Sustainability practices implementation and the multidimensional performance effect: the ´Balsamic Vinegar of Modena´ case

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Abstract
The aim of this study is to investigate the implementation of sustainability practices in the food supply chain and the effects that such practices can have on sustainability performances. The study is based in the analysis of seven cases in the ´Balsamic Vinegar of Modena´ supply chain. Companies in the sector apply diverse sustainability practices but differ in their approach to focus in one or more sustainability dimensions. Regarding sustainability performances, most of the practices implemented have multi-dimensional effects, which makes the sustainability performance assessment highly complex, and difficult for companies to identify what to measure and how.

Keywords: sustainability performance, food supply chain, certified product

Introduction and research background
Food supply chains (FSCs) involve companies responsible for the production and distribution of vegetable or animal-based products (van der Vorst, 2006). In the last decade, sustainability has become increasingly important for companies in the food supply chains because they deal with several issues such as food and packaging waste; land, energy and water consumption; food safety insurance; unfair trade relationships (Fritz and Schiefer, 2008). Consumers and stakeholders´ requirements regarding sustainability in this industry are among the most demanding (FAO, 2013), hence, consumers and government agencies are paying growing attention to the social and environmental performance of the players in this industry (Maloni and Brown, 2006; Deblonde et al., 2007),

Food supply chains face numerous challenges regarding health, hunger, malnutrition, waste, environment, rural support and animal welfare (European Commission, 2014a; FAO, 2013). Moreover, food provision is considered as the activity with the largest environmental impact (Smil, 2001). Accordingly, companies have defined sustainability practices as a response to strict regulations, consumers´ expectations and to search for competitiveness (Taticchi et al. 2013). Literature has identified the main sustainability

practices of FSCs related for instance to manufacturing, logistics and transportation management, competence development, working conditions and stakeholder management (Walker et al., 2008). Moreover, given that food supply chains are becoming global, the effects multiply, entailing increased coordination, collaboration and support (Beske et al. 2014).

Sustainability performance measurement has been studied in literature as key to evaluate whether sustainability goals and stakeholder requirements are achieved (Beske-Janssen et al. 2015; Grosvold et al. 2014; Schaltegger and Burritt, 2014; Taticchi et al. 2013). On one hand, previous literature proposed many indicators and measures to assess sustainability performance (e.g., GRI Model). On the other hand, the industry defined several tools to ensure the supply chain transparency and visibility (Beske-Janssen et al. 2005; Taticchi et al. 2013). Within this context, it is difficult to assess how different sustainability practices are related to company performance. In an industry characterized by multi-dimensional practices, companies struggle to identify what to measure and how (Bourne et al. 2002). Most of the literature has investigated impact of a single practice on a single performance, without a multi-dimensional analysis. Moreover, researchers have studied different actors in different stages of the FSCs having different sustainability challenges and thus, companies implement different practices requiring with different tools to measure the performance (Golini et al., 2016).

Therefore, the main literature gap to be addressed in this study is the need of a framework to support companies in identifying the measures to be used at different levels of the supply chain, considering especially multi-dimensional impacts. Thereby, with a multiple case study analysis, this paper aims at investigating the multi-dimensional effect of sustainable practices on FSC sustainability. The paper is organized as follows: in next section the research goal and design are reported; then the methodology is described. Following, it illustrates the main findings of the cross-case analysis and then conclusions end the paper.

Research design

This study investigates the implementation of sustainability practices in a specific product supply chain and the effects that such practices might have into companies´ sustainability performances. Thus, the study intends to answer the following research question:

What are the multi-dimensional effects of sustainable practices on SC sustainability performances?

Two main groups of constructs will be used for answering the research question proposed. The first one refers to the sustainability practices that a company in any stage of the food supply chain could apply. For the aim in this study we consider the categorization proposed by León-Bravo et al. (2017) who compiled practices in the triple bottom line, specifically including elements relevant to food industry (See Table 1).

Following, for the second group of variables we bear in mind the framework proposed by Varsei et al. (2014) regarding the multiple dimensions of sustainability performances to be considered in supply chain studies:

- Economic performance: Supply chain cost (SCC), Service level and customer satisfaction (SL).
- Social performance: Labor practices & decent work (LP), Human rights (HR), Society care and enforcement (SE), Product responsibility (PR).
- Environmental performance: GHG emissions (GHG), Water usage (WU), Energy consumption (EC), Waste generation (WG), Use of hazardous and toxic substances (HTS)

Table 1. Sustainability practices in food industry (León- Bravo et al. 2017)

Sustainability dimension		Example of Practices
Environment	Natural Resources conservation (NRC)	Animal Welfare: Elimination of cruelty; safe handling, housing, slaughter and transport Soil conservation: Conservation forest, species; prevent soil erosion and pollution, prevent loss of arable land and biodiversity, responsible farming methods (reducing fertilizer and pesticides), elimination of contaminant and pollutant agents Water conservation: reducing water consumption, efficient water use, waste water re-use and recovery
	Green processing, packaging and transportation (GPPT)	Design, materials and packaging: effective design for reuse and recycling, use of design for disassembly and reuse, material reuse and recycle, reducing packaging, using reusable/ recyclable packaging Waste: reduce waste and hazardous materials, composting organic waste, producing renewable energy or animal feed with waste, lower disposal costs, damage compensation, recycling Processing and transportation: reducing energy use, conservation of energy, reducing CO2 emissions and GHGs, reduce pollution, reduction of fuel consumption
Social	Health and Safety (H&S)	Improved product quality, food safety, food security, traceability and transparency. Promotion of healthy life styles and local food sources. Safer warehousing and transportation
	Work and Human Rights (W&HR)	Better working conditions that result in higher levels of motivation and productivity and less absenteeism. Training, education, advancement. Regular employment, elimination of illegal and child labor, respect of worker rights, gender equality, freedom of association, safe working conditions
	Community	Donation, collaboration with NGOs, philanthropy, support to the economic development in local communities, educational practices, health care, job training, volunteering, childcare
Economic	Sustainable sourcing (SS)	Increasing supplier diversity, confidentiality, eliminating deception and impropriety, transparency, proper purchasing processes (reciprocity, fairness, no power abuse or special treatment), supplier's labor programs, local sourcing that result in shorter lead-times. Environmental and social considerations when selecting, monitoring and controlling suppliers.
	Support SC partners	Profit sharing with actors in the upstream SC, premium price payment, support and monitoring for obtaining sustainability certification. Facilitate partners' access to markets, knowledge and technology transfer, fostering financing opportunities, information and expertise sharing.

Methodology

The study is based on the analysis of the Balsamic Vinegar of Modena (BVM) industry. Information was collected from multiple companies and industry experts, that way, building a multiple case study base. The analysis is focused to characterize the sustainability practices implementation in this supply chain and performances related,

through pattern and relationships recognition among the cases studied and as a result of the within case and cross case analysis (Voss et al., 2002, Eisenhardt and Graebner, 2007, Yin, 2008)

Data collection and analysis

The Balsamic Vinegar of Modena is one of the main PDO and PGI products made in Italy (Consortium Balsamic Vinegar of Modena, 2016). The PDO (i.e., Product Designation of Origin) and PGI (i.e., Product Geographical Indication) labels represent two of the three European quality schemes that have a specific link to the region where the product comes from (European Commission, 2017). The BVM sector produces more than 90 million liters per year, from which up to 90% is exported to 120 countries around the world. Such production volumes represent more approximately 1 billion Euros turnover (Consortium Balsamic Vinegar of Modena, 2016). Data from the BVM Consortium reports 50 companies associated, 62 must concentrators, 72 vinegar plants and 177 packers. In this industry, the bottlers are the focal companies as they have higher market shares and they drive the application of certain practices and compliance to the PGI certifications along the chain.

Three industry experts were interviewed in a first data collection wave, then a set of seven companies were selected with the objective to cover most of the activities in the supply chain, and most of the business participation in the sector. The cases selected sum up to 50% market share (See Table 2). These companies work in different parts of the supply chain, from the manufacturing, must concentrating, aging, bottling, vinegar production, to raw material supplying (See Figure 1). Data was collected by means of semi-structured interviews, and for validity purposes, data was also gathered from secondary sources as websites, sustainability reports, and also triangulated with company visits and the industry expert's insights (Voss et al., 2002; Yin, 2008).

Table 2. General information of the interviewed companies and experts

Data source	Interviewee	Firm Revenue[1]	Role in the SC
Company A	CEO & Main Shareholder	21 ML €	Focal Company
Company B	CEO & Main Shareholder	15 ML€	Focal Company
Company C	CEO	100 ML€	Focal Company
Company D	CEO	5ML€	Focal Company
Company E	CEO	12ML €	First tier supplier
Company F	CEO	100 ML€	Second tier supplier
Company G	President	110 ML€	Focal Company
Industry expert	Business Consultant	-	-
BVM Consortium	General Director	-	-
Industry expert	Advisor: Traditional BVM Consortium	-	-

[1] Financial data gathered from 2014 Firm Balance sheets available on AIDA database Bueau Van Dijk.

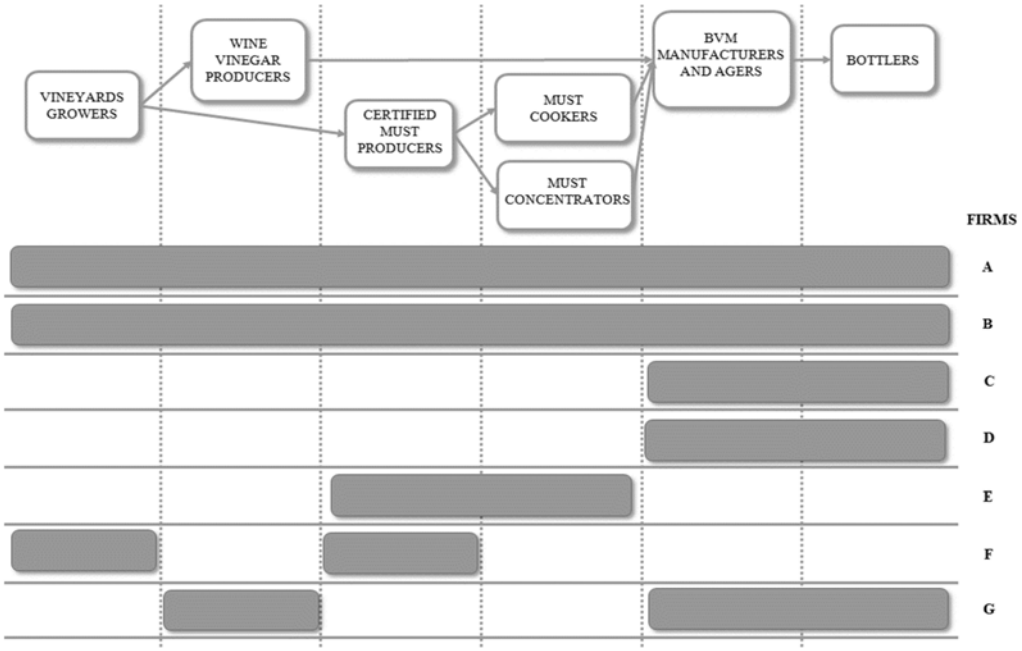

Figure 1. Companies´ distribution along the BVM supply chain

Findings and Discussion

A total of 35 different sustainability practices were identified across the cases studied in the BVM supply chain. The practices are implemented in the three sustainability dimensions: environmental, social and economic with different concentrations depending on the company´s interests or capabilities.

For instance, Company B, one of the most integrated firms in the sample, shows to be one of the most committed to sustainability (in terms of number of practices implemented). The company exhibits a wide spectrum of sustainability practices. One of the initiatives the company is proud of regards the decision to grow its own grapes in the Modena region for its own BVM production. This way, the company ensures the control of all the production steps until the bottling, also monitoring each activity and guaranteeing the expected quality levels. As its CEO declared: "*the decision to be integrated is the most sustainable decision*".

On the other hand, less integrated companies as company D (the smallest in the sample) and company G (the largest in the sample) are the second and third in number of sustainability practices implemented. These companies also spread their sustainability initiatives in the triple bottom line, however, their concentrations are divergent. Company D mostly focuses on economic practices while G combine its initiatives in the economic and social dimension. These examples show that regardless of vertical integration or company size, firms in the BVM supply chain are dedicated to sustainability in terms of number of practices implemented, but they differ on the decision to focus on one or more sustainability dimensions.

Nonetheless, the BVM supply chain commitment to sustainability cannot be taken for granted. Although companies implement certain practices along the triple bottom line, it does not mean that sustainability is part of their business strategy. For instance, company F is particular case in the sample because even though the company does apply few practices, it does mainly to comply with regulations and is not really interested in sustainability, as the interviewee mentioned: "*we don´t pay special attention to it {sustainability}, it is not worthy because customers only focus on price, then price and*

price". Therefore, company F´s business goal is to cut costs in order to satisfy its customers.

Furthermore, the aim of this study was to characterize the sustainability performance dimensions that are influenced by the sustainability practices implemented in the BVM supply chain. Beyond sustainability practices implementation, their performance measurement could be useful to demonstrate transparency and to ensure visibility, especially in food industry, where many customer and stakeholder´s expectations regarding sustainability exist. However, in the current state companies are not yet fully aware on how the practices adopted are related to different performances, if they are, and how to demonstrate their efforts to the market. Sustainability performance measurement and management is not part of their business management priorities yet.

From the data analysis, it was observed that practices implemented by companies in the BVM supply chain influence more than one performance dimension (See Annex A), that is, a multi-dimensional effect is present. For instance, *reducing fertilizers and pesticides* have an effect on supply chain cost (SCC) and also on product responsibility (PR), e.g., health and safety performance. This could have in turn, contradictory performance goals: production cost increases when sourcing alternative raw materials, but product safety increases as well, companies need to manage such different trade-offs, while at the moment, they do not.

Another example of multidimensional effects is the *raw materials local sourcing*, an economic practice, that is usually adopted with the objective of getting lower transportation costs (SCC), it could also help the company to ensure higher service level in terms of delivery time (SL). Moreover, with the same practice firms aim at safer products (PR) thanks to the easier suppliers' monitoring and control, while supporting local communities too (SE). Hence, this practice would have an effect on four different performance dimensions that would be worthy to evaluate with the application of appropriate indicators, as company D's CEO acknowledged. Moreover, the level of impact that each practice has on the identified performance dimensions should be determined as well, with the aim of prioritizing actions and measures according to the company´s main business objectives.

In this line, the analysis evidenced that sustainability practices' assessment is barely applied in the BVM supply chain. Given that companies work in different parts of the chain, with different productive processes, they apply different type of sustainability practices, the measurement becomes complex and resource demanding, interviewees explained. Companies in this FSC are not yet clear on how to assess sustainability and interviewees stated that is very difficult to understand how to do it in an efficient manner. Some companies might have a performance measurement system (as companies A, C and G), mainly for reporting to the Consortium, but not necessarily for evaluating the sustainability practices. As company A explained: "*All the larger firms probably have their own analysis, but there are no standards or common/shared indicators {for sustainability}*".

According to the varied sustainability practices applied, the assessment is expected to be heterogeneous and intertwined, thus, requiring specific information for applying measures, tools or systems that help with sustainability performance measurement. Still about company A, the interviewee mentioned that the IT system measures performances "*in terms of time, quality and cost*", and it would be extremely difficult to extract new measurements for sustainability purposes if the data is not already gathered in the existing system. Similarly, the other companies with an established performance measurement system, as companies C and G, explained that they store important amounts of data, but are not clear how to actually use it for sustainability performance management purposes.

On the other hand, companies without an IT system, as B and D (the smallest in the sample), explained that performance measurement is not a priority as they consider to have the processes already under control. However, given that sustainability implies to address multiple dimensions simultaneously, and that a certain practice could have an effect in more than one performance dimension, measurement and management becomes a challenge to be tackled. Companies in the BVM supply chain would first need to prioritize the sustainability practices to assess according to the company and industry performance goals. Then, they would need to identify the most appropriate measurement mechanisms in order to attain the expected performance. This would mean to build an efficient performance management that helps achieving better business results, and, to increase company visibility and transparency.

Conclusions

The paper has the goal to investigate the multi-dimensional impacts of sustainable practices on sustainable performance. Through the conduction of 7 case studies of companies in Balsamic Vinegar of Modena supply chain, the study provided an overview about the implementation of sustainability practices along different tiers of the supply chain and how those practices jointly impact on sustainability performances.

Although still exploratory, the paper provides some contribution to literature and practice. Firstly, this study contributes to the literature on sustainability performance measurement and management (Beske-Janssen et al. 2015; Grosvold et al. 2014; Schaltegger and Burritt, 2014) by identifying the multi-level effects of each sustainable practices, considering not only direct and expected benefits. The study also investigates a certified food supply chain, characterized by particular features regarding production, regulations and market (Taticchi et al. 2013). Moreover, it is observed that the special attention paid to social performance in this supply chain could have an effect on the overall sustainability in the production district that could be further analyzed. Literature is rich about the role of industry to improve side-effects and elements of collaboration but the influence on sustainability is still limited: additional research might be oriented to investigate this element.

Additionally, the paper might help practitioners to identify the multi-dimensional performance influenced by the variety of practices implemented. This result might support them in their sustainability journey for selecting the right practices to implement on the basis of the desired performance impacts. In this vein, findings could also help the identification of strategies for a sustainability performance measurement system and management: measuring the right KPIs consistently with the broader sustainability objectives.

The study has some limitations that open opportunities for further research. Firstly, knowing that companies operate at different supply chain tiers, the contingent variables in each tier influencing the choices in terms of practices and measures of KPIs could be studied. Secondly, the paper investigates the main practices and performance measures without providing a taxonomy of the main recurring approaches: further research could aim at identifying some possible standard archetypes. Thirdly, a main limitation of the paper regards the analysis of a single industry with a case based perspective: future research might be oriented to either compare results with other certified products or to validate current results through a statistical significant sample, with the goal to improve generalizability.

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Annex A:

			Areas of sustainability performance influenced by the sustainability practices implemented										
			Economic		Environmental					Social			
Sustainability practices			**SCC**	**SL**	**GHG**	**WU**	**EC**	**WG**	**HTS**	**LP**	**HR**	**SE**	**PR**
Environmental	**NRC**	Reducing fertilizer and pesticides	B	A,F					B				B
		Protecting biodiversity		B									
		Prevent soil erosion/pollution/salinization	B	B									
		Water efficient use	B,G	A									
	GPPT	Using recyclable/reusable packaging	C, G	C, G	G		G	G	G				
		Reducing packaging	G	G	G		G	G	G				
		Waste reduction	C		C			C					
		Composting all organic waste	B										
		Using waste as an input for other production processes	C				C					C	
		Reducing energy use	A,C,G		C,G		C,G						
		Recycling	C					C					
		Renewable energy use	A,B,C,G	C	G								
		Adopt technologies to reduce emissions	E		A								
		CO2 emissions and GHGs reduction	C,E,G		G		G						
		Transport optimization	C		C		C						
		Use of cleaner technology	E	E									
Social	**H&S**	Ensure transparency along the chain	G	B,D,F,G						G	G	G	D,G
		Health and safety certifications		B,F						B	B	B	B
		Standards and certification (Quality, Bio)	B,D	A,D							A	A	A,D
		Comply with environmental regulations		F									F
		Consumer education to more sustainable diets										A,C	
	W&HR	Ensure gender equality	B										

		Respect of Human Rights	B										
		Better working conditions	A,D							D			
	Community	Donations	B,D,G	D								D	D
		Collaboration with NGOs	B,D,G	D								D	D
		Protection of traditional knowledge	B	D								D	D
ECONOMIC	**SS**	Raw material local sourcing	A,B,D	A,B,D						D		D	D
		Shorter Supply Chain	A,B	B									
		Codes of conduct for selecting suppliers	C							C	C	C	
	Support SC partners	Develop and enhance relationship with virtuous suppliers	B,D,F	B,D							D	D	D
		Partner selection and development	B,D	B,D									
		Care for economic development of suppliers and local community	D	D						D	D	D	D
		Long-term relationships	D	D									
		Joint development	D	D									