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A template for sustainable food value chains

RESEARCH ARTICLE

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Abstract

This paper proposes a template to assist food value chain actors in their collaborative efforts to develop common sustainable strategies and business models. Inspired by the simplicity of the Business Model Canvas, the template reintroduces sustainable practices as a support for management solutions for sustainable food value chains. The template requires cooperation between actors and stakeholders and comprises three steps: (1) identification of needs for sustainability; (2) development of value chain practices aimed to deliver sustainable value, and assignment of responsibilities to actors for these practices; and (3) formulation of a sustainable value proposition. The template also allows a simple graphical representation of sustainability in value chains, which helps improve communication between actors, and allows stakeholders to be kept informed. The template is applied to a sustainable pork value chain to illustrate how it captures various aspects of sustainability in the pork industry.

Keywords: sustainability, food value chains, collaboration, business strategy, business model

JEL code: L21

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1. Introduction

It is estimated that to meet the nutritional needs of the world's population and ensure food security in, 2050, food production will have to be increased by 70% (Bruinsma, 2011). Meeting this target raises concerns about the ecological impact of food systems (Ericksen, 2008), food production significantly contributing to the human-induced environmental footprint (FAO, 2014a; Garnett, 2013). For example, in the European Union more than 20% of various environmental impacts are attributed to food (European Commission, 2006). The social implications of enhanced production also have to be considered, food systems providing income and social well-being for over one billion people worldwide (FAO, 2012). Intensified ecological and social stress underscores the necessity for a balanced, sustainable development of food systems based on the conservation, protection, and enhancement of natural ecosystems, and on the protection and improvement of livelihoods and social well-being of people engaged in food production (FAO, 2014a). Ultimately, sustainability can be seen as a prerequisite to ensuring food security in the long term (Berry *et al.*, 2015).

Although the development of sustainable policies is often considered to be a national-level agenda (FAO, 2014a), it is not only scientists, experts, or global agencies who recognize the need for a global shift towards sustainable development: food businesses and value chains are already experiencing increasing pressure from stakeholders and government regulations, urging them to seek ways to be more sustainable and responsible regarding their activities (Bloemhof *et al.*, 2015; Soosay *et al.*, 2012; Wognum *et al.*, 2011). Many authors argue that the advancement of a whole value chain towards sustainability is often more successful than unconnected actions by its individual actors (Lassale-de Salins *et al.*, 2014; Porter and Kramer, 2010). Such a value chain-based vision calls for new business models that allow alignment of stakeholder demands with activities of value chain actors in order to formulate a sustainably sound value proposition.

In the food industry, existing tools and approaches can assist specific aspects of modelling sustainability, such as identification of sustainable value, mostly with the aim of measuring it (FAO, 2013; Maloni and Brown, 2006), development of a conceptual view (Lassale-de Salins *et al.*, 2014), or can provide extensive guidelines that require specific expertise to facilitate sustainable implementation (FAO, 2014a,b; M4P, 2008). Applying tools, each designed for other purposes, to create a business model for sustainable food value chains would lead to a complex, time-consuming, and possibly inconsistent process, whereas the need for aligned performance requires mechanisms to facilitate collaboration among value chain actors.

In this light, we address the following research issue: how can we help actors in their collaborative efforts to create a vision and develop a model for sustainable food value chains? We pursued three objectives: (1) identify a vision and means for sustainability in the food industry, and in food value chains in particular; (2) develop a tool that assists the collaboration-based business modelling process, and definition of strategies for sustainable food value chains; and (3) illustrate the application of the proposed tool to an existing value chain.

This paper is in four parts. After an introduction, Part 2 discusses the evolution of sustainable thinking in business modelling, together with tools and approaches to assist sustainable modelling in food value chains. It concludes with a proposition for a template that synthesizes a vision of sustainability in food value chains to help actors in a food value chain rethink their strategies and business models in terms of sustainability. In Part 3, the application of this model to an existing pork value chain is demonstrated. Finally, Part 4 presents a discussion and conclusion on the advantages and limitations of the proposed template and case study.

2. Literature review

2.1 Sustainable thinking in business modelling

■ *Conventional business model*

Teece (2010) defines a business model as aiming to identify a market segment, formulate a relevant value proposition, and define how a business creates and delivers value to its customers while generating a profit. A business model serves to represent business strategy and ultimately assist in developing tactics (Casadesus-Masanell and Ricart, 2010). The Business Model Canvas (BMC) developed by Osterwalder and Pigneur (2010) is a concise graphical representation of generic business models. BMC is composed of nine building blocks that encompass the above aspects of business models: (1) business infrastructure (key partners, key activities, key resources, and cost structure); (2) market segments and customers (customer relationships, channels, customer segments, and revenue streams); and (3) value proposition.

BMC is a popular tool among managers because it allows both a description of existing businesses and the development of new ones. In addition, owing to its simplicity in visual representation, BMC is commonly used for communicating business strategy (Frick and Ali, 2013). However, with the rise of sustainable thinking in management science, the conventional understanding of business models such as BMC has appeared ill-suited to sustainable business modelling, because it tends to focus primarily on customer value (Bocken *et al.*, 2013), whereas sustainable thinking requires consideration of a wider range of stakeholders. Accordingly, a new vision has emerged, incorporating sustainability into the conventional understanding of business, and leading on to a conceptual transformation of business models.

■ *Stakeholder perspective*

The broad understanding of business sustainability is underpinned by the concept of the Triple Bottom Line (Elkington, 1999), which implies that sustainability requires the value proposition to be extended beyond a demand from potential customers. According to Triple Bottom Line, a sustainable value proposition incorporates interests of stakeholders representing three pillars of sustainability: business, society, and nature (Hart and Milstein, 2003). In food systems, an extended overview on the three pillars of TLB is represented by 'sustainable dimensions', along with more detailed indicators. For example, Maloni and Brown (2006) propose eight dimensions for food sustainability: animal welfare, biotechnology, health and safety, labor and human rights, procurement, fair trade, community, and environment. The United Nations Food and Agriculture Organization (FAO, 2013) proposes 118 indicators clustered in four main dimensions: environmental integrity, economic resilience, social well-being, and good governance. The sustainable dimensions typically represent an overview on relevant aspects of sustainability in the food sector, while indicators aim to assess sustainability both quantitatively and qualitatively.

The large number of indicators is explained by the diversity of sustainability issues, which depend on different contexts of specific value chains (animal or plant production, geographical contexts, institutional set-ups, etc.). Although many of the dimensions and indicators overlap, they differ overall, being based on the broad practical experience of the experts who propose them. Hence it is practically impossible to propose a definitive set of indicators that will fit all food value chains (FAO, 2013). These disparities create difficulties for actors operating within a specific food system context to implement sustainability. Hence the identification of the 'hotspots' for sustainability and adjustment of indicators and dimensions relies on the analysis of the specific food value chain, which can be based on literature reviews or direct communication with stakeholders.

■ *Value chain perspective*

Embedding sustainable thinking into conventional business arrangements requires more than just considering the interests of society and nature; it calls for the transformation of a firm's business models (Stubbs and Cocklin, 2008). Many authors argue that isolated efforts of individual firms is not sufficient for such transformation, and that sustainability is instead achieved through aligned performance of value chain members (Boons, 2012; Lassale-de Salins *et al.*, 2014; Soosay and Hyland, 2015). Some inconsistency is observed in discussions on sustainability: certain authors use the term 'supply chain', whereas others prefer 'value chain'. The meaning of 'supply chain' and 'value chain' become intertwined in such a way that it is often practically impossible to separate them. In this paper, the authors have opted to use the term 'value chain' to refer to groups of organizations that exchange materials, financing, and information, as well as collaborate in the medium and long terms. However, in the references to works of other scholars, the terms initially used are cited: the matters referred to can to a large extent be assumed to be applicable to both supply and value chains.

Humphrey and Memedovic (2006) state that the food business is increasingly dominated by value chain relationships, in which retailers and branded marketers exercise vertical coordination. Such collaboration is typically associated with power imbalances (Hartmann, 2011). The power imbalances can negatively influence collaboration and trust between actors (Kähkönen, 2014). Meanwhile, collaboration is seen as a key principle to improve sustainable performance in the food value chains (Touboulic and Walker, 2015; Varsei *et al.*, 2014). Although bigger players have more sources and power to drive sustainability in the value chains (Hartmann, 2011), a lack of collaboration caused by power imbalances may have negative effects on overall sustainable performance in the value chain (Touboulic and Walker, 2015). Thus sustainability thinking implies reconsidering chains in the sense of building a new form of communication and coordination between their actors. It can be assumed that a sustainable value results from a synergistic effect of the contributions of value chain actors who share a willingness and vision for sustainability together with a common sustainable strategy. The necessity for redefining productivity in value chains is clearly expressed by Porter and Kramer (2010) through the concept of Shared Value. Hence the practices applied in the chains are seen as a source for the creation of sustainable value. Beske *et al.* (2014) summarize practices commonly used in sustainable supply chain management and discussed in the scientific literature, placing them in five categories. These are 'strategic orientation', which indicates a company's determination to address sustainable values, 'continuity', representing the structural aspect of permanent relationships between actors, 'collaboration', which describes the technical and logistical alignment of activities and information flows, 'risk management', concerning the mitigation of possible risks, including those related to external pressure from stakeholders, and 'pro-activity', indicating collaboration with stakeholders and openness to changes (Table 1).

These practices are aimed to enhance productivity of supply chains directly or indirectly in order to achieve greater sustainable effects and keep a company profitable (Beske *et al.*, 2014). This comprehensive overview on practices to achieve sustainability opens up powerful perspectives for the development of new business models, strategies and tactics for sustainable value chains especially if gathered into a simple tool. We go on to discuss the existing tools for managers that assist in building sustainable food value chains.

■ *Tools to support development of business models for sustainable food value chains*

The FAO (2014b) have proposed a guiding approach to analyzing sustainability in food value chains and developing strategies and plans to improve sustainability across value chain activities. The approach falls in line with the principles of the Shared Value concept, combining an analysis of the stakeholders' needs and expectations with practices to achieve greater sustainable results. However, the approach calls for positive impacts at larger scales, covering entire product sub-sectors, and so targets the behaviors of large firms, institutional changes and policies, in what is a largely top-down view (FAO, 2014b: vii, 52). At the same time, the scientific literature highlights the importance of sustainable actions at micro-levels (Hart and Milstein, 2003; Porter and Kramer, 2010; Varsei *et al.*, 2014), which requires awareness and pro-activity from individual

Table 1. Sustainable supply chain practices (Beske *et al.*, 2014).

Strategic orientation	<ul style="list-style-type: none"> • Supply chain management • Triple bottom line
Continuity	<ul style="list-style-type: none"> • Long-term relationship • Partner development • Partner selection
Collaboration	<ul style="list-style-type: none"> • Joint development • Technical integration • Logistic integration • Enhanced communication
Risk management	<ul style="list-style-type: none"> • Individual monitoring • Pressure group management • Standards and certification
Pro-activity	<ul style="list-style-type: none"> • Learning • Stakeholder management • Innovation • Life cycle assessment

value chains and their actors. In recent years, increasing attention has thus been paid to tools able to assist managers in defining strategy and sustainable business modelling at organization and chain level (Bocken *et al.*, 2013; Stubbs and Cocklin, 2008; Varsei *et al.*, 2014). However, these approaches have been developed primarily for the general context of sustainability, and not for the specific context of the food sector.

In the field of food sustainability research, a number of findings can be applied for this purpose. In general, approaches tend to focus on one particular pillar of sustainability – environmental (Pelletier, 2015; Soosay *et al.*, 2012), or social (M4P, 2008), or on particular practices that can enhance sustainability, e.g. collaboration (Wognum *et al.*, 2011). An integrated yet theoretical approach is proposed by Lassale-de Salins *et al.* (2014) to implement all three aspects of sustainability, referred to as ‘extended demand’ in supply chain management. The sustainable dimensions and indicators discussed earlier (FAO, 2013; Maloni and Brown, 2006) provide general directions for sustainable performance in the food industry, and so are suitable for operational purposes. To support such operationalization in food chains, Heikkurinen *et al.* (2012) propose a visual framework to place sustainable indicators in the supply chain context. However, since indicators define what sustainably is, rather than how to create it, they are best suited to measuring sustainability and/or to specifying value propositions, and are therefore insufficient to cover all aspect of business modelling, which ideally should include the identification of a market segment, and formulation of a value proposition, as well as defining how a business creates and delivers value to its customers while generating a profit.

Each of the above tools can be used to support particular aspects of business modelling. However, their disconnected use makes managers’ tasks more complicated, and is liable to hamper information flow, thereby jeopardizing communication between actors, especially important in the context of the food value chains. To date, to our best knowledge, there is no tool for assisting the design of business modelling and defining business strategies in a sustainable food value chain that is comparable to the BMC for simplicity. We shall now introduce a template aimed to assist value chain actors in defining a sustainable strategy and business model.

2.2 A template for sustainable food value chains

We set out to develop a template to assist practitioners in developing business models for sustainable food value chains. Based on our literature review, we argue that the following considerations should underpin the template:

- The template should embrace the aspects of a conventional business model: i.e. customer demand, architecture of a value chain, and a value proposition.
- In addition to the customer demand, it should include the interests of stakeholders representing all three pillars of sustainability.
- The template should allow the demands of stakeholders to be aligned to the architecture of a value chain so as to formulate a valid sustainable value proposition.
- The structure of the template should allow the roles of different value chain actors along the process of creation of shared sustainable value to be demonstrated, in line with the concept of Shared Value (Porter and Kramer, 2010).
- Since stakeholders, sustainable practices, or indicators can vary depending on the context, the structure of the template should allow for flexibility, providing clear yet easily adjustable directives.
- The template should provide simple and easily understandable directions that allow improved communication among value chain actors.
- The tool should have a concise graphical representation, similar to that proposed by BMC, to favor efficient communication of sustainability performance to other stakeholders.

Figure 1 presents a tool based on all the above considerations – a template for sustainable food value chains. The template graphically represents the process of alignment of value chain practices to a sustainable value proposition, and ultimately aims to help actors identify new areas and solutions for the sustainable development of their value chains. Following Figure 1, detailed guidelines for the use of the template are provided.

We emphasize that the aim of this template is not to define what sustainability is or to provide set-in-stone directions on how it should be built, but to provide general yet comprehensive guidelines for the creation of a business model for a sustainable food value chain. Above all, the template calls for a three-step collaborative action plan that includes communication with stakeholders and cooperation between value chain actors. It is through the commitment of stakeholders and value chain actors that the tool is turned from a general conceptual vision into a practical context-specific tool.

	Identification of stakeholder demands		Identification of solutions				Assignment of responsibilities			Proposition of value
	Step 1		Step 2						Step 3	
	Stakeholders	Value destroyed or missed	Sustainable practices				Value chain activities			Formulation of sustainable value
			Continuity	Collaboration	Risk management	Pro-activity	Production	Processing	Retail	
Design process	Society									
	VC actors									
Data sources	Customers									
	Environment									
Data sources	Literature analysis, interview with stakeholders		Workshops and discussion between value chain actors							

Figure 1. Template for sustainable food value chains. VC = value chain.

The Template for Sustainable Food Value Chains (Figure 1) includes a structured three-step procedure for developing a sustainability-oriented strategy for food value chains.

In the first step, the template is used to lay a foundation for developing a problem-oriented sustainable strategy and business model. This step involves the collection of information about stakeholders' needs in order to define the main sustainability-related problems that require solving by the value chain actors. It is recommended that the information is collected by at least two project managers – representatives of different activities of the value chain – to mitigate possible biases. The project managers should carefully identify stakeholders of the value chain representing different dimensions of sustainability. Stakeholders can be identified through either literature review or interviews with experts. The list of stakeholders is further used by the project managers to analyze stakeholder needs or, in other terms, as suggested by Bocken *et al.* (2013), what is destroyed or missing value in the respective food industry. Identification of value issues requires closer interaction with stakeholders, i.e. it should occur through communication, surveys or interviews with them. The dimensions and indicators for sustainability in the food industry discussed in 2.1 (FAO, 2013; Maloni and Brown, 2006) can be used to make more detailed tentative check lists so as to identify gaps and opportunities for sustainable value, with the added consideration that stakeholders may raise new issues, rarely mentioned by scholars. The issues detected are then placed in Step 1 of the template.

The second step assumes that sustainability should not be based on a single decision-maker, but requires the collaborative effort and consent of the value chain actors (Lassale-de Salins *et al.*, 2014). This second step requires representatives from each value chain activity to gather for a meeting in the form of an open discussion or workshop. During the meeting, destroyed and missed values identified in Step 1 are first introduced by the project managers to the value chain representatives. Following this introduction, value chain representatives and project managers propose potential solutions to compensate for the missed or destroyed values. The template allows the positioning of solutions to existing problems in a matrix-like pattern. In the default version of the template (Figure 1), the authors propose practices summarized by Beske *et al.* (2014) (Table 1) (except for 'strategic orientation', which characterizes the whole process represented by the template), with the added consideration that more specific actions are likely to be developed by value chain actors during the discussions and workshops. Responsibilities for identified practices are then assigned in such a way that the actors have a clear understanding of what their role is in the process of sustainable value creation. The idea of this representation belongs to Heikkurinen *et al.* (2012), who initially used it for measuring the sustainable performance of a value chain.

In the third step, once the agreement is reached (solutions are designed and responsibilities are assigned), the proposition of sustainable value for the food value chain should be formulated. It is not necessary to separately identify different types of value for the final value proposition – it is often not possible to distinguish between them (e.g. an environmental value can be at the same time a social value, and this is indeed most often the case). The third step allows a reasonable value proposition to be constructed that corresponds to both the real needs of stakeholders and the architecture of the value chain.

Once all three steps are completed, the template provides a firm grounding for mission, strategy and tactics throughout the value chain. It can be used to identify and specify changes necessary for improved sustainable performance. The final version of the template (including all three steps) can additionally be used for general marketing purposes, and for communication with consumers and other stakeholders. Our next part illustrates the application of the template to the case of a pork value chain in France.

3. Case study: a pork value chain in France

3.1 Introduction to a case study

For reasons of business confidentiality, we could not conduct a direct application of the template to a food value chain. This case study illustrates the ability of the template to summarize the sustainability-relevant problems of a mainstream French pork value chain. In addition, the actions conducted by an existing value chain already working on the sustainability of its activities are collected and represented in Part 2 of the template to highlight the nature of the solutions mobilized. This process allows the verification of the relevance of sustainable practices proposed by Beske *et al.* (2014), which are used in the template for the identification of actions aimed to improve sustainability in food value chains. Finally, the template is used to highlight the stakeholder needs not addressed in the case study sustainable value chain. The identification of these gaps could help managers update the sustainable strategy of the value chain if needed. What we sought to define here is the ability of the template to synthesize the sustainability issues of a value chain, to position solutions addressing these challenges, and to highlight contributions to both impacts and improvements of each actor in the value chain. The ability to account for these aspects is central in the Sustainable Food Value Chains.

The following subsections provide a general overview on the French pork sector and on the pork value chain case. The data were obtained through a literature review and through interviews with experts.

The case study follows the design of the template proposed in 2.2 This analysis was carried out by us, acting as neutral experts. In the first step (3.2), a brief overview of the French pork industry is presented in order to identify sustainability-related issues. In 3.3 we describe the sustainable performance of a value chain. Finally, 3.4 reassembles and recapitulates the information introduced in 3.2 and 3.3 from the perspective of the template for sustainable food value chains (Figure 2), and introduces a detailed overview on the sustainable value created by the pork value chain.

3.2 Overview on the pork sector in France

The European pork production sector comprises different organizations. First, breeders can be independent (producing or buying piglets) and work alone. Second, they can be independent but associated in producer groups. This type of association improves their negotiating capacities for feed buying and the sale of pigs. Third, they can be integrated by an industrial organization that can be a feed producer or a downstream actor in meat processing. When a breeder is integrated he becomes the employee responsible for fattening the animals supplied by the cooperative or industrial organization. Roguet and Rieu (2011) report that pork production differs markedly from one European country to another: in Germany and the Netherlands, the vertical coordination between breeders and their partners is poorly standardized and not well documented; in Denmark, about 90% of the pork production is by breeders who are members of the Danish Crown cooperative, a commercial company; in Spain, between 85 and 90% of the farmers in charge of the pork fattening step are integrated (Daridan and Gil, 2007).

French pork production is represented by two main types of actors: (1) independent actors (who make up the lowest proportion of the whole production sector) and (2) agricultural cooperatives or industrial groups that in general include suppliers of animal feed and other agricultural inputs. In 2009, 93% of pork production was by breeders who were members of the 56 existing producer groups (Roguet and Rieu, 2011). In 2010, only 34% of the pork meat output was produced by integrated breeders (Nicourt and Cabaret, 2014). As of 2015, total French pig stock was 13.3 million; the sector has been facing competition from the Netherlands and Spain (Agreste, 2016; Roussillon and Legendre, 2015). The Netherlands and Spain have lowered operating costs through new automated and more productive installations and lower labor costs. Poor integration of French channels also limits the possibilities of coordination and strategic alignment between actors from different links in the value chain (Roussillon and Legendre, 2015). This weak integration results from a desire for independence in parts of the farming communities, which ultimately contributes to the non-homogeneity

Step 1		Step 2						
Stakeholders	Value destroyed or missed	Solution proposed by the case study value chain						
		Continuity	Collaboration	Risk management	Pro-activity	Input supply	Production	The cooperative of retailers
Society	1. People living close to livestock farms could be disturbed by odor and noise pollutions.							
	2. Inconsistent capacities of actors: in particular capacities of slaughter and needs of distributors are not well aligned.							
Value chain actors	3. Specialization of producers (animal breeding without cropping, or monoculture farming) increase their dependency on international markets and their exposure to price fluctuations.							
	4. Breeders are exposed to price volatility on primary product markets and on their products with, in all cases, low margins.							
	5. Uncertainties related to risks in the food industry hamper investment capacities of actors.							
	6. Uneven distribution of financial risks across the value chains. Since some actors are more exposed to the risks than others, the capacity of the whole value chain to sustain market price fluctuations is reduced.							
	7. Lack of trust regarding origin of meat and breeding conditions.							
	8. Limiting the use of antibiotics.							
Customers	9. Modern animal feed contributes to a too-high omega-6/omega-3 ratio.							
	10. National demand is focused on certain pork parts, while other parts are considered of little value.							
	11. Conditions of breeding can induce a too-high stress for the animal (living conditions too far from the natural mode, lack of space, problems of temperature, etc.).							
Environment	12. Pollution of water and soil through excessive use of manure and other agro-inputs in the production of feedstuffs for animals.							
	13. Carbon emissions related to transport including that of foodstuffs for animals.							
	14. Deforestations related to cultivation of soya in the Americas.							
	15. Environmental and social impacts of animal production create a negative image of this profession in society. This makes farmers especially vulnerable, both economically and psychologically.							
Employees								

Figure 2. Model of a case of a sustainable pork value chain in France.

of the production capacities between the different activities of the value chain (i.e. production, processing and retail). Difficulties in coordination and risk-sharing between actors of the pork industry reduce their financial ability to withstand changes in market demands. Furthermore, less time spent preparing meals and changing diets has led to the concentration of domestic demand on certain parts of pig carcasses (approximately 30% of a carcass is used for raw meat; the rest is processed into different meat-based products (e.g. sausages) or used in medicine, or for other products such as glue, energy production based on fat, feed, etc. (European Commission, 2005). This disqualification of some cheap cuts has economic consequences, and entails sales work by slaughterhouses to ensure the economic stability of their activity. On the positive side, pork has a competitive advantage, its sale price being lower than that of beef or lamb. Hence pork could be an economically attractive alternative in the food budgets of many households. Nevertheless, in recent years, the sales of pork meat in France have been decreasing (94 kg carcass equivalent kgce/capita (kilo carcass equivalent/capita) sold in 1988 against 86 kgce/inhab. in 2014) (FranceAgriMer, 2015).

To conclude, farmers are exposed to high economic risks, caught between price volatility for agricultural raw materials, and unstable, low prices of the pork market. In addition, the environmental and social impacts of livestock production foster a bad image of breeders in civil society. This is a factor of psychological distress among part of the profession. Overall, pork production is associated with various environmental and social impacts that can be summarized as follows:

- Water and soil pollution (by manure in the case of overuse and by fertilizers and pesticides used in crops).
- Carbon emissions associated with animal feed.
- Deforestation in the Americas associated with soy crops.
- Noise and olfactory pollution close to breeding farms.

3.3 *The case of a sustainable pork value chain*

The present study uses the case of a sustainable pork value chain. The objective of this case study is to clarify how the template for sustainable food value chains can help identify the relevance of the proposed business model to the real needs of stakeholders. Our study aims to identify how the elements communicated on this 'sustainable' value chain form part of a strategy that seems logical with regard to the sustainability issues identified for the French pork industry. The case described here is a real French case, but the commercial names of the organizations are not disclosed. For the same reasons, only published data from the literature are used here to describe the case.

The value chain described in this experiment was created in 2014 by a contract for a partnership lasting at least three years between a cooperative of producers (referred to in the text as CPX) and a French cooperative of distribution (referred to in the text as CDY). This contract governs a common commitment to a set of specifications, volumes and prices. CPX was established in 1889 and is present in an area equivalent to a quarter of France. It provides 14,000 jobs, and its activities cover the plant and animal sectors. The conditions for farmers to be members of the cooperative are their geographical presence in the territory of CFX and their adherence to its values. CPX includes approximately 20,000 farmers, and voluntary members. Part are engaged in an intensive ecological farming approach. The sector that we consider in this example includes approximately 180 farmers and committed volunteers in a procedure designed to provide a more sustainable farming and distribution process without being organic. According to the communication of the agricultural cooperative commitment, this process involves various aspects for volunteer breeders. The specification involves GMO-free feeds for the second age feed and no soy for fattening feed. This fattening stage meets the criteria of pork load specifications defined by the French Heart Association Bleu-Blanc-Coeur. This specification was defined to meet four objectives:

- Improve the nutritional quality of meat by increasing its omega-3 content (through introducing linseed mix in animal feed).
- Reduce emissions into the environment by structuring the diversity of animal feed to allow rotation of crops on soils that limit the needs for nitrogen and phosphorus chemical inputs.

- Develop the autonomy of farmers by enabling them to reclaim the link between crop land and farms.
- Reduce use of antibiotics.

All the constraints that these specifications entail require investment by farmers and hence raise operating costs. Economic studies had already shown that in France, pig feed represents on average 60% of the cost of breeding. After the farming step, pigs are slaughtered and butchered in the slaughterhouse and two butcheries that are subsidiaries of the cooperative. The products from the butcheries are shared among three types of use:

- raw meat parts (10 references) marketed in the form of trays ready to go;
- sausages (4 references);
- parts that do not fit into the above two categories, and are sold without special labelling along with pork meat from conventional farms.

Product reference management is conducted jointly by CPX and CDY, and aims to optimize the economic performance of the value creation chain. The economic support of the upstream phase is ensured by the payment to the farmers of a gain of 8-12 cents per kilogram compared with the price set each week for French pork. The investments made by farmers are facilitated by the cooperative, an assistance made possible by the commitment for supply over 3 years binding both partners.

3.4 Model for the case of a sustainable pork value chain

The analysis of the information published on the Internet and press together with discussions conducted with the value chain actors were used to fill out the template (Figure 2) in order to recreate a model for the case of a sustainable pork value chain. The main issues on sustainability (or concerns of different types of stakeholders in the pork industry), revealed in the overview presented in 3.1, are summarized in Step 1 of the template. Step 2 of the template includes the practices used in the pork value chain (3.2), and highlights issues they target in green. Finally, blue in the last three columns indicates who the actors responsible for implementation of these practices are. In the template, the cooperative of retailers is referred as 'R', and the cooperative of producers is represented by two activities – input supply 'IS' and production 'P', to highlight the importance of agricultural inputs to the implementation of sustainability.

In what follows, the actions implemented by the pork value chain in response to the sustainability issues are detailed. This synthesis provides further insights into the relevance of the proposed practices to the real needs of stakeholders.

- Issue 1: people living in the proximity of livestock farms could be disturbed by odour and noise pollutions.
There is no public mention of any action conducted to modify this situation directly or indirectly. However, the partnership secures those breeders most inclined to invest in the renovation of buildings: sound insulation and optimized ventilation to minimize odour.
- Issue 2: inconsistent capacities of actors: in particular production capacities of slaughter and needs of distributors are not well aligned
Having contracts binding the agricultural cooperative and the distributor over a period of three years, favours investment when it is necessary for breeding. The longer-term relationship can also make it possible to jointly seek how to make more gainful use of the parts of the carcass in least demand.
- Issue 3: specialization of producers (animal breeding without cropping, or monoculture farming) increase their dependency on international markets and their exposure to price fluctuations
The introduction of locally grown crops helps reduce farmers' dependence on agricultural commodity prices. This solution is made possible by the acceptance of a purchase price of the carcass above the standard price of the pig.
- Issue 4: breeders are exposed to price volatility on primary product markets and on their products, with low margins in all cases

Contractual agreements offer guarantees in terms of compensation for carcasses, even though these guarantees are limited because the price is indexed on average prices. This is a form of collaboration aimed at increasing the quality of the product.

- Issue 5: uncertainties related to risks in the food industry hamper the investment capacities of actors. Help is provided by the payment of a surplus per kilo, which influences the decision-making for the investment.
- Issue 6: uneven distribution of financial risks across the value chains. Since some actors are more exposed to the risks than others, the capacity of the whole value chain to sustain market price fluctuations is reduced.
The proposal of a differentiated offer compared to competitors through a commitment to product quality, and the sharing of profits underpinned by financial contracting encourage a reduction of financial risks for all players
- Issue 7: lack of trust regarding origin of meat and breeding conditions
Full traceability of livestock products, a plentiful meat offer on the market, and information on livestock conditions contribute to ensuring the transparency of the information transmitted to consumers.
- Issue 8: limiting the use of antibiotics
This is a voluntary action by the actors in response to the perception of their use as dangerous by consumers and civil society. This action is also a source of cost reduction.
- Issue 9: modern animal feed contributes to a too-high omega-6/omega-3 ratio
The change in animal feed makes it possible to modify the omega-3/omega-6 ratios to help redress the imbalance observed in epidemiological surveys.
- Issue 10: national demand is focused on certain pork parts, while other parts are considered of little value
In the communication developed around the value chain described, there are no solutions to this issue
- Issue 11: conditions of breeding can induce too-high stress for the animal (living conditions too far from the natural mode, lack of space, problems of temperature, etc.)
In the communication developed around the value chain described, there are no solutions to this issue
- Issue 12: pollution of water and soil through excessive use of manure and other agro-inputs in the production of feedstuffs for animals
In the communication developed around the value chain described, there are no solutions to this issue
- Issue 13: carbon emissions related to transport including that of foodstuffs for animals
In the communication developed around the value chain described, there are no solutions to this issue
- Issue 14: deforestations related to cultivation of soya
The integration of locally grown foods helps reduce this effect.
- Issue 15: environmental and social impacts of animal production create a negative image of this profession in society. This makes farmers especially vulnerable, both economically and psychologically. Communicating on actions for society and consumers helps improve the image of upstream agriculture. It is an upgrading factor for producers.

Overall, the template for sustainable food value chains demonstrates that the performance aspects of this case of a sustainable pork value chain fall in line with the sustainability issues identified for the French pork industry. This means that the sustainable proposition corresponds to the expectations of main stakeholders in the pork value chain. A second observation is that for issues 10, 11, 12, 13, no solutions were found. This might indicate room for improvement, but the available sources of information may have been insufficient to enable us to identify solutions.

4. Discussion and conclusions

The case study described here was intended to verify the capacity of the template to synthesize the sustainability issues of a food value chain. The different hotspots identified in the survey on the sustainability issues of the French pork sector are stated in the first part of the template in relation with the stakeholders concerned. Facing these issues, the actions conducted by a value chain acting to improve its sustainable performance

are found in the columns created in relation with the proposition for the sustainability of the food value chains. Finally, the matrix-based representation allows easy identification of the issues not dealt with, and the actors contributing to value creation. This then makes it possible for the value chains actors concerned to define a new sustainable strategy to improve the performance of their activities.

Importantly, the template does not make it possible either to rank the issues listed in the first column, or to measure the efficacy of the responses provided by the solutions implemented (whether they solve a small part of the problem, a large part, or all of it). However, the issue of prioritizing could be addressed by a cost-benefit analysis of the proposed solutions. The relevance of the proposed solutions requires tests and measurements for the progressive constitution of a balance score card to monitor the levels of performance achieved.

To summarize, the tool is not intended to provide means to directly measure the sustainable performance of food value chains. The added value of its use lies in the template, which (1) enables stakeholder driven process of defining sustainable strategy and business model; (2) encourages collaboration between value chain actors; and (3) offers a synthesis, i.e. a single-picture representation, of the major issues in a particular value chain, and the potential and existing forms of action that can be mobilized (as defined in column headings of the template: continuity of relationships, contractualization, etc.). The impact of the right-hand side of the template, which indicates 'who' in the value chain supports the efforts to improve the sustainability of the value chain, could not be tested in our case. The expected effect of this information is to facilitate the sharing of the economic value between the actors according to their contribution to the final value of the product. Hence it is important to find out whether this representation influences the economic negotiations of the actors.

The next step will be to test the template in a real situation with different actors of a food value chain. This step will enable us to determine whether this common representation offered by the template promotes collaboration between the actors. To test this aspect, the ideal situation would be to use it in a case where the value chain actors are about to start cooperating for sustainability.

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