

Abstract number: 020-0292

Sustainability in the food supply chain: evidences from the Italian beef industry

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POMS 22nd Annual Conference
Reno, Nevada, U.S.A.
April 29 to May 2, 2011

Abstract

Sustainability in supply chains is a relevant but complex topic to study, especially when considering at the same time the three pillars of sustainability, namely social, environmental and economical. In particular there are many evidences that it is not only a matter of the decisions taken by companies individually, but it is more related to how the whole supply chain, including the market and the regulator, behaves (Seuring and Muller, 2008). Given the strong differences from industry to industry, we focused on the Italian beef supply chain that is relevant for its impact on the economy, the environment and the health of people. Through a set of case studies of companies at different stages of the chain we identified the sustainability practices put in place and which are the triggers - in particular if they come from inside or outside the company - and the related implications.

Introduction

With the Brundtland Declaration of 1987 the definition of sustainable development was introduced as meeting “the needs of the present without compromising the ability of future generations to meet their own needs”. Overtime, this definition led researchers to converge over the idea of the three pillars of sustainability stated at the 2005 World Summit and defined by Elkington (1998, 2004).

The basic idea is that to reach such sustainable development, any developmental action should consider not only the economical side, but also the social and environmental one.

Starting from this seminal idea, many studies have been developed over time with increasing intensity on this topic. Sustainability is a relevant topic in several sectors such as manufacturing (Seuring, 2004; Zhu et al., 2008), food industry (e.g. Elkington, 1998; Hamprecht et. al, 2005) and oil and gas sector (e.g. Matos and Hall, 2007), agriculture (e.g. Seuring and Müller, 2008). Previous contributions have shown that, when studying sustainability, several perspectives can be taken from policy making to marketing and operations management. Moreover, different industries show different characteristics in terms of sustainability. Because of that, we positioned our paper inside a specific research stream and focusing on one industry.

In particular, we aim at analyzing sustainability from an operations management perspective, so focusing on what companies can do and how they can leverage sustainability to increase their competitiveness. More in detail, we took a supply chain perspective, as sustainability issues should be solved not locally, but globally along the supply chain (Seuring and Müller, 2008). In particular, we adopted a value chain perspective so to analyze the characteristics of the networks that characterize the industry. Moreover, we focused on one sector of the food industry that is the beef production that has a relevant economic impact and shows several critical points in terms of sustainability.

Given this positioning and starting from the literature, in this paper we aim at analyzing the beef industry value chain and identify which are the critical points for every stage in terms of economical, environmental and social sustainability. Moreover, through a set of case studies of companies at the different stages of the supply chain we identified what actions are put in place to address sustainability critical points and what are their effects. Finally, thanks to the supply chain perspective, we could analyze if these actions are induced and/or affect other players along the supply chain.

The remainder of the paper is organized as follows. In the literature review we will report the main contributions analyzing the food supply chain and then the Italian beef supply chain, with specific reference to sustainability critical points. Next, we will detail the objectives and methodology of this work. After that, the results are explained and, finally, discussion and conclusions are drawn.

Literature review

The Food Supply Chain

According to the literature, the food industry has a relevant economic impact (Stock, 2004) and shows many critical aspects in terms of environmental and social sustainability (Yakovleva and Flynn, 2004). The main issues in terms of sustainability that the food industry is facing nowadays are related to the following factors: price fluctuations (Van Der Ploeg, 2010); intensive agriculture (Brussaard et al., 2010); food safety (Trienekens and Zuurbier, 2008; Wilson and Clarke, 1998). Because of that, governments and organization defined several industry standards or guidelines to address these issues (e.g. GRI, USDA, DEFRA, WWF).

On the other side, also companies started to react to these critical points. As a consequence, many authors developed researches in the following areas:

- Food value chain analysis (Francis et al., 2008; Taylor, 2005)
- Food safety and traceability in the supply chain (Wilson and Clarke, 1998)
- Partnerships along food supply chains (Fearne, 1998)
- Sustainability drivers in the food supply chain (Calker et al., 2005; Hamprecht et al., 2005)
- Alternative agro-food networks (Murdoch, 2000)

A common trait of the mentioned researches is that they take into account the entire supply chain, as, on average, distributors have the higher bargaining power, but upstream stages (e.g. growers) are those under the major economical, social and environmental stress (Lowe and Gereffi, 2009).

A food supply chain is composed by hundreds of actors engaged in the activities from growing to processing and distributing food. Because of the complexity and the high number of actors, literature often refers to it as the food supply network - FSN (Van der Vorst et al., 2000).

However, the main actors operating in the network can be grouped into three main segments: agricultural (e.g. feeders, growers), industrial (e.g. food processors, slaughters), and distribution (e.g. wholesalers, retailers). Despite this general categorization, FSN can vary significantly for different types of food products (Den Ouden et al., 1996; Van der Vorst et al., 2000). In particular, we can identify two typologies of FSNs (Smith, 2008): fresh products (e.g. fruits and vegetables, flowers) that get to the market with little or no processing; and processed food (e.g. dairy, snacks, sweets, beef) that are subject to a meaningful content of industrial activity. Among this second category, we can identify fast perishable goods (e.g. meat, bread) that should be sold in days and slow perishable goods (e.g. cans, frozen).

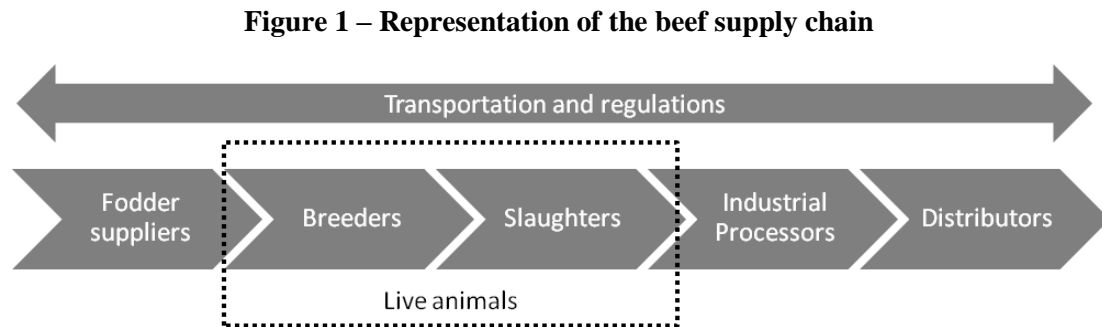
Moreover, different FSNs can be subject to different regulations. For example, in the meat supply chain, the transportation and feeding of live animals must be compliant to some specific regulations.

Given these differences in the supply networks, we decided to focus on one specific industry that is the beef production industry. This industry and its supply chain are described in the next chapter with specific reference to Italy where the analysis has been conducted. Italian regulations are essentially similar to European ones, thus most of the following considerations can, at least partially, be considered valid also for others European countries.

The Italian beef supply chain

The beef production industry is particularly relevant for the agri-food system in Italy. Italy is the third European producer of beef and the second one in terms of consumption.

Previous studies in the beef supply chain highlighted the following stages (Francis et al., 2008; Lowe and Gereffi, 2009): fodder suppliers; growers; slaughters; industrial processors; distributors (Figure 1).



Data from the referential associations (Eurostat, Ismea, Osservatorio Agri&Food di CremonaFiere, Mipaaf) report that in Italy, this supply chain is characterized by a high numbers of breeders, while the other stages are more concentrated. Slaughters should follow strict veterinary controls and regulations, so that small slaughterhouses are closing in favor of few big companies. Also the distribution side is dominated by few big retailers that are always more substituting small points of sale. In 2010, in Italy, were operating 80,000 stock farms, 2,200 slaughterhouses and about 50,000 points of sales of which about half belong to large retailers groups (Istat).

The Italian beef supply chain is characterized by producing, on average, high quality meat, but with breeding costs that are fairly high. Because of that, the dominant model is the intensive breeding, in order to reduce costs. Moreover, given a lack of competences in the system, calves and bullocks are mainly imported from France (Istat, Eurostat, Ismea). Moreover, given the high demand, meat is also imported from abroad, mainly South America and Eastern Europe.

Transportation and regulations characterize all the stages of the supply chain, specifically those who involve live animals (breeding and slaughtering). Furthermore, companies in the supply chain must keep the traceability of the products.

Research objectives

Despite the literature developed so far, gaps still remains in the sustainable food supply chains development, in particular, in the beef supply chain. In particular, limited evidence can be found concerning the critical points that this supply chain may show. As pointed out by Seuring and Müller (2008), it is important to consider not only companies, but also their supply chain. In particular sustainability issues can occur not only within one company, but also between two companies in the management of their interface. This problem is more critical and significant when the different sustainability pillars are considered together. Based on this consideration, our first research question is:

RQ1. Which are the main critical points in terms of economical, environmental and social sustainability along the Italian beef supply chain?

Several studies focused on the analysis from the industry or policy making perspective (Francis et al., 2008), but few works concentrate on what companies can do and which are the impacts on sustainability performance. In particular, there is an ongoing debate in current literature about the existence of trade-offs between profitability and sustainability. Some authors say that that actions concentrated on environmental performance improvement can increase also the competitiveness of companies (Porter and Van der Linde, 1995). On the contrary, other contributions highlight that trade-offs may exist, for example in the terrain exploitation and productivity. Given this gap in the literature, on the basis of the previously identified critical points, we aim at identifying which actions companies take at the different stages of the supply chain and which are the impacts on sustainability performance. Given this objective, our second research question is:

RQ2. Which are the actions undertaken by companies at the different stages of the supply chain and how do they impact on sustainability performance?

Finally, several authors pointed out that improvements in the supply chain, also in terms of sustainability, are often triggered by focal companies (Gereffi et al., 2005; Seuring and Müller, 2008) or by the regulatory environment (Linton et al., 2007) . Actions can then affect other actors along the value chain. Because of that, we aim at exploring whether actions taken by companies to improve sustainability performance are triggered by a third party, namely the lead firm or regulations. Thus, the third research question we investigate is:

RQ3. Are undertaken actions triggered by internal or external causes and what are the impacts on the other actors along the supply chain?

Methodology

In order to answer to the first research question, we performed a content analysis from secondary sources. Information from the websites of the beef industry associations and from sector laws has been recorded. In this way, we identified a list of sustainability critical points inside the supply chain. Then we applied a very simple classification scheme based on the phase in the supply chain and the affected sustainability pillar. We associated critical points to sustainability pillars basing on the most consolidated framework in the food sustainability field. For example, animals' well-being has been considered into the social pillar. We also validated our analysis through interviews to industry experts and preliminary case studies.

Next, to answer to the second and third research questions, we interviewed a set of companies involved in the different stages of the supply chain (SC). Following the practice described by Eisenhardt (1989) and Yin (2009) we selected cases according to different criteria looking for theoretical and literal replication. Literal replication is the expectation that similar cases will produce similar results, while theoretical replication is the expectation that cases will provide different results but for predictable reasons. In our case, we selected companies of different sizes with different levels of vertical integration.

We interviewed one or two people from the company with visibility on the SC activities. An interview protocol was followed in order to check whether all the relevant information was collected. Moreover the interviewees were free to give further information to avoid missing some relevant elements. In particular, we asked companies an assessment of their sustainability situation and commitment. Next, we asked which actions they put in place to respond to the sustainability criticalities previously identified and what are the impacts in terms of sustainability performance. Finally, we asked whether these actions were pushed by internal or external actors (i.e. lead firms and or regulations) and which effect they have on other actors along the supply chain (upstream or downstream).

Table 1 reports the descriptive information for the case studies.

Table 1 – Case studies description

Case Name	Position in the SC	Brief description
Case A	Processing and distribution	Wholesaler of a broad range of agricultural products.
Case B	Breeding, processing and distribution	Medium enterprise, highly vertically integrated.
Case C	Distribution	Large national retailer.
Case D	Breeding	Small breeding company.
Case E	Slaughtering, processing and distribution	Medium company. Slaughtering represents the core business.
Case F	Processing and distribution	Medium company, they cut and distribute meat.
Case G	Breeding, slaughtering, processing and distribution	Family business highly vertically integrated. They directly sell the products to the final market.

Since many companies are vertically integrated, we could have more companies for the same supply chain stage (Figure 2).

Figure 2 – Activities performed by case studies along the supply chain

	Fodder suppliers	Breeders	Slaughters	Industrial Processors	Distributors
Case A					
Case B					
Case C					
Case D					
Case E					
Case F					
Case G					

We coded the information collected as represented in the table in appendix. Basically, for each supply chain stage, we reported the sustainability domain (economical, environmental or social) and critical points previously identified. Then for each critical point we reported cases and the action they put in place to address that critical point, if any. Next, which is the impact on the economical, environmental and social performance is assessed. Finally, for each action we asked whether the trigger came from an internal decision or an external pressure is identified.

Results

Sustainability critical points in the supply chain

Answering to the first research question led to the identification of a series of critical points in the value chain in terms of environmental, social and economical sustainability (Figure 3).

Figure 3 – Sustainability critical points along the supply chain

	Fodder suppliers	Breeders	Slaughters	Industrial Processors	Distributors
Environmental		Waste disposal			Packaging
	Intensive agriculture/farming model				
Social		Traceability, food safety and hygiene			
		Animals well-being			
		Workers' skills and satisfaction			
		Social reputation			
Economical	Concentration		Concentration		Concentration
		Low margins			
		Dependency on imports			

Interestingly, some critical points are shared by different stages in the VC, while others are specific for one stage. Moreover, as better detailed in the following description, regulations associated to several of these critical points exist in order to keep the supply chain under control.

In terms of environmental sustainability, first of all we identified waste disposal: this is an issue that affects almost all the supply chain stages other than the distribution and fodder supply. Players usually should follow regulations that are specific for their sector. Intensive agricultural models represent the next issue: companies in the fodder supplying and breeding usually adopt intensive agricultural models that can create pollution and degrade natural resources.

In terms of social sustainability, it is important first of all to keep a high food safety. This is usually guaranteed by traceability and hygienic normative. Next, animals' well-being represents a critical point specific for the phases that involve the living stock. Furthermore, workers' skills and satisfaction is another issue in terms of social sustainability. For example, in the industrial processing of the carcass, it is important to have a high skill in order to cut the meat in the right way. Satisfaction of employees is another important aspect and not easy to obtain in contexts like slaughterhouses. Finally, social reputation of companies operating in the meat industry is important as, in past, the public opinion badly reacted to animals mistreatments.

In terms of economical sustainability, we identified that this sector is characterized by several sub-sectors with a high concentration level, namely fodder suppliers, slaughterhouses and distribution. On the contrary, breeders operate in a fragmented market. As a consequence, despite the high value added they provide, breeders have, in percentage, the lowest margins. This is related also to the fact that breeders import grown-up calves losing part of the value added they could provide.

Sustainability actions and impacts

After the identification of the main critical points in terms of sustainability at the different stages, we moved to analyze which actions companies undertake to face such problems and which are the impacts on sustainability performance.

Starting from the fodder suppliers, in our sample we have only companies that self-produce fodder for their living stock. In terms of environmental sustainability, the two companies involved in this phase try to reduce the impact of the intensive agricultural model by following the agricultural Best Management Practices guidelines. By doing this, growers can also enjoy better working conditions (positive social impact), reduce costs and allow their activity to be performed in the long run (positive economical impact). Moving towards social sustainability, companies have the direct control of the fodder they give to their living stock, improving traceability. Finally, from the economical sustainability perspective, self-producing fodder allows to be independent from multinational suppliers with a positive effect on the company's margins.

Next, we have breeders. Companies usually overcome the problem of waste disposal by using the sewage for their fields (cases D and G) or those of local growers (case B). In terms of intensive farming model, companies are just complaint to the European regulation about minimal spaces for the animals. Besides avoiding hazardous conditions, this keeps an acceptable level of workers satisfaction and animals' well-being (social impacts) and avoids meat deterioration (economical and social impact). On the other side, companies cannot avoid to use the intensive farming model otherwise costs to raise cattle would be too high (trade-off effect). In terms of social sustainability, all the companies interviewed respect the standards of traceability and hygiene with positive impacts also on workers satisfaction. For the animals' well-being, Case B is particularly active in selecting fodder, rotate animals among boxes and keep everything clean. However, overall this induces higher costs, even if it partially reduces vet control costs. Moreover, they also try to keep a high social reputation avoiding any mistreat to animals, especially during transportation of ill

animals. In terms of economical sustainability, companies try to reduce their low margin position in different ways. Some of them integrated vertically upstream (Case D), downstream (Case B) or both (Case G). On average, all the interviewed cases try to differentiate, especially from foreign competitors, aiming at higher quality products through fodder selection, imported calves selection and breeding conditions.

Slaughterhouses are subject to strict regulations imposed by the waste disposal and hygienic normative. For the wastes, they usually rely on specialized external companies and they try to take care of the animals' well-being before it is killed. This has also an economical impact as stress can make the meat worse. Anyway, workers and animals conditions represent still an issue on which interviewed companies are working on. Given the high costs induced also by the environmental normative, this sector is under a concentration process which creates for the interviewed cases (Case D and G) a tough competition.

Since slaughterhouses just kill and halve the animal, a further processing is needed that is basically made of cutting the meat in pieces and packing it. Almost all of the interviewed companies perform this phase beside Case D. Also Case C, which is a large retailer, created a platform to directly manage this activity supported by some external suppliers. Waste disposal is still a critical element to be managed. The majority of the companies lets an external specialized company to do this activity with the beneficial effect that wastes collection is centralized and managed more efficiently. Moreover, wastes can be sold for other uses with some positive economical impact. In this phase working conditions and hygienic standards are critical to preserve food safety and workers satisfaction (positive social impact), despite higher costs (negative economic impact). Traceability, towards an appropriate labeling is also fundamental. Finally, it is critical to keep and enhance workers' skills since cutting can affect meat quality (positive economic impact).

Distribution, the last phase, it is dominated by large retailers (as Company C), but all the interviewed companies involved in the processing phase also perform some kind of distribution. All

the companies that have significant use of trays and boxes to transport meat have in place system to wash and reuse such systems (Cases A, B, F). This also improves food safety, hygienic conditions (positive social impact) and reduces costs (positive economical impact). The whole distribution phase is subject to regulations about food safety and hygienic conditions, in particular about refrigeration chain that necessarily increases operational costs. The technique of conservation in vacuum or modified atmosphere is adopted by all the companies involved at this stage as it preserves food at an economically viable price. In terms of economical sustainability, especially smaller companies cannot compete with large retailers. Because of that some of them (Case E, for example) directly sell the product staying independent from large retailers. In this way, leveraging on a higher quality product, they can keep more margin than selling through wholesalers and retailers.

Cross-phase impacts

The last analysis we performed was aimed to check for cross-phase impacts (Table 2). What we observe is that upstream phases strongly contribute to food quality. Beside an obvious effect on the quality of sold meet, when food is of high quality it facilitates the activities for downstream players and allows higher selling prices.

Then, the only synergy identified that moves upstream is related to the use that fodder suppliers can make of manure from breeders. In the other cases, players in concentrated phases tend to control upstream phases. This happens with slaughters that exert some control on breeders, but also with distributors which tend to sign agreements and impose standards to the players upstream.

Table 2 – Cross-impacts of sustainability actions along the chain. On the rows is reported who takes the actions; on the columns how other stages are affected by that action.

	Fodder suppliers	Breeders	Slaughters	Industrial Processors	Distributors
Fodder suppliers		The fodder quality affects meat quality, animals well-being and procurement cost.	Healthy animals and high quality meat reduce costs and hazards.	High quality meat makes easier the processing.	Higher quality meat translates to higher selling prices.
Breeders	Manure can be used to fertilize fields. A good balance between land used for animals and land used for fodder allows minimal costs and environmental impact		Healthy animals and high quality meat reduce costs and hazards.	High quality meat makes easier the processing.	Higher quality meat translates to higher selling prices.
Slaughters		Slaughters tend to control breeders so they can have the meat as required		A good slaughtering phase makes the processing easier.	Higher quality meat translates to higher selling prices.
Industrial Processors					Higher quality cut translates to higher selling prices.
Distributors		Agreements, imposition of standards	Agreements, imposition of standards	Agreements Creation of platforms to centralize transformation activity	

Discussion and conclusions

First of all, it is important to remark here that the interviewed companies are at the different stages of the supply chain and they have different degrees of vertical integration. This somewhat suggests that there are no common configurations, but each case is different.

Looking at Figure 3 we observe that some sustainability critical points are shared by several actors (e.g. waste management, food safety and traceability, social reputation). This suggests that when studying sustainability it is important to look at the whole chain as these transversal issues should be solved for the whole chain and not only for one stage only. Companies belonging to different stages might also cooperate or even vertically integrate to overcome some issues. For instance, we highlighted the advantages in terms of economical and environmental sustainability of managing together fodder production and breeding activities.

Starting from the identification of the critical points we moved to the analysis of the action performed by companies, the impacts and the triggers. It emerges that the majority of the actions is triggered by external regulations or by internal economical reasons. Companies seldom declared that their actions were mainly aimed at improving their sustainability performance. Moreover, nobody in the chain pushes other actors to adopt sustainable practices over what is imposed by the normative even if there can be positive outcomes for the whole chain (Table 2).

However, it is interesting to notice that for many stages there is the possibility to invest in environmental sustainability with benefits also on economical and social performance. On the contrary, social sustainability actions, especially those aimed to better animals' conditions, tend to negatively impact economical performance. This highlights the existence of complex relationships between the sustainability pillars. Apparently, environmental sustainability can be positively related with the other two pillars, while social sustainability seems to be in trade-off with economical sustainability. Finally, actions aimed at improving the economical status, seem to be rather independent from the other two pillars.

Despite the different models, in conclusion, we can observe two basic typologies of companies: those who operate mainly in the chain driven by large retailers and those who prefer alternative distribution channels (e.g. Case G). Apparently, in the first one, players do not have strong incentives towards a higher sustainability other than keep an acceptable social reputation. Moreover, breeders, that are the players who could potentially do more for sustainability, are in the worse economical condition. However, evidences of this research suggest that players could reconsider this situation as upstream stages significantly affect the whole chain (Table 2). In particular, lead firms – especially in the slaughtering and distribution phases - could help the economically weaker stages to identify those actions that can improve sustainability, reduce costs for the whole chain and improve the quality of the product.

Further developments of this work include the extension of the sustainability critical points identified including, for instance, land and other natural resources use and bio-diversity preservation. Moreover, the final market should be included as an important player which can affect and is affected by sustainability choices. Finally, we would like to interview more cases not only at the Italian, but also at the European scale.

Appendix

Supply Chain Stage	Sustainability domain	Critical point	Case	Action	Impact			Trigger	
					Economical	Environmental	Social	Internal	External
Fodder Supply	Environmental								
	Social								
	Economical								
...

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