

The role of policy instruments for an environmentally sustainable and competitive food industry: Sweden in a comparative perspective

A Literature Review

Lisa Scordato
Antje Klitkou
Lars Coenen

Working Paper 8/2014

NIFU

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Published by Nordic Institute for Studies in Innovation, Research and Education (NIFU)
Address P.O. Box 5183 Majorstuen, N-0302 Oslo. Office address: Wergelandsveien 7, N-0167 Oslo

Sponsor Tillväxtanalys
Address Studentplan 3, 831 40 Östersund, Sweden

www.nifu.no

Preface

This report is a literature review on the role of policy instruments for an environmentally sustainable and competitive Food industry. The review focuses its attention on the food industry in Sweden and in an international perspective, and covers developments after 1990. The report was commissioned by the Swedish Agency for Growth Policy Analysis (Tillväxtanalys).

The project was conducted by researcher at NIFU, Norway (Lisa Scordato and Antje Klitkou) and by Circle, Sweden (Lars Coenen). The project was co-ordinated by Lars Coenen.

Oslo, April 2014

Sveinung Skule,
Director

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Summary

This review focuses its attention on *production, trade and distribution* of the food and beverage industry. The purpose of the review is to give an account of the scholarly literature on the role of policy instruments for creating an environmentally sustainable and competitive food industry.

Over the past 50 years the food production system has made considerable gains in economic efficiency by means of intensification and specialisation. Over this period, food production has had a remarkable increase and it has been possible to produce more food from the same or less amount of land and with less labour. Food and manufacturing have followed the same specialisation trends which occurred in agriculture as few large food-processing industries have replaced many smaller ones. Retailers control product supply from producers to consumers and have replaced the central role traditionally played by food manufacturers. The change of power structures in the supply chain is an important perspective that can explain many of the challenges affecting the food industry.

The food and beverage sector is a leading manufacturing sector in Europe. In 2011, it had a turnover of €1.017 billion and employed 4.25 million people. The sector has been growing in turnover and profitability despite the general economic downturn in recent years. The growth in turnover from 2010 to 2011 was of 6.8% and of 32% compared to 2006. The sector nevertheless, faces important challenges related to the intensifying consequences of climate change, competition for energy, fresh water and land. Other concerns mentioned in the literature are world population growth and growth in per capita consumption of food in general and of meat in particular are described as factors that will put the global food system under even more pressure in the future.

The reviewed literature shows that the modern food production and consumption system poses serious impacts on ecosystems and societies. A factor that is often mentioned as a key problem in overcoming these challenges is the lack of information to consumers on the environmental impacts of the food production chain. The introduction of environmental labels or “eco-labels” is suggested as an instrument that can have important positive effects on enhancing information flows in the value chain from production to consumption.

Actors in the food system have taken different measures to respond to health, safety and environmental concerns mentioned above. The development of the organic foods provides an example of how the food industry has responded to the sustainability needs of society and consumers and to tensions that originated from the incumbent food system. Organic foods have steadily grown in popularity during the recent two decades.

A recent report stresses the importance of sustainable technological innovation in food processing as a key factor for the European food and beverage industry to be able to stay competitive on the longer

term. Policy instruments and regulations have an important role in driving the implementation of such sustainable process technologies. The different stages of the food chain present different emission patterns and the approaches to mitigate them therefore need to be of different nature. National energy and infrastructure policies will ultimately need to be changed if drastic carbon emission reductions are to be achieved. From a regulatory perspective food security and sustainability are key goals.

The food industry, being a “low R&D intensity sector”, struggles harder compared with other important manufacturing sectors with higher R&D investments. The literature suggests that the European food industry is rarely presenting any new or radically new innovations. Similar conclusions are drawn for the Swedish food sector.

Regulatory challenges are therefore often (and closely) related to the imbalances in food security on the one hand and environmental externalities on the other. In an era of globalised food markets regulation has become increasingly difficult. According to the literature, the present externalities of the food sector have become far more global and are increasingly exposing resource interdependencies between food production, fuel, energy, water, carbon and waste. Compared to past periods the current system presents more and diverse regulatory challenges and instabilities. At the same time, scholars argue that it demands more proactive national and supranational governments. As suggested in the literature, policy initiatives that address the role of the food sector in mitigating climate change appear to, currently be in their infancy and largely focussed on the primary stages of the value chain.

1 Introduction

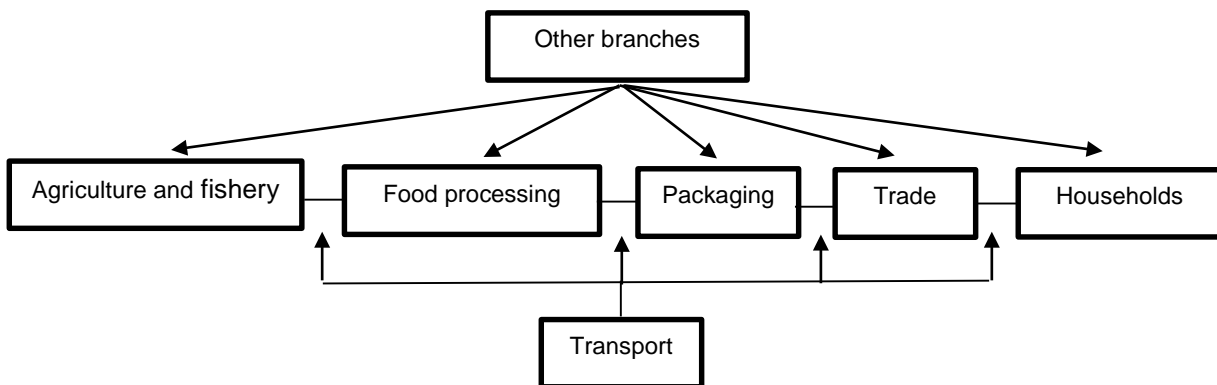
The purpose of this literature review is to give an account of the scholarly literature on the role of policy instruments for creating an environmentally sustainable and competitive food industry. The review seeks in particular to answer the following questions:

- The role of policy instruments: How have national and international policy instruments affected the Swedish (and other countries') food industry in becoming more environmentally sustainable *and* competitive?; What specific types of instruments have been the most effective? ; What is the reason behind the effectiveness of these instruments?
- What other factors have been essential for environmental sustainability and competitiveness in the (Swedish and other countries') food industry since the 1990s?
- Industry response: How have the actors (food industry companies) responded to these measures and factors, for instance with regard to the introduction of process/energy efficiency measures, product development, etc.?; To what extent have companies responded differently to these measures?
- Effects: To what extent have policy measures led to the establishment of new actors on the market; what factors and policy instruments have been important to foster innovation; what has been the environmental and climate effects of these measures?; How has the companies' competitiveness been affected by these measures?

The literature review covers articles within the domain of the social sciences. The selection of articles is limited to articles published in international peer review journals. The review also includes a selection of reports published by international organisations. An overview of the articles and reports is available in the reference list. These articles and reports have been published in the period 2005-2013. However, the content of the articles may refer to data preceding this period.

The review focuses its attention on *production, trade and distribution* of the food and beverage industry. The review follows the food system described in Fig. 1 with the exception that "Agriculture and fisheries" is not included.

Figure 1: Schematic illustration of the food system as examined in this review (Wallgren and Höjer, 2009)



The search of the scientific literature was carried out by using a key word approach in the recognised article database ISI Web of Science for the period 2000–2013. The search has led us to the most relevant articles related to the questions described above.

1.1 Structure of the report

The structure of the report follows broadly the four thematic questions described above to the extent they have been identified in the literature. Following this introduction, Chapter 2 introduces the development of the food industry during the past 50 years and discusses the role of policy instruments and regulations in creating a sustainable food and beverage sector. Chapter 3 gives an account of important factors affecting environmental sustainability and competitiveness of the sector. Chapter 4 addresses how the industry has responded to different factors and policies. The last Chapter 5 presents the overall conclusions of the review.

2 The role of policy instruments and regulations

2.1 Background

Over the past 50 years, the food production system has made considerable gains in economic efficiency by means of intensification and specialisation. Over this period, food production has had a remarkable increase and it has been possible to produce more food from the same or less amount of land and with less labour. Food and manufacturing have followed the same specialisation trends which occurred in agriculture as few large food-processing industries have replaced many smaller ones. Due to increased liberalisation of trade regulations and the abundant availability of cheap fossil fuels food production has become increasingly globalized, with different elements of the value chain becoming distributed across large distances. (Sundkvist, Milestad et al. 2005). Similarly to other manufacturing industries fossil fuels have played an important role for the implementation of many technological innovations in the food industry (Langelaan, Silva et al. 2013). However, important advancements in food production and processing (such as refinery technologies, drying, preservation, canning, packaging, refrigeration and transport) were also achieved through the integration of knowledge from different domains such as engineering, chemistry, physics, nutrition, toxicology and, more recently, biotechnology, genomics, ICT and nanotechnology (Langelaan, Silva et al. 2013). Although there has been much debate in the literature as to the precise driving factors behind these developments, it has become increasingly evident that this transformation entailed important ecological externalities (such as impoverished soils, nutrient and toxin polluted waters and loss of biodiversity) and social externalities (for instance social costs as a consequence of the replacement of people with machinery, cheap (or more recently increased) food prices, the race for more arable land, food and life style related diseases, etc.).

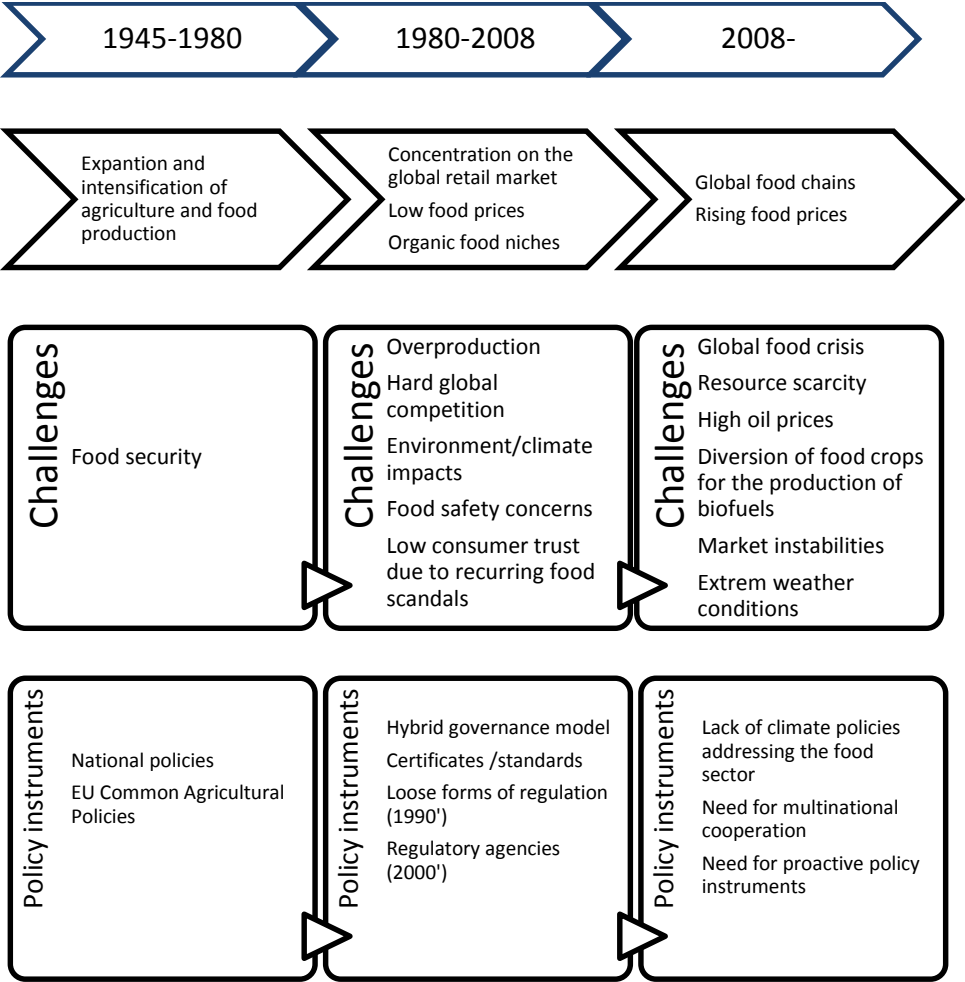
A further trend in recent decades has been the concentration of processing and production activities and convergence of consumption patterns (Sundkvist, Milestad et al. 2005). Currently, only a small number of agro-business and food firms control entire production chains. According to Beckeman et al. retailers control product supply from producers to consumers and have replaced the central role traditionally played by food manufacturers. The change of power structures in the supply chain is an important perspective that can explain many of the challenges affecting the food industry (Beckeman, Bourlakis et al. 2013). Beckeman et al lists three main reasons for the change of power in the supply chain: consumers' wish for differentiation; the restructuring of the supply chain by retailers to reduce cost and time and to push manufacturers for faster deliveries; mergers and acquisitions in the retail chain triggered by low retail margins (Beckeman, Bourlakis et al. 2013).¹

¹ See also Van Donk (2001) Make to stock or make to order: the decoupling point in the food processing industries, *International Journal of Production Economics*, Vol. 69 No. 3, pp. 297-306.

The food and beverage sector is a leading manufacturing sector in Europe. In 2011, it had a turnover of €1.017 billion and employed 4.25 million people. The sector has been growing in turnover and profitability despite the general economic downturn in recent years. The growth in turnover from 2010 to 2011 was of 6.8% and of 32% compared to 2006 (Langelaan, Silva et al. 2013). Nevertheless, the sector faces important challenges related to the intensifying consequences of climate change, competition for energy, fresh water and land. Other concerns mentioned in the literature are world population growth and growth in per capita consumption of food in general and of meat in particular are described as factors that will put the global food system under even more pressure in the future (Marsden 2012, Langelaan, Silva et al. 2013).

The impacts of climate change on food production constitutes a major theme in the United Nations Framework Convention on Climate Change (UNFCCC). Scientific reports have increasingly provided evidence that many regional food production systems have negative effects on climate change and also that the food sector is one of the main sources of GHG emissions. At the international level, the role of the food sector in mitigating climate change is however only emerging and is primarily focussed on the primary stages of the value chain (Feindt and Flynn 2009).

Figure 2: Overview of trends, challenges and policy instruments of the food system since 1945 (own illustration).



In addition to concerns related to environmental and social sustainability, the food and beverage industry faces a number of short-term interdependent challenges that have implications for the industries' competitiveness. These factors are related to price competition and rising/more volatile raw material prices, food contamination scandals undermining the trust of consumers and loss of competitiveness in the global export market. A recent report stresses the importance of sustainable technological innovation

in food processing as a key factor for the European food and beverage industry to be able to stay competitive on the longer term. As suggested by Langelaan et al., in the longer term, technological innovations in food processing should support the development of new and better food products (to meet the growing food demand, alleviate food security, prevent life style diseases, etc.), resource efficient manufacturing processes (to consume less water and energy, prevent waste, allow for product diversification, etc.) and integrated and transparent supply chains (such as increase consumer trust, provide objective information, allow for transparency and tractability of raw materials in all parts of the supply chain, etc.). Policy instruments and regulations have an important role in driving the implementation of such sustainable process technologies (Langelaan, Silva et al. 2013). Figure 2 gives an overview of the main trends, challenges and policy instrument developments from the post second world war period up to current times.

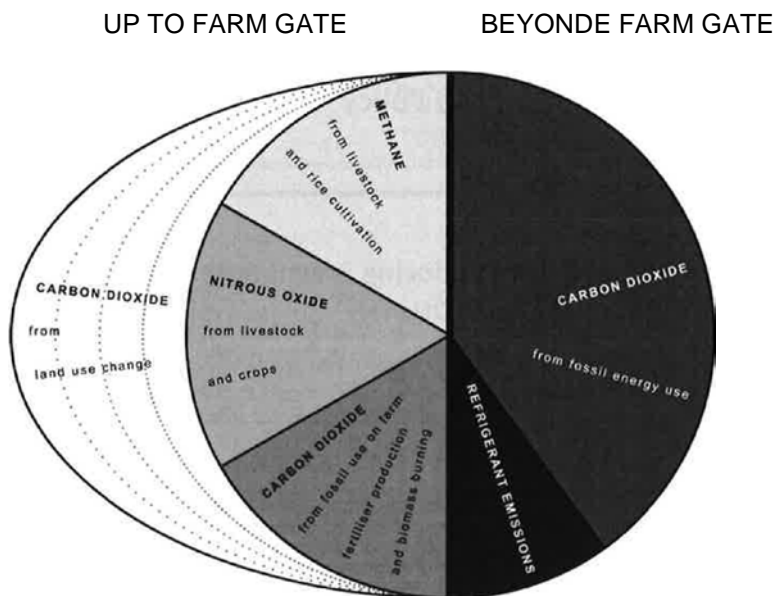
2.2 Options for reducing greenhouse gas emissions in the food system

The reviewed literature shows that the modern food production and consumption system poses serious impacts on ecosystems and societies. A factor that is often mentioned as a key problem in overcoming these challenges is the lack of information to consumers on the environmental impacts of the food production chain. According to Sundkvist et al. the lack of information flows between consumers and producers has made it increasingly difficult to relate “concerns about quality of food and environmental risks to consumer choices or food production methods” (Sundkvist, Milestad et al. 2005). They thus see improved information flow between consumers and producers as essential to change the current food system in a sustainable direction. In this context, the authors claim that policy should provide frameworks to regulate such information provision in a clear, understandable and standardized way (Sundkvist, Milestad et al. 2005). The introduction of environmental labels or “eco-labels” is suggested as an instrument that can have important positive effects on enhancing information flows in the value chain from production to consumption. The Swedish KRAV label is described as a successful example of a control organisation for organic food production that has gained widespread visibility and enjoys high credibility and trust among consumers. In other countries the functioning of eco-labelling has however been under harsh critique due to their abundance, geographical fragmentation and different meaning which has undermined their proper functioning (Aragon-Correa and Rubio-Lopez 2007). In this context, the EU has introduced the European Pollutant Emission Register (EPER) as a tool to enhance consumer information on emissions from industrial facilities.

Moreover, economic incentives, legislation and cooperation with actors in the food sector are mentioned as being measures that are important to foster sustainability in the food sector and to provide improved feedback. The internalisation of the environmental costs of production in the price (as opposed to the current situation for environmentally labelled food products, which have a high cost due to subsidised conventional production and externalised environmental costs) is also described as a potentially effective instruments for future policies (Sundkvist, Milestad et al. 2005).

The different stages of the food chain present different emission patterns and the approaches to mitigate them therefore need to be of different nature. Emissions resulting from beyond the farm gate account for approximately half of the food chain emissions (Wallgren and Hojer 2009). For manufacturing and retailing stages where refrigeration is a major source of emissions, measures such as energy efficiency, low carbon building design and the use of renewable energy are measures that can have a positive effect on emission reductions. Other types of emission reduction measures are needed for addressing transport, packaging and food waste (Wallgren and Hojer 2009, Garnett 2011). Figure 3 gives an illustrative indication of the distribution of the different GHGs in the food chain, differentiating between emissions stemming up to and beyond the farm gate.

Figure 3: Food chain impacts and the distribution of the different gases (Garnett, 2011)



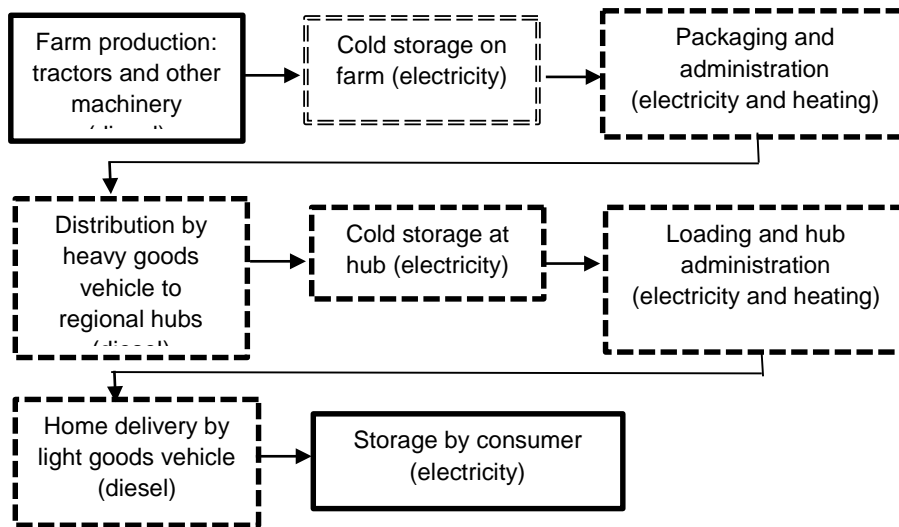
Wallgren and Höjer identify possibilities for reducing energy use in the Swedish food supply chain. According to the authors, energy-efficient technology can considerably reduce energy use in industrial processing. Converting to less energy demanding food products is identified as a further important opportunity for energy savings. Similarly they suggest that innovative technological developments are important options for packaging. According to the study, energy use for packaging in Sweden was 12% and for household electricity (cooking, cooling and washing up) was about 25% of the total energy use in the food supply chain. Efficient use of energy in buildings and for cooling devices are described as the two most important measures for energy reduction in trade and commerce. Energy use for transport corresponded to about 14% of energy use of the food supply system in Sweden.² Energy efficiency measures in vehicles and logistics and strengthening local and regional food production in combination with appropriate distribution systems and implementing systems for energy efficient e-commerce are additional ways that could decrease energy use related to the transportation of food (Wallgren and Hojer 2009). Figure 4 illustrates the main sources of fossil fuel related carbon emissions and flow of product for the large-scale system.

National energy and infrastructure policies will ultimately need to be changed if drastic carbon emission reductions are to be achieved. As suggested by Garnett, the main options for reducing food chain emissions are as follows:

- *Energy efficiency*: good management, correct sizing and use of equipment, clean transportation methods.
- *Cleaner and renewable fuels*: biomass, solar, wind, etc.
- *Resource efficiency*: reducing unnecessary use of products and equipment: recycling and reuse were environmentally appropriate.

² The percentage figures used in Wallgren and Höjer are based on an analysis of the energy use in the Swedish food supply system by Statistics Sweden and refer to the year 2000.

Figure 4: Main sources of fossil fuel related carbon emissions and flow of product for large-scale systems (Coley et al. 2009).



While technological improvements will be important, they will not be sufficient in reducing GHG emissions from the food system. In this context Garnett stresses the importance of considering the social, cultural, economic and geographical contexts within which these improvements are applied (Garnett 2011). For example with regard to the issue of reducing waste, it is important to consider people's life styles, consumption patterns, and consumer behaviour. Ultimately, there are several system challenges that hinder an effective way to address the issues of unsustainable food chains. Research suggests that if substantial reductions in food related GHG emissions are to be achieved it is necessary to address not only the production and distribution chains but policy makers need to address changes in consumption patterns. The literature frequently mentions the positive effects that a considerable reduction in the per capita consumption of certain products such as meat and dairy foods could bring to reduce significant emissions (Wallgren and Hojer 2009, Garnett 2011). However, there are currently no government recommendations or policies within high income countries addressing this issue (Garnett 2011).

So far, little research seems to exist on *how* changes in behaviour actually can be achieved. On the other hand, there is a multitude of studies investigating the role of technological development for mitigation. Garnett concludes that this apparent imbalance can be attributed to the "relatively low priority that policy makers have hitherto placed on behaviour changes as an approach to GHG mitigation- which in turn perhaps indicates their reluctance to question the inevitability and desirability of today's growth-consumption development model" (Garnett 2011 p. S31).

3 Key factors affecting sustainability and competitiveness

3.1 Regulatory factors

From a regulatory perspective food security and sustainability are key goals. Regulatory challenges are therefore often (and closely) related to the imbalances in food security on the one hand and environmental externalities on the other. In this section, we take a brief look at the regulatory factors that shaped the development of the food sector during the past thirty years.

Since the immediate post war-period until the beginning of the 1980s food security was at the core of regulatory frameworks. The enlargement and intensification of the agri-food system was supported by government policies and was made possible largely through continued technological advancements contributing to increased yields per hectare and per animal. By the end of this period, a regulatory change came about marking the transition towards a twenty-year period (1984-2008) of what has been defined as *post-productivism*. According to Marsden “the post-productivist phase has reared a more hybrid governance model and in which both the public and private sectors strive to codify, rationalize and regulate the safety and quality of foods” (Marsden 2012 p.297). During the 1990s and early 2000s low food prices, driven down by tight supply chain management encouraged looser forms of regulation. As a reaction to the food crisis such as the BSE outbreak, public intervention became increasingly legitimate and necessary and as claimed by Marsden it drove a new wave of institutionalisation in food regulation in Europe in the 2000s. In this period, for instance the European Food Safety Agency was established as a regulatory agency to uphold consumer confidence. This model, the author claims, is however vulnerable to both food security and sustainability limits. Policy interventions therefore came merely as a reaction to contingent crisis rather than confronting the fundamental structures of intensive systems of production and supply (Feindt and Flynn 2009, Marsden 2012). At the same time, the global sourcing of foods limited the regulatory reach of national governments. The concern of food security was replaced by the one of overproduction and by the late 1980s the problem of food sustainability and environmental externalities were clearly recognised by consumers and policymakers (Marsden 2012).

The emergence of the post-productivist regime is explained in the literature as a consequence of the gradual recognition of policymakers in the EU and EU Member States of the “financial, economic and ecological costs of overproduction”. A regulatory shift in the food sector thus came as a reaction to problems of food surpluses and environmental externalities. It also meant a shift in the sets of relationships between the state, producers and consumers. In particular, this period saw the raise of retailer corporatism and retailer led-supply chain regulation (Marsden 2012).

After 2008, the problem of food security again presented itself as a global challenge, caused by resource scarcity and related market instabilities. Rising food prices coincided with significant increases in the price of oil. One of the consequences of the competition for energy and oil shortage has been the diversion of food crops for the production of transport fuels from biomass. The growing interest in biofuel production has clearly affected large part of the rises in food prices (Marsden 2012).

In an era of globalised food markets regulation has become increasingly difficult. According to Marsden the present externalities of the food sector have become far more global and are increasingly exposing resource interdependencies between food production, fuel, energy, water, carbon and waste. Compared to past periods the current system presents more and diverse regulatory challenges and instabilities. At the same time, scholars argue that it demands more proactive national and supranational governments (Marsden 2012).

3.2 Competitiveness factors

As described in previous sections the European food industry faces several competitiveness challenges. Increased competition from new actors on the global market such as countries in Asia and South America are creating a race for appropriating global market shares. All traditional food exporters, such as Australia, Canada, US are affected by these trends (Langelaan, Silva et al. 2013).

The food industry, being a “low R&D intensity sector”, struggles harder compared with other important manufacturing sectors with higher R&D investments. The food sector appears to be particularly affected by the European innovation paradox, meaning that research and development conducted in the field is insufficiently resulting into new products or processes (Langelaan, Silva et al. 2013). The lack of knowledge exchange between science and industry and across national and regional borders is mentioned as being an important factor explaining this paradox. Another bottleneck is the weak innovation capacity of SMEs which make up a significant share of the European food and beverage sector (Langelaan, Silva et al. 2013). Large food producers are the driving forces behind growth and innovation and are responsible for the majority of R&D expenditures of the sector. Also from this point of view, the food and beverage industry distinguishes itself from other sectors like pharmaceuticals, ICT or biotechnology where SMEs are important drivers of innovation. A range of policy instruments exist that aim at stimulating knowledge exchange in the food sector (see H.C Langelaan 2013 page 48 for a detailed account). However, there is little evidence that suggest there are *best practices* concerning these instruments (Langelaan, Silva et al. 2013).

The food sector is a highly regulated market. Several food safety regulations and standards are developed by national and international organisations such as the WTO, FAO, WHO and the EU but also by private parties. While regulations are necessary to guarantee food quality and safety they can also create obstacles for innovation. The Novel Food Regulation (EC Directive 258/97 concerning the placing on the market of novel foods and novel ingredients) is mentioned as an example of a regulation that for some aspects impedes innovation in the food sector. The regulation stipulates that when the application of a novel process results in significant changes in the product, this product must be subjected to risk assessment before the new technology is approved for application. Food companies claim that the regulation is not clear enough in specifying what the regulation actually means by *significant change*. Besides food safety the regulation also has an important environmental dimension as it contains regulations for preventing waste and the re-use of food by products (Langelaan, Silva et al. 2013).

In sum, the literature suggests that the European food industry is rarely presenting any new or radically new innovations. Similar conclusions are drawn for the Swedish food sector, which appears to be developing very few radical or market driving innovations (Beckeman, Bourlakis et al. 2013). According to Beckeman et al. research investigating innovation practices used by food manufacturers in Sweden is, however fairly limited. In this context, Beckeman et al. attempt to uncover some of the main issues and shortcomings for food development in Sweden. Their main findings suggest that Swedish retailers

appear to follow similar developments of the UK market in terms of focussing on differentiated products, increased food competence and products globally sources (Beckeman, Bourlakis et al. 2013). On the other hand, Swedish food manufacturers often develop products “in-house” as opposed to adopting an open innovation approach, which scholars say, is of primary importance to foster innovation.

The lack of trust between actors in the value chain is identified as a major problem that originates from the unequal power in the supply chain and lack of integration. Similarly to Sundkvist et al., the authors point at a lack of a transparent information flows in the food chain as a negative element for innovation development. Hence, the innovation management model of Swedish manufacturers appears to make little use of external competences, without profiting from consumer involvement. Other studies of food manufacturers in the Netherlands describe a similar situation (Fortuin and Omta 2009).

For the food sector in particular it is claimed that innovation must be consumer/market driven or “even driving for more radical innovations” (Beckeman, Bourlakis et al. 2013 p. 954). This is regarded as important as consumers are becoming more individualistic, have the opportunity to be more informed and increasingly demanding. In this regard, the closed innovation management approach of Swedish food manufacturers is identified as a major shortcoming. The study of Beckeman et al. was based on interviews with respondents in 12 companies including SMEs and multinationals. Respondents were active in the food industry, including management or R&D. Concerning sustainability the respondents stated that to combine innovations and environmental aspects such as energy, waste, new materials, etc. “considerable rethinking and reworking is required”. At the same time, gaining sustainability in the value chain appears to be a strong driver for change in the food business (Beckeman, Bourlakis et al. 2013).

4 Responses of the food industry

Actors in the food system have taken different measures to respond to health, safety and environmental concerns mentioned above. Some of the measures that have been taken are the introduction of food assurance schemes and integrated farm management and policy reforms. In this section we describe the development of organic food as an example of an emerging and growing alternative response to the incumbent food system (Smith 2006). A case study on the development of the organic niche in the UK serves as an illustrative example of how the food industry has responded to the sustainability needs of society and consumers and to tensions that originated from the incumbent food system.

Organic foods have steadily grown in popularity during the recent two decades. It attracts media attention and enjoys policy support. The organic movement has grown largely from consumers' reactions to regularly occurring scandals linked to food safety and health issues such as pesticide residues in vegetables, food contamination, the BSE crisis, foot and mouth disease, environmental impacts of food miles and concerns linked to the GMO debate. By the late 1980s the organic niche was attracting interest from mainstream actors. In the UK, government began directing public funds to organic research and by the late 1999 investment in organic research reached £1 million a year. However, compared to support for conventional agriculture, policy support for organic farming remained relatively small. The use of public procurement of food has also in some cases emerged and helped support local food networks while at the same time supporting other policy goals such as environment, health, education and economic development (Smith 2006).

The issues of environmental standards receive particularly attention in the reviewed literature. There is currently a large amount of environmental standards, developed by both governmental and nongovernmental actors that create incentives for industries to, on a voluntary base, introduce systematic environmental management. Some of the best-known certification schemes are the global ISO 14001 and the Eco-Management and Audit Scheme (EMAS) managed by the European Commission (Aragon-Correa and Rubio-Lopez 2007). The introduction of standards for organic food production has also supported the growth of this particular niche.

Moreover, the success of the organic foods among consumers is related to its strong environmental and health appeal. The organic food chain differs radically from the practices of the mainstream food system. As a reaction to the steady growth in popularity of organic food products the mainstream food producers started to produce their own organic brands and lines, however, without however embarking fully on the initial vision of the organic movement, based on "supplying fresh, wholesome food and doing so through decentralised distribution networks linked closely to local mixed farming systems " (Smith 2006 p.451). Increasingly with the strengthening of public interest for organic food in the 1990s, the organic mainstream interests became more visible and supermarkets were pressing for more quantities and making several demands on the organic producers. According to Smith: "Such mainstream involvement

confronted the organic movement's ethos of supplying fresh, wholesome food, and doing so through decentralised distribution networks linked closely to local mixed farming systems"(Smith 2006 p.451). As a reaction to this situation, other popular initiatives have in their turn developed, such as box schemes and farmers' markets. The literature stresses that new niche innovations, consumer and producer practices are emerging and presenting them self as alternatives to the present global food system, increasingly under pressure (Marsden 2012).

The case of the mainstream involvement in organic food illustrates further the perspectives raised in the literature on environmental management of firms. According to Haverkamp et al. companies have in fact made little progress in terms of paying attention to environmental issues in strategic planning and decision making. They argue that for the food and beverage sector in particular measures with respect to environmental management are short termed, internally instead of supply chain oriented, mainly "end of pipe" oriented and predominantly defensive instead of prospective (Haverkamp, Bremmers et al. 2010). Based on a study on the Dutch food and beverage industry, Haverkamp et al. concludes that the deployment of managerial capabilities that supports ecological modernisation in the industry (here in the meaning of supply chain cooperation and network information exchange, or product redesign) is rather low.

The study indicates that only a minority of companies were proactive with respect to environmental capability building. The policy implications of the findings suggest that generic measures focusing on voluntary cooperation, self-governance and market-induced innovation are only effective with respect to a minority of companies and not sufficiently effective in terms of stimulating environmental management performance in the sector. According to Haverkamp et al. a differentiation of public policy is needed and should be based on the understanding of drivers of managerial behaviour. Moreover, public environmental policy with respect to the food and beverage industry should be adjusted to discernable managerial patterns and categories of companies. The conclusions challenge established views of ecological modernisation which relies on the self-regulating ability of industries (Haverkamp, Bremmers et al. 2010).

5 Effects on sustainability and competitiveness

The reviewed literature provides significant evidence on the negative contribution of the current food system to global GHG emissions. (Sundkvist, Milestad et al. 2005, Coley, Howard et al. 2009, Garnett 2011). While there are estimates to calculate global GHG emissions arising from global agriculture production there are no corresponding studies that quantify emissions from the global food chain (Garnett 2011). Nevertheless, there exist regional and national accounts, which illustrate the magnitude of the climate impact of food.

Based on a regional analysis it was found that food accounts for 31% of EU-25's total GHG impacts (Garnett 2011). Other studies estimating emissions in developed countries at national level find that food consumption contributes between 15% and 28% to overall national emissions (ibid). According to Garnett it is not possible to make meaningful comparisons between different countries as food emission estimates vary due to differences in methodological approaches, the placement of boundaries, assumptions made and the quality of the data obtained. Life cycle assessments of individual food products are though more abundant and suggest that meat and dairy products, air freighted foods carry the highest GHG emissions (Garnett 2011).

To measure emissions from particular industries is neither a straightforward exercise. In fact, measuring the environmental effects and environmental progress of environmental industries (defined as those involved with the protection and preservation of the natural environment) has shown to be problematic. Beneficial environmental effects related to the operation of these type of industries can easily be overstated. For instance, the high growth of the organic food market is generally viewed as highly positive and as a positive indicator of environmental activities' evolution. It is however important to consider the often very low initial figures. Hence, large percentage increases may actually mean only moderate growth in absolute terms. Moreover, it is important to consider the process behind the production. (Aragon-Correa and Rubio-Lopez 2007 p.364). In fact, as explained by Aragon-Correa et al., *large scale* organic food production may actually generate harmful effects such as significant transport or waste emissions and marginalising smaller producers (Aragon-Correa and Rubio-Lopez 2007).

As mentioned in earlier sections, the number of environmental standards and the number of certified industries have increased rapidly in recent years. The rationale of the certifications is that firms, by voluntary participation should develop proactive environmental strategies. However, contrary to the stated aim of the certifications there is growing evidence that highlight problematic effects related to environmental certification. For instance, Aragon-Correa finds evidence of a non-significant relationship between emissions and EMAS certified environmental management systems (Aragon-Correa and

Rubio-Lopez 2007). A main shortcoming of environmental standards appears to be that they do not put any requirements on firms' actual environmental output progress but are limited to measure process intentions.

6 Discussion and conclusions

The literature review presents facts and results from different studies and analyses that indicate that policy instruments and regulations have had a limited role in directing the food industry towards environmental sustainability. Despite being a heavily regulated sector, the food industry continues to be a major source of GHG emissions through the value chain and at the same time creating serious impacts on ecosystems and society. During the last three decades, the food industry has become increasingly global and characterised by the dominance of large retailers controlling entire product supply chains. At the same time, the global sourcing of foods has limited the regulatory reach of national governments. On the other hand, results indicate that policy instruments and regulations have an important role in supporting the implementation of needed sustainable process technologies. There are nevertheless, examples of large retailers now taking active initiatives to improve sustainability. The literature also points at the necessity to focus not only on technological improvements but to consider social, cultural, economic and geographical context when designing policy measures aiming at reducing emissions from the food industry.

Moreover, the literature highlights the importance of consumers and the need to improve information flows in the value chain. The introduction of eco-labels as a means to improve consumer information has been effective in certain countries (KRAV in Sweden) but the success of such measures is strongly dependent on the level of trust it conveys to consumers and society. Studies suggest that if substantial reductions in food related GHG emissions are to be achieved, policy makers inevitably need to address changes in consumption patterns. However, few policies seem currently to exist that address changes in this direction. How changes in behaviour actually can be achieved remain however largely a question for further investigation. The rationale of the current economic development paradigm based on a “growth-consumption” model is used to explain the lack of political initiative in this context.

The literature devotes relatively large attention to the role of environmental standards and certifications in mitigating the food sectors environmental impacts. Studies show that voluntary standards have not been successful tool in fostering a sustainable food industry. An explanation of their failure is that they rarely measure real output progress.

National energy and infrastructure policies will ultimately need to be changed if drastic carbon emission reductions are to be achieved. Energy efficiency measures, the use of cleaner and renewable fuels and an effective use of resources are important options to reduce emissions originating from the food chain.

Food actors have responded differently to the concerns and tensions related to health, safety and environment impacts. The emergence of organic food producers is a result of consumer’s reaction to mainstream food practices and to recurring scandals stemming from the food system. While organic foods have become steadily popular and part of many supermarkets’ regular product supply, the

literature questions the actual benefits for the environment and society of the growth of large-scale and retailer led organic food production.

Fluctuations in the price of oil and rising/more volatile raw material prices has had an impact on food companies' competitiveness. Moreover, with the entrance of new actors from Asia and South America many food companies in the Western World face the challenge of shrinking market shares. The exponential growth of the food sector in past decades, largely a result of increased liberalisation of trading regulations and the abundant availability of fossil fuels, is today facing re-emerging challenges in terms of food scarcity. The problem of overproduction of food during the last three decades has recently turned into a global problem of food security/scarcity. Compared to the past, the current system presents more and diverse regulatory challenges. The literature indicates that this situation demands more proactive national and supranational governments.

As suggested in the literature, policy initiatives that address the role of the food sector in mitigating climate change appear to, currently be in their infancy and largely focussed on the primary stages of the value chain. This situation may also reflect the lack of articles addressing the role of existing policy instruments (national and international) in supporting the food industry to become more environmentally sustainable. On the other hand, abundant articles were found that addressed issues related to food safety, food health and nutrition. This has clearly been a limitation of this review.

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