmers might provide a better picture as to the extent to which there is commitment to environmental concerns. This could give some indication of the effectiveness of the approaches for implementing training, new environmental techniques, etc. It could also give a better understanding of why farmers do or do not implement environmental techniques, and what approaches should be taken to promote further implementation.

It was pointed out in this research that related businesses, organizations, and others have an influence on government through lobbying. Further research could be useful to uncover what these various firms are lobbying for, how effective they are, and what the resulting influences on agriculture and environmental policies are. Looking specifically at individual policies might also be helpful for uncovering what is and is not effective, indicating how future policies should be constructed.

This research covered only several related businesses and interest groups to get a general idea of the role these types of organizations play in influencing the agriculture industry. It is clear that these organizations do have a vital role to play within the industry. A more complete study of each of the different industries (pesticide, fertilizer, seed development, machinery, etc.), co-operatives, institutions, non-government organizations, and others, could provide useful research for explaining what is happening in the agriculture industry. Each of these may also be an interesting case study in itself, regardless of usefulness to agriculture, and could be analyzed using similar methodology to that used here.

In general, the ecological modernization framework used in this study only allowed a general analysis of the different factors that are influencing the agriculture industry. It is very plausible that a study of each individual eco-factor, and aspects of each eco-factor, could provide very useful information regarding the ecological modernization of the industry.

Furthermore, it is important not to forget the role of the additional circuits of political ecology mentioned in chapter 3. With an insider's view on the industry, an understanding of the circuits of political ecology might help more clearly determine what steps can be taken to open up the various power structures in order to implement further ecological modernization within the agriculture industry in Sweden.

6.2.2 Market research

Some work has been done on the possibility of promoting Swedish agriculture outside of Sweden as having specifically high environmental and health qualities. Perhaps this could be done using branding techniques. A study of the work that has already been done in this area, as well as approaches and possibilities for further implementation of such a strategy would be highly useful for further progressing in this area.

It is likely that consumer behavior and ideas are constantly changing. Of course there are some fundamentals about how the consumer prefers to buy agriculture products, for example, the tendency of consumers to prefer less expensive products. Consumer views on environmental expectations might not be very predictable. It could be useful to ensure the data about consumers' expectations concerning the environment and agriculture production are up to date. This would give farmers, buyers, food processors, retailers, and others an indication of not only what environmental characteristics consumers want, but also the approaches necessary to educate them further about environmental techniques in the agriculture industry. This may also help farmers, and other stakeholders, to develop a strategy for competitive positioning.

6.2.3 Economic benefits of pollution prevention

A further understanding of how pollution prevention can give a competitive advantage in the market place to individual farmers, agriculture companies, or even an entire country's agriculture production may be useful in order to maximize the economic benefits of environmental improvement. Often, improving environmental conditions is first thought to be an economic burden. Research should continue to see how pollution prevention measures could be further integrated into the agriculture industry in a way that maximizes economic benefits for all involved stakeholders.

6.3 Final Comments on the Methodology

This research took an exploratory approach to develop a general understanding. To do this, it was necessary to gather the thoughts, opinions, and ideas from a number of different stakeholders representing various parts of the industry. This lent itself to conducting discussions with individuals, or in some cases small groups of two to four people. It appears that this approach was useful not only for the purpose of collecting data, but also to give the various stakeholders who are directly involved with the industry an opportunity to process and express their own thoughts about the pertinent issues they face in their everyday work. As was pointed out by the four discussion participants from Kristianstad municipality, it is not often that there is time within the normal busy workday to sit down and discuss these important issues with one another. This research provided some opportunity for brainstorming, building thoughts, and discussing the various problems and possible solutions the stakeholders in the agriculture industry undoubtedly must deal with.

It was useful to approach this study from a sociological perspective. It gives attention to the idea that the agriculture industry is more than just a technological practice. Agriculture in itself is influenced by many different disciplines, as seen in this study. The analytical tool, the ecological modernization framework, provided a beneficial opportunity to explore the various disciplines such as economics, policy, consumer behavior and ethics that influence farming activities. However, it should be remembered that the framework is merely that, a framework. There are times that expansion of the framework might enable research to paint an even more accurate picture of what is influencing the agriculture industry.

Bibliography

Åckerman, A. (2002, June 12). Personal interview.

Arnfalk, P. (2002). Virtual Mobility and Pollution Prevention. *IIIEE Dissertations* 2002:1 Doctoral Thesis; Lund University, Lund, Sweden.

Allsopp, M., Erry, B., Santillo, D., Johnston, P. *POPs In The Baltic. A review of persistent organic pollutants (POPs) in the Baltic Sea.* Green Peace. 2001 Research Laboratories Department of Biological Sciences University of Exeter

Andersson, G. (2002, August 08). Personal interview.

Andersson, L. (2002, August 22). Personal Interview.

Andersson, R. (1998). Objectives of sustainable agriculture. *Swedish Environmental Protection Agency*: *Sustainable Agriculture*. Proceedings from a Nordic Seminar in Stockholm. p. 15-19.

Andersson, T. (2002, August 22). Personal Interview.

Aventis (2001). ICM Edition: The contribution of Aventis to Integrated Crop Management. *Aventis Crop Science.* Volume 2:Aventis Crop Science.

Bayer (2000). Integrated Pest Management. *Nachrichten Bayer.* Edited by Spürck, W. 2-3:53.

Björnberg, A. (2002, August 06). Telephone interview.

Blix, L. (2002, June 17). Personal interview.

Collins (1999). English Dictionary Millennium Edition. Glasgow, England.

Dahlman, M. (2002, August 26). Personal interview.

David, C., Bernard, C., and Just, F. Eds. (2000). *Sustainable Agriculture in Europe, State of the Art and Policies in five European countries: Denmark, France, Latvia, Netherlands, and Spain.* European Research Project DG XII Environment and Climate Programme.

Ekolantbruk. (2000). Organic Farming in Sweden.[Online]. Available: http://www.ekolantbruk.se/english/ecoinswe.htm [2002, July 10]

Ekologiska Lantbrukarna. (2001). The way to the market organic products: A summary. [Online] Available: http:/www.ekolantbruk.se/english/way_to_the_market.htm

Ellström, Solweig Wall. (solweig.wall-ellstrom@krav.se). (2002, June 28). Re: agriculture research. E-mail to Steven Archambault (steven.archambault@mail.iiiee.lu.se).

Eriksson, K. (2002, August 15). Personal interview.

European Commission (2001). Agriculture. [Online] Available: http://europa.eu.int/scadplus/leg/en/s04000.htm [2002, September 1]

European Commission (2002). Available: http://europa.eu.int/comm/index_en.htm [2002, July, 15, August 15, September 1]

Federation of Swedish Farmers. (2001). *The Swedish Approach.* p. 11. Brochure.

Fogelberg, Fredrik. (2001). *Research on pest control and pesticide reduction in Sweden, Denmark and the Netherlands - ongoing work and new ideas for the future.* Dept. Agricultural Engineering Swedish University of Agricultural Sciences. [Online]. Available: http://www-mat21.slu.se/publikation/pdf/FF_rapport.pdf [2002, June 20]

Giddens, A. (1984). *The constitution of society: an outline of the theory of structuration*, Cambridge: Polity Press; Giddens 1995; Ritzer 1992; Long & Van der Ploeg 1994, Heterogeneity, actor and structure: towards a reconstitution of the concept of structure, in: D. Booth (ed.), *Rethinking social development: theory, research and practice*, London: Longman, pp. 62-89.

Granstedt, A. 2000 Increasing the efficiency of plant nutrient recycling within the agricultural system as a way of reducing the load to the environment—experience from Sweden and Finland. *Agriculture, Ecosystems and Environment,* 80, p.169–185.

Gren, I.M., Turner, K., and Wulff, F. (2000). *Managing a Sea, The Ecological Economics of the Baltic.* London:Earthscan Publications.

Grolink. (1998). *Organic agriculture.* [Online] Available: http://www.grolink.se/org_agriculture.htm [2002, September 12]

Gustafsson, A.H. (2001). *Environmental regulations in agriculture, a Swedish perspective.* The International Workshop on Environmental Regulations. Koldkaergaard, Denmark.

Hansson, H. (2002, August 19). Personal interview.

Heaton, S. (2002). *Assessing organic food quality: Is it better for you?* In Powell et al. (eds), *UK Organic Research 2002: Proceedings of the COR Conference*, 26-28th March 2002, Aberystwyth, pp. 55-60.

Hedlund, U. (2002, August 26) Personal interview.

Heidenmark, P. (2000). *Going organic? A comparative study of environmental product development strategies along two Swedish bread supply chains.* Licentiate Dissertation. Lund, Sweden:International Institute of Industrial Environmental Ecomnics 2000:4.

HELCOM (1998). The Third Baltic Sea Pollution Load Compilation Baltic. Sea Environ. Proc. No. 70 Online] Available: http://freia.nobman.com:15041/environment/pollution/hotspots.html [2002, June 20]

Helsinki Commission. (2002). *The Baltic Sea Environment Protection Commission.* [Online] Available: http://freia.nobman.com:15041/environment/pollution/hotspots.html [2002, June 20]

Hempel, E.K (2002, August 18) Personal interview.

Hempel, E.K. (2002, August 07) Telephone interview.

Hempel, I. (2002, August 18) Personal interview.

Hinrichsen, D. (1998). *Coastal Waters of the World.* Washington, D.C.:Island Press

European Commission. (2002). Nitrates Directive. [Online] Available: http://europa.eu.int/comm/environment/water/water-nitrates/directiv.html#top [15 August, 2002]

Hultgren, J. (2002, June 13) Personal interview.

Husby, Jens (2002, August 13) Personal interview.

Hushållningssällskapet. (2002) [Online] Available: http://www.hush.se/ [2002, September 3]

Jansson, B-O. and K. Dahlberg. 1997. The environmental status of the Baltic Sea in the 1940s, today and in the future. Technical Report No. 24. Stockholm: Department of Systems Ecology, Stockholm University.

Johnson, M. Cultivating the potential bioregionalism and corporate citizenship: Toward collaborative problems solving through bioregion-sensitive energy planning and development in southern Sweden. Master's Theses 2001:14. Lund, Sweden: International Institute of Industrial Environmental Economics.

Lindahl, Per (2002, August 15) Personal interview.

Lubieniechi, S.A. *Romanian consumers' behaviour regarding organic food.* British Food Journal, Vol. 104 No. 3-5. pp. 337-344. 2002

Lundh, B.M. (2002, August 05) Telephone interview.

Mejersjö, E.M. (else-marie.mejersjo@sjv.se). (2002 August 12). Re: agriculture research. E-mail to Steven Archambault (steven.archambault@mail.iiiee.lu.se).

Ministry of theEnvironment (2001). *Summary of the Swedish Environmental Objectives.* [Online] Available: http://miljo.regeringen.se/pressinfo/pdf/p9798_145e.pdf [2002, July 15]

Mont, O. (2002). *Environmental Product Communication.* IIIEE Masters Course Lecture.

Neal, C.; Jarvie, H.P.; Wade, A.J.; Whitehead, P.G. 2002 Water quality functioning of lowland permeable catchments: inferences from an intensive study of the River Kennet and upper River Thames. *The Science of the Total Environment,* 282-283, p. 471-490.

Ongley, E.D. *Control of Water Pollution from Agriculture.* GEMS/Water Collaborating Centre Canada Centre for Inland Waters Burlington, Canada Food and Agriculture Organization of the United Nations Rome, 1996 [Online] Available: http://www.fao.org/docrep/W2598E/w2598e00.htm [2002, July 14]

Organic farming in Sweden. (2000). p.1-23 Ecological Agriculture in Sweden, A Short Introduction 1998. [Online] Available: http://www.ekolantbruk.se/english/ecoinswe.htm [2002, July, 15]

Orsato, R.J., den Hond, F., Stewart, C.R. (2002). The political ecology of automobile recycling in Europe. *Organizational Studies.* 23:4.

Orssatto, R.J., and S.R. Clegg (1999). The political ecology of organizations: Framing environment-competitiveness relationships. *Organization & Environment.* 12:3, p. 263-289.

Orssatto, R.J. (2001). *The Ecological Modernisation of Industry: A study of the European Automobile Field.* Doctoral Thesis; University of Technology, Sydney, Australia.

Pesticide News (1998). Pesticide use in Europe Part 1. [Online] Available: http://www.pan-uk.org/pestnews/pn39/pn39p18.htm [2002, September 10]

Peterson, G., (2000). Political ecology and ecological resilience: An integration of human and ecological dynamics. *Ecological Economics: Special Issue: The Human Actor in Ecological Economic Models. 35.*

Ragn-Sells. (2002) http://www.ragnsells.se/english/index.htm [2002, August 14]

Regeringskansiliet. 2000 The Swedish Environmental Objectives-Interim Targets and Action Strategies. *Summary of Government Bill 2000.* [Online]. Available: http://miljo.regeringen.se/M-dep_fragor/hallbarutveckling/miljokvalitetsmal/M%202001%20-11%20MMP%20sammanfattning%20eng.pdf [2002, June 30]

Regnell, G. (2002, July 28) Telephone interview.

Reganold, J.P., Glover, J.D., Andrews, P.K., Hinman, H.R. (2001). Sustainability of three apple production systems. *Nature*, 410, p. 926-929.

Rinhardt, F. (1998). Environmental Product Differentiation: Implications for corporate strategy. *California Management Review*, 40(4): 43-73.

Sharpley, Andrew N. 2001 Phosphorus loss from land to water: integrating agricultural and environmental management. *Plant and Soil,* 237, p. 287-307.

Skålberg, S. (2002, August 26) Personal interview.

Staaf, H. (hakan.staaf@naturvardsverket.se). (2002, June 25-June 27). Re: agriculture research. E-mail discussion with Steven Archambault (steven.archambault@mail.iiiee.lu.se).

Starck, A. (2002, August 26) Personal interview.

Steineck, S., Jakobsson, C., Åkerhielm, H., and Carlson, G. (2001). Sweden. In Clerq, P.D., Gertsis, A.C., Hofman, G., Jaravis, S.C., Neeteson, J.J., Sinabell, F. *Nutrient Management Legislation in European Countries.* p. 251-265. Rennes, France:Cemagref.

Svenska Lantmännen - the Swedish Farmers Supply and Crop Marketing Cooperative. Available: http://www.lantmannen.se/

Swedish Board of Agriculture. (2002) http://www.sjv.se/net/SJV/Home/Facts+about+Swedish+Agriculture/Political+Guidelines [2002, June 15]

Sylvander, B., and Widel, A. L. F. (2000). *Consumer demand and production in the EU.* AgBioForum Volume 3, Number 2 & 3. Pages 97-106.

The Baltic Marine Environment Protection Commission. (2002). [Online]. Available: http://www.helcom.fi/helcom/pressroom/pressreleases/280502.html [2002, June 14]

The International Workshop on Environmental Regulations. October, 2001. *Environmental regulations in agriculture, a Swedish perspective.* Koldkaergaard, Denmark. Paper from Workshop.

Töner, L. (2002, August 27). Personal Interview.

Tuncer, B. (2001). *From Farm to Fork? Means of Assuring Food Quality.* Master's Theses 2001:26. Lund, Sweden: International Institute of Industrial Environmental Economics.

United Nations Environmental Programme. (2002). *Interactive Maps. Baltic Environmental Atlas.* [Online] Available: http://maps.grida.no/ [2002, June 20]

University of Wisconsin Sociology Department. (2002). http://www.drs.wisc.edu/ [2002, September 7]

Alabama Cooperative Extension System. (2002). *Organic foods no better than conventional foods, expert says.* [Online] Available: http://www.aces.edu/dept/extcomm/newspaper/may21bO2.html

Wennberg, H. (2002, August 06) Telephone interview.

Wiberg, K., Oehme, M. Haglund, P. Karlsson, H., Olsson, M., and R.appe, C. *Enantioselective Analysis of Organochlorine Pesticides in Herring and Seal from the Swedish Marine Environment.* Marine Pollution Bulletin. Vol. 30, No. 5, pp 345-353.

Wier, M. and Morch, A. *Consumer Demand for Organic Foods- Domestic and Foreign Market Perspectives.* Working paper #1, Survey. 2001. (Online). Available: http://www.akf.dk/organicfoods/Papers/wp1-mw.pdf [25 July 2002].

Wolcott, H.F. (1990). *Writing up qualitative research.* Qualitative research methods series 20. Sage Publications. London.

Wiskerke, Han. and Oerlemans, Nataja. (2000). Research Methodology. In Assouline, G. and Just, F. *Making Agriculture Sustainable, The role of farmers' networking and institutional strategies.* (14-25) European Research Project DG XII Environment and Climate Programme.

Wolf, Ph. (1956). *Utdikad Civilization.* Gleerup, Lund.

X.rates.com. (2002).[Online] Available: http://www.x-rates.com/ [2002, September 7]

Zethraeus, Bjorn. (bjorn.zethraeus@ibp.vxu.se). (2002, August 16). Re: agriculture research. E-mail to Steven Archambault (steven.archambault@mail.iiiee.lu.se).

Appendix 1 Personal Contacts

Name and Description	*Reason for contact*	*Contact Method*
Åcherman, Ann--Researcher in Lund University's Environmental Science Department, Wetlands Specialist	To provide valuable information about the use of wetlands for reducing agriculture emissions to the Baltic Sea. She also gave insight regarding the goals, progress, and struggles of wetland implementation.	Face-to-face interview
Andersson, Gunilla—Manager in the development of an organic food market in the Ecological Market Center	To provide insight into the market demand and market structure for ecologically produced products. She also provided information about the important issues and difficulties being faced in retail markets and food processing plants, the differences between organic production and integrated food production, and food cooperatives.	Face-to-face interview, e-mail exchange
Andersson, Togny and Lisbeth--Organic farmers specializing in dairy production, also have an organic production of sheep and other products	To provide insight into the issues faced by organic farmers. They were able to discuss the problems, successes, and challenges to organic production. This included a discussion about the motivation of farmers to grow organically, technical constraints, and EU subsidies.	Face-to-face interview
Berglin, Christina—Student from the Swedish Agriculture University doing a research project on the success and failures of cooperation between Swedish farmers	To provide additional information and another outsider perspective of the mindset of farmers and the possibilities for working together to solve some of the problems faced in the agriculture industry.	E-mail exchange
Bjorkland, Johana—Academic researcher at the Swedish Agriculture University specializing in sustainable agriculture techniques	To provide insight to the agriculture industry from the perspective of the academic world. She was able to provide information regarding actually sustainable agriculture practices, their effectiveness, and successes and difficulties for implementation. She also discussed the issues regarding the passing of information between researchers and farmers.	Telephone interview
Björnberg, Anna—Trader of organic agriculture products with Läntmannen, a large farmer owned cooperative in Sweden	To provide information about environmental improvements from an integral part of Swedish agriculture, the cooperative system. She was also able to give information about specific business goals of Läntmannen regarding environmental improvement.	Telephone interview
Blix, Lisa—Environmental specialist working in the Skåne regional LRF office	To discuss the issues influencing the agriculture industry from the perspective of a non-governmental organization. Lisa Blix works closely with issues from the perspective of both farmers and government officials. She therefore provided insight into the various factors influencing the agriculture industry.	Face-to-face interview, e-mail exchange
Dahlman, Michael—Environmental manager in the Kristianstad Municipality Office of the Environment	To discuss the issue of what is influencing the agriculture industry from the perspective of a government official working directly with related issues on the local level.	Face-to-face interview
Eriksson, Karin—Large-scale dairy farmer	To get a better understanding of the issues directly facing the agriculture industry from somebody who is a full-time farmer. She was able to provide insight into the feelings of farmers, their commitment to the environment, and obstacles they face. She also participates in an environmental management system from the ISO 14000 series. This provided additional data about the requirements and effects of such a system on production.	Face-to-face interview

Hansson, Högni—An environmental manager working with the Environmental Administration office in the city of Landskrona	To discuss the issue of what is influencing the agriculture industry from the perspective of a credible government official who is well known for his involvement with, and concern for environmental issues. He provided good information as he is working directly with related issues on the local level.	Face-to-face interview
Hedlund, Ulrica—Environmental planner in the Office of the Environment in Kristianstad Municipality	To gather information about as to the role of local environmental officials regarding the agriculture industry, and how the role of local government might influence agriculture activities.	Face-to-face interview
Hempel, Eva Karin and Ingvar—Large- scale farmers raising crops and pigs in Velinge Municipality. Eva Karin is a board member of LRF	To gain further information about the activities of farmers, and to try to get a feel for what motivates, influences, and drives their activities and decision making. It was also an opportunity to get further perspective from a non-governmental organization that represents farmers' interests (LRF).	Face-to-face interview
Hultgren, Jan—Farmer in Velinge Municipality, LRF board member	To gain further information about the needs, motivation, and obstacles facing farmers from the perspective of a farmer who also works with the greater interests of farmers through the LRF organization.	Face-to-face interview
Husby, Jens—Integrated Pest Management Specialist working for Bayer Chemical Company	To gain information about related businesses, including their interests, vision in terms of improving the environmental performance of the agriculture industry, steps taken to improve environmental performance, and obstacles they face. It was an opportunity to gather the thoughts and ideas of a business from an industry (pesticides) that is often considered a threat to environmental improvement.	Face-to-face interview
Lindahl, Per—Owner of a large-scale chicken farm in Kristianstad, Skåne. He was also the local president of LRF at the time of the interview	To gain insight on the motivations, actions, obstacles, and goals of a large scale farmer regarding environmental improvement. As he is the president of the local LRF, he was able to provide insight into the various concerns, motivations, and abilities of farmers in general regarding environmental issues.	Telephone interview
Lund, Britt-Marie—Sustainable investment banker working for Foreingssparbanken Bank in Stockholm	To gain insight from a financial institute that has a tradition of working with the agriculture industry. She was able to provide information about the role of financial institutions in promoting and hindering environmental improvements. She also gave information about the role of sustainable development financing of agriculture projects.	Telephone interview
Mejersjö, Else-Marie—Nutrient specialist from the Swedish Board of Agriculture	To gain perspective of the role of national government related organizations on the environmental improvement of the agriculture industry. She had specific insight into the steps taken by the national government to improve nutrient losses. She also explained the process of law making and subsidy programs on the national and EU level.	E-mail exchange
Gösta, Regnell—Wetlands specialist who manages wetland permits from the Skåne county administration office	To gain perspective of the regional government regarding the implementation and promotion of wetland development, and to develop a better understanding of the processes and procedures for implementing wetlands. He was also able to provide practical information about the role wetlands play in reducing emissions to the Baltic.	Telephone interview
Staaf, Hakan—Natural resource manager from the Swedish Environmental Protection Agency	To gain perspective of the role of national government related organizations on the environmental improvement of the agriculture industry. He was able to further explain some of the steps the EPA has taken to reduce emissions to the Baltic Sea.	E-mail exchange

Starck, Anna—Enforcement officer of agriculture/environmental related regulations in the Kristianstad Municipality Office of the Environment	To gain further insight into the success and problems regarding the enforcement of various environmental regulations involving the agriculture industry. She was able to provide insight into what she felt are problems hindering environmental improvement.	Face-to-face interview
Töner, Lars—Project leader at Nutrients in Balance, Odlings i Balanas, Vallåkra, Skåne	To gain insight from the perspective of a non-governmental organization about the influences promoting or hindering environmental improvement in the agriculture industry. He was able to provide specific information the technique of environmental improvement using integrated management techniques. He was also able to discuss some of the economic incentives associated with environmental improvements in the agriculture industry.	Face-to-face interview
Wall-Ellestöm, Solweig—Standards development professional for KRAV Organic products standards division	To gain insight into the promotion of organic products, and how the role of an organization key in regulating the production of organic food throughout Sweden.	E-mail exchange
Wallensteen, Karin—Agriculture policy analyst in the Swedish Ministry of Agriculture	To gain perspective of the role of national government related organizations on the environmental improvement of the agriculture industry. She also explained the process of law making and subsidy programs on the national and EU level.	E-mail exchange
Wennberg, Hans—Head of environment and assessment and risk analysis at Foreingssparbanken Bank in Stockholm	To gain information as to the importance of environmental performance in the financing of agriculture related projects. He was also able to give some insight into how the financing of business related to the agriculture industry might impact the success of financed agriculture projects.	Telephone interview
Zethraeus, Bjorn—Bio-energy specialist at Växjö University.	To gain insight on the technology of bio-energy crops, and how these crops might improve environmental performance. He was also able to give some insight into the economic advantages of growing such crops.	E-mail exchange

Appendix 2 Discussion questions for stakeholders

1) What direct or indirect relationship does you or your organization have with farmers?

2) Do you think your organization has an ability to influence farming activities? Explain.

3) Does your organization have an interest in the environmental improvement of agriculture? Explain.

4) Can you think of any incentives your organization could provide to farmers/or reveal to farmers so they could reduce their impact on the environment (specifically impact on the Baltic Sea)? Explain these.

5) What actors directly or indirectly influence your organization's activities?

6) Does any of these actors have the ability to influence the environmental performance of farmers? How?

7) Is your organization currently in dialogue with other actors (government, public, private enterprises, educators, researchers, etc.), or stakeholders, who are interested in the environmental improvement of agriculture?

8) Do you think it would be/or is beneficial to work with other actors who are interested in the environmental improvement of agriculture?

9) If these questions have created more relevant ideas or thoughts, please mention them here.

Appendix 3 Bio-energy

Presented here is the unedited transcript of an electronic mail written by Björn Zethraeus (2002), explaining the difficulties associated with different aspects of bio-energy production. Section 4.3.4 discusses the industrial ecology conditions of bio-energy. The quoted text is in its original unedited form.

"As it comes to the market situation there are some problems: There's three types of situations with significant differences.

1) Assume a farm is situated within the fuel-uptake area of a larger plant, mainly firing wood residues of different kinds. Then that plant will - very generally speaking - be able to cope with small amounts of odd fuels such as willow or reed canary grass or.... On the other hand: Since that plant is big and it will be crucial as a base energy supplier for a large number of customers, they will have long-term contracts with a number of reliable fuel-suppliers. So the plant will be able to cope with the fuel but maybe the administration will not be able to cope with a small, odd fuel delivery. (Of course - I'm painting this in black. Many utilities WILL be able to cope with such oddities, but you will have to be aware that this is the main difficulty in this case.)

2) Assume there is a small, stand-alone plant nearby - maybe even run by a collective of farmers or anyway it's run by a small company not having a large number of other plants. Now the small plant will be very sensitive to fuel quality and it will generally speaking not be operated by skilled people and there will definitely not be all-day manning. If such a plant receives a load of odd fuel - and even chopped willow is odd in this respect - the plant may go out in the worst case. You see, chopped willow - with the ratio of bark-to-stem-wood and with the moisture content is usually has - demands that the burning equipment be adjusted differently from what it should be when firing - say – pine chips. And grasses, and straw, and ... do also put such demands on the equipment. And in the small plant - when there comes a load of any of these odd fuels, this fuel will be the major fuel for at least a couple of hours. However, small companies running single plants are usually very flexible when it comes into dealing with odd deliveries. So in this case, the administration will certainly be able to cope with the single farmer - but the boiler might not....

3) The third case is a combination of the two: Assume a larger energy utility company operates small plants over a certain area. In this case there will be a central control room from where the single plants are observed and to some extent controlled. There will be someone highly skilled in boiler technology going around and visiting all the single boilers daily. There will be skilled personnel in the central control room and there might even be a policy to try to take in local fuel into the distributed plants. In the best of worlds there would even be someone aware of the importance of fuel homogeneity and fuel mixing for the smaller plants - but that might be hoping too much... The utility will, in this case, be capable of coping with odd fuels and they will have the routines to handle odd deliveries. In this case you will then find the flexibility you are asking for. You would have to expect that the fuel deliveries would physically have to go via the central office of the utility for sampling and for quality assessment at their lab and that the transport would then be directed to the plant where the fuel should be delivered, so it would not necessarily guarantee minimized transports but it would not be a problem for the farmer to sell their crop. In the worst case - the fuel could be delivered to a waste-fired plant - but they would usually not pay(!) since their business idea is to get paid for taking the fuels they are handling...

Finally - there is a completely different way to attack the problem:

4a) Assume the farmers join in a co-operative to upgrade the fuel to pellets and then try selling to private customers. In that case, there is a limitation to what mixture goes into the pellitzing process since - in this case - the quality of the product (the fuel pellet) will be crucial for the success. So doing this you might guarantee (or anyway promote the market situation) the sales but you might slightly corrupt your ambitions as nitrogen fixation or other soil improving aims are concerned. So in this case you'll have to find a compromise. I would imagine you're aware of the fact that the farmers organization (LRF) is talking about entering into this business - launching what I've heard mentioned with the trade mark "Agro-pellets" that would be a competitor to the wood-pellets on the market. But then - as I said - the product quality will have to be highest priority and the need to rotate crops for the soil will be pushed down to second priority.

4b) As an alternative to upgrading by pellet production you might also upgrade your fuel producing a bio-gas and use that to produce and sell electricity. I'd say that would not be profitable unless you can also hook on someone who needs the heat but if - for example - you can locate the whole thing near to a greenhouse plantation or something.... If you can accept a low productivity you would - in this case - have a reasonable flexibility as the mixture of crops into the process are concerned and you might not have to corrupt your soil-improving ambitions by compromising... You'd also get a compost out of the process that might be sold back to the farms again.... Both ways of upgrading are capital-intensive and demand significant investments and - on top of that - running a pellet factory takes running costs. So these two options are larger scale. The single farm might extract gas from mixing some of the rotation crops with their manure and covering the whole thing and connecting a tube and finally connecting and old diesel engine with a generator but then that might change the quality of the manure.... What I'm trying to say is that option (4b) - for someone who likes to play around with technical things and who is not really interested in high efficiency but is willing to take-what-they-get - could well be implemented individually if the material and manpower is available at no/low cost."