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Iciar Pavez, Louis-Antoine Saïssset, Leïla Temri, Zouhair Bouhsina

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AGRIFOOD CHAIN CHARACTERISTICS AND SUSTAINABILITY SIGNALLING

Abstract

Sustainability is an increasing concern for agrifood firms because of consumer requirements, leading to a wide range of related signals on the food. Considering three different food chains (apple and mango purees, wine), we aim to explain differences in sustainability signalling in food chains. Using a qualitative and a quantitative methodology, we provide an overview of existing signals and show that differences result primarily from governance and the institutional framework.

Résumé

La durabilité est une préoccupation grandissante des entreprises agroalimentaires et des consommateurs, menant à de nombreux signes spécifiques sur les aliments. Etudiant trois chaînes (purée de pomme et de mangue, vin), nous souhaitons expliquer les différences entre filières. Grâce à une méthodologie quantitative et qualitative, nous brossons un tableau des signes existants et montrons que les différences proviennent principalement du cadre institutionnel et de la gouvernance.

Keywords: New Institutional Economics, Transaction Cost Economics, sustainability, standards, food chains, apple, mango, wine.

Iciar Pavez^(ab), iciar.pavez@supagro.fr +33 499 612 868

Louis-Antoine Saisset^(b), louis-antoine.saisset@supagro.fr,
+33 499 612 700

Leïla Temri^(b), leila.temri@supagro.fr, +33 499 612 722

Zouhair Bouhsina^(b), zouhair.bouhsina@inrae.fr, +33 499 612 052

^aCorresponding author

^bMoISA, Univ Montpellier, CIRAD, CIHEAM-IAMM, INRAE, Institut Agro, IRD, Montpellier, France, UMR 1110, 2 place Pierre Viala, Bât 26, 34960 Montpellier

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Introduction

In recent decades, sustainability has been at the heart of society's concerns. Firms are increasingly being asked to adopt a more responsible approach to the environment and to society in order to overcome sustainable development challenges. Nowadays, firms are deemed responsible for incorporating social, environmental, economic, and ethical concerns into their management practices (Elkington, 2013). Firms are asked to identify and measure the drivers of improved sustainability and the degree to which standards are adopted, while also signalling compliance with their responsibility of providing society with the necessary high-quality products and services. There is nevertheless considerable variability in how firms measure and report sustainability (Sebhatu, 2009). There is no suitable common tool, partly because of the heterogeneity among agricultural chains, where the functioning of chains is shaped by their particularities (Carbone, 2017). In the agricultural sector, some industries have developed their own standards to capture their own particularities, with no harmonization (Lampridi, Sørensen and Bochtis, 2019). Furthermore, numerous standards take partial dimensions of sustainability into account, such as CODEX and GlobalGap (Codron *et al.*, 2005; Pavez *et al.*, 2019).

A rich body of literature has studied the solutions adopted within a range of agrifood chains to develop and signal compliance according to the type of transaction, i.e. the attributes of products traded, the institutional environment, technological changes (Ménard and Valceschini, 2005), the characteristics of the chains (Raynaud and Sauvée, 2000; Carbone, 2017), consumer awareness and firms' strategic decisions (Codron *et al.*, 2005).

Against this backdrop, we examine how to explain differences in sustainability signalling in food chains, calling on New Institutional Economics (NIE) (North 1990; Ménard, 2004), Transaction Cost Economics (TCE) (Williamson, 1996) and insights from the strategic literature (Porter, 2008). Our aim is to shed light on the interconnections between the characteristics of the supply chains, the institutional environment and the resulting sustainability signals. Accordingly, we chose three food chains and two different levels of processed products: a first, simple level with mango and apple purees and a second, more complex one involving wine. Although all three are fruit-based chains, they differ in asset specificity, the prevailing modes of governance and the strength of the institutional framework. We compare the use of sustainability signals, applying a qualitative analysis to a set of business to business (BtoB) interviews. Then, using external business to consumer (BtoC) data, we apply a multivariate method to identify which signals (public and private standards or marketing claims) are used (Dankers, 2003), and which dimensions of sustainability they address (Meemken *et al.*, 2021; Torma and Thøgersen, 2021).

The rest of the paper is organized as follows. In section 1, we present the theoretical framework, the background to the concept of sustainability and the factors affecting the choice of sustainability signalling. In section 2, we explain the methodology, research

design and context of the three chains studied, their key characteristics and the methodology used. The results are presented in section 3, which precedes the concluding remarks.

1.Theoretical framework

1.1 Sustainability signalling

Sustainability emphasises the interdependency among the economic, social and environmental dimensions of development (Brundtland Commission, 1987). Through the Sustainable Development Goals (SDGs), firms are explicitly deemed responsible for inclusive economic growth, while protecting labour rights and environmental and health standards (United Nations, 2015). This responsibility not only applies at the core firm level, but across entire value chains, industries, and economies (Elkington, 2013). Sustainable agrifood chains (see figure 1) must therefore report their performance in terms of several indicators: economic, i.e. profits, jobs/incomes, tax revenues; social: added value distribution, cultural traditions, nutrition and health, worker rights and safety, animal welfare; and environmental, carbon/water footprint, soil conservation, biodiversity, food loss and waste and toxicity, among others (FAO, 2014). A recent study identified 129 public and private food information labelling schemes relating to sustainability available at European and national levels (Grunert et al., 2014). The multidimensionality of sustainability leads operators within the food chains to resort to an increasing number of signals because of the lack of meta-standards incorporating all facets of sustainability (Torma and Thøgersen, 2021).

Sustainability signalling has attracted increasing attention in the literature. One branch of the research focuses on the demand side to identify the signs used in consumer-products, the level of orientation towards sustainability objectives (Torma and Thøgersen, 2021), and the extent to which the information they convey results in responsible purchasing (Grunert *et al.*, 2014; Asioli *et al.*, 2017). Sustainability signs are only beneficial if complemented by consumer motivation, understanding and behaviour (Grunert *et al.*, 2014). To make purchasing decisions, buyers assess product quality through research, experience (Nelson, 1970) and credence (Darby and Karni, 1973). Research is the process by which buyers gather information through signals, certifications and advertising (Caswell and Mojduszka, 1996). Experience exists for products whose attributes can be assessed after purchase and use by the buyer, while credence applies to products whose attributes cannot be identified even after use. Sustainability attributes can be neither observed directly by consumers before purchase, nor experienced after purchase (Meemken *et al.*, 2021).

Another branch posits the analysis on the two-way link between sustainability standards and the organization of food chains. Eco-label schemes are supposed to encourage food chain operators to adopt more environmentally-friendly practices, with impacts mostly limited to farmers rather than to mid- and downstream stages in the chains (Miranda-Ackerman and Azzaro-Pantel, 2017). Furthermore, the introduction of sustainability standards generally alters transaction forms, demanding a higher degree of coordination (Banterle, Cereda and Fritz, 2013).

1.2 Interactions between factors relating to agrifood chains and sustainability signalling

Through TCE, Williamson (1996) posits that the efficiency of alternative modes of governance, i.e. markets, hybrids and hierarchies, varies according to the institutional environment (e.g. laws, standards, norms) and to individuals, i.e. the economic actors. Although Williamson mainly takes the institutional environment as given, the author identifies the feedback effects between the institutional environment, governance institutions and individuals. Changes in one level generate adaptive changes in the others. The institutional environment – rules and the mechanisms to enforce them – intervene in amplifying or mitigating the contractual hazards (North, 1990). Accordingly, standards have two main and related roles: to provide credible information and to reduce information asymmetry concerning the product attributes. Information and control costs are significant sources of transaction costs (Ménard, 1996).

According to TCE, information asymmetries exacerbate opportunistic behaviour, i.e. a lack of honesty by the parties to the transaction that hides information to their advantage. The seller has more knowledge about the product attributes than the buyer. Uncertainty linked to product quality rises when compliance with requirements is not observable by the buyer, for example compliance with sustainable production standards. Quality uncertainty leads to the risk of principal-agent problems, adverse selection due to hidden information and moral hazard due to hidden actions by the supplier (Akerlof, 1970).

Quality control of agricultural-food products concerns BtoB and BtoC transactions. Through procedures ex-ante, during and ex-post, quality control at BtoB level verifies compliance with the specifics of the production process as detailed in the agreed technical requirements. To guarantee credible commitment, enforcement devices exist such as the possibility of delisting a provider or decertifying a non-compliant partner (Ménard, 1996; Saisset and Codron, 2019). BtoC transactions show signs of standards that are visible to the consumer with some, corresponding to intermediate transactions, remaining in the domain of BtoB standards e.g. ISO (Raynaud *et al.*, 2005). Standards and certifications can be both public/official and private, or public-private when private ordering is backed by a public guarantee scheme (Menard, 2004).

Uncertainty, emerging either from a weak institutional environment or from product quality, coupled with higher levels of asset specificity¹ therefore increases the risk of opportunism (Williamson, 1996). As a result, alternative governance modes are chosen to minimize transaction costs while protecting the specific assets that are difficult to redeploy to other buyers (Williamson, 1996). There are two ways to overcome information asymmetry: one is to infer true characteristics from experience and the second involves ex-ante and ex-post transaction auditing (Williamson, 1973).

A rich body of literature has been developed on how the institutional environment and the transaction attributes (uncertainty, assets specificity and frequency) explain the choice of governance in food chains. Ménard (1996) analyses how the high-quality labelling system in the French poultry industry, as a coordinated network (hybrid), affords producer groups a stronger position to negotiate contracts with processors and retailers. Raynaud *et al.* (2005) observed an alignment between quality enforcement mechanisms and supply chain governance. They showed that, in food chains where firms' reputational capital is high, the coordination method is closer to hierarchy whereas in supply chains

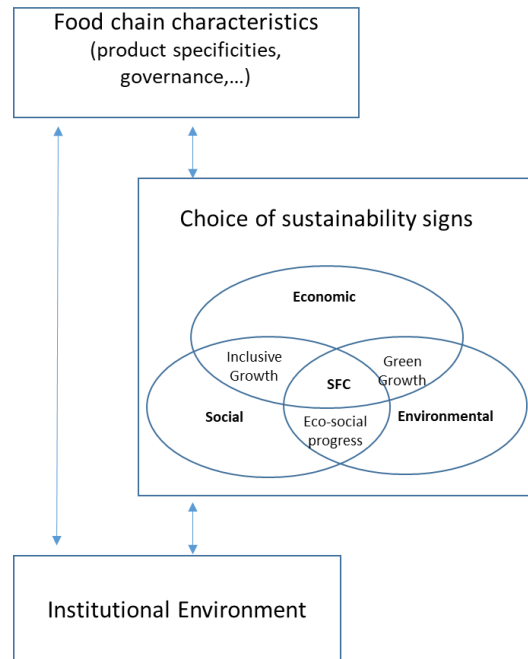
¹ Specific investments are of different types: physical, site, time, human, dedicated and brand specificity (Williamson, 1996).

governed primarily by public certification, governance is closer to market forms. Labelling and certification also impact on changes in value chain configurations (Caswell *et al.*, 1998; Fulponi, 2006). Research has also focussed on the multiplicity of private standards and the link between sanitary and phytosanitary standards and the choice of alternative types of contract (Pavez *et al.*, 2019) as well as the control decisions within supply chains (Saïssset and Codron, 2019).

This literature has also shown how the characteristics of the food chains, the environment and the type of governance influence the development of new standards (Gereffi *et al.*, 2005). Carbone (2017) draws heavily on NIE and strategic literature to classify the agrifood supply chains according to the type of organization leading the chain (i.e. retailer global processing, cooperatives); the target market (i.e. global, local, niches markets); the specificity of assets linked to quality, reputation, innovation and the importance of the origin. The author argues that these factors shape the supply chains, the stakeholders' governance and the relational environment.

Ménard (1996) explains the creation of quality labels as a differentiation strategy in sectors with generic products and a high concentration in the intermediate stages of the value chain. Raynaud and Sauvée (2000) propose a model in which the creation of a quality sign (a collective private label) is explained by elements emerging from the institutional levels, e.g. regulations by authorities, contract law; and elements rooted in the characteristics of the sector in which the economic actors operate, i.e. market size, degree of concentration, intensity of competition, etc. Codron *et al.*, (2005) explains that the definition of new food quality standards by the retailers is determined by the two-way interaction between the institutional environment and the sector characteristics (market orientation, product's technical aspects, consumer awareness and individual firms' decisions).

This framework (Figure 1) leads to our research question of how to explain differences in sustainability signalling in food chains. Before attempting to answer this question, we need to understand the context in which the studied food chains are embedded and the methodology used.



Sources: Based on Raynaud and Sauvée (2000); FAO (2014); Williamson (1996)

Figure 1. Factors influencing the choice of sustainability signs

2. Methodology

2.1 Context

We studied downstream-processed products from three very different vegetal supply chains: apple and mango (purees) as well as wine.

Apple production accounts for 12.26% of world fruit production. In France, apples are the most important fruit crop, mostly intended for fresh consumption. In terms of industrial uses, around 75% of apples used in processing serve to produce fruit desserts, especially compote (puree) which displays high demand. The majority of apple-producing firms are producer organizations (POs), either cooperatives or private (Pavez and Bouhsina, 2020). Mangoes are the eighth most produced fruit in the world, with France an importer rather than a producer. Mangoes are mostly consumed fresh. They are processed into purees and juices, among other things. Mangoes produced in La Réunion Island are mostly produced by POs and consumed fresh, and more marginally in juice. Producers face strong competition from Asian countries (Pavez and Bouhsina, 2020). Wine production and trade is dominated by Spain, Italy and France, which account for than 50% of the world market in terms of volume (OIV, 2021). In France, wine production and consumption has evolved over decades towards the prevalence of distinctive signs of origin and quality wines: Protected Denomination of Origin (PDO) and Protected Geographical Indication (PGI). These wines are produced by numerous small and medium-sized wine estates and co-ops (Saisset et al, 2017).

2.2 Method

In this study, we apply a constructivist approach and sequential qualitative research design (Tashakkori and Teddlie, 2003) in two phases: semi-structured interviews and external data (table 1).

Table 1. Summary of the research design

	Phase 1	Phase 2
Position in the chain	BtoB: growers-processors	BtoC: retailers
Method	Case study method	Exploratory multivariate analysis
Data collection	Semi-structured interviews	External textual data (open food facts)
	Professional data and documents	
Observations	15 interviews	716 apple purees 115 mango purees 1,349 wines

2.2.1 Semi-structured interviews

Exploratory interviews with French managers of private firms and cooperatives, as well as governmental and non-governmental organizations, were conducted to uncover how firms signal their sustainability efforts at the downstream BtoB level. (table 2). The central questions at this stage were: who are the key players in the chain? How are transactions organised between growers, processors and commercial intermediaries? How do firms signal their sustainability compliance? What is the firm doing in the field of sustainability? What are the general and sustainability standards adopted by the firm to deal with the customers and consumers?

Interviews were conducted in Metropolitan France, except for the case of mangoes, which refers to La Reunion Island. Lasting between 60 and 150 minutes, the interviews were conducted by the authors between 2018 and 2020 with stakeholders in the three supply chains: apple (5), mango (5) and wine (5). The profile of these actors is as follows:

Table 2. Salient features of the interviews

Chain	Interviews	Position	Description
Apple	2 growers, 2 processors	Sales manager, technical manager, quality manager	Leading firms in the French industry Distribution channels: marketing, partly under own brand, on the national market and for export.
	1 collective interview with 2 interprofessional organizations	Directors	Apple growers and F&V processing organizations
Mango	2 growers, 2 processors	Director, purchasing manager	The largest mango producers and F&V processing in La Reunion Island Distribution channels: mostly local and national marketing
	1 interprofessional organization	Director	Agricultural sector chamber
Wine	4 wine co-ops	Manager, chairman	Distribution channels: wine merchants, mass distribution, restaurants, direct sales, export. Three of them are bulk-oriented whereas one mostly sells bottled wine
	1 technical institute	Manager	Vine and wine service provider

2.2.2 External data

We used external data to identify sustainability signals at BtoC level and to gain new insights into consumer product labelling. These external data were gathered to complement the results from the first phase. We built a database using information available on Open Food Facts as well as processing and distribution companies' websites.

This database contains labelling information on brands, processing locations, ingredients and their origins, additives, labels, certifications, awards and nutrition.

We extracted records from the Open Food Facts² database, searching for products sold in France using the French keywords “*pomme*”, “*mangue*” in the sauces and desserts category, and “*vins francais*”. Bulk data was downloaded and processed using Stata16. Apple and mango purees have multiple origins, both for the raw materials and the intermediate product, e.g. purees for industrial use. We focused our analysis on purees for the end consumer. Indications of the country of origin of raw materials were included in the analysis. Concerning wine, we focused solely on French wines.

Our final sample was composed of 716 apple compotes and purees produced by French companies or companies established in France, 115 mango products (27 made of pure mango and 88 made of a blend of mangoes and apples) and 1,349 wines. The data covered the period 2014-2020 and was treated as cross-sectional. This exploratory study was not intended to be statistically representative.

For each product, we retained signs indicating aspects of the social, economic or environmental dimensions of sustainability (translation of main terms in annex). In order to map the different signs, we classified each of them into public or private standards or claims. Public standards are government rules, which may be directly defined or validated by the public authorities. When used, they engage the civil liability of those who display them. Private standards are documented agreements certified by an accredited body based on a formal and verified commitment of the actors who display them and engage their commercial responsibility. They can be regional, national, international or sectoral. Claims are marketing statements set and controlled by firms that are not based on any objective verification system (Dankers, 2003).

2.3 Analysis methods

Information gathered from the interviews was examined through content analysis. The external data were analysed through network coincidence analysis, which is a multivariate technique. We used the Coin ado program for Stata (Escobar, 2015). This program enabled us to identify the structure and relations of the occurrence of signs. In this text analysis, one word or segment of words is treated as a variable. In our case, each signal was a variable and one product could simultaneously carry different signs (polytomous variables). The Precoin program for Stata was used to convert these into dichotomous variables (1/0). Results are shown using multidimensional scaling (MDS) to map the labels in our datasets (Escobar, 2015).

3. Results

3.1 Institutional framework and governance of the studied food chains

3.1.1 Institutional framework

In our qualitative interviews, most of the respondents indicated that the main standards used in BtoB raw materials transactions for processing purposes concern quality and food safety. Quality is related to physical, chemical and organoleptic

² Open Food Facts is a non-profit association, independent from the industry and openly collaborative.
<https://fr.openfoodfacts.org/>

properties. Food safety is related to the protection of human health (e.g. traceability). Requirements can be mandatory by law, such as the maximum permitted pesticide residue levels. Apples and wine are subject to EU-specific marketing standards, while mangoes are bound by general and less stringent standards. Additional private standards, such as GlobalGap, are common and stricter than law. When we asked about specific sustainability standards, those most frequently mentioned were ISO 14000 (environmental management), ISO 26000 (a social responsibility standard) and ISO 26030 (specific to the food industry). However, *“the traditional ISO system is stagnating. People are more interested by environmental oriented labels specific to agriculture”* in the wine chain, as mentioned by the ICV deputy manager.

Furthermore, the majority of respondents understood sustainability in its environmental dimension, describing how their organizations have engaged in natural resource management. We nevertheless noted a lack of responses from the interviewees about social matters. A crucial issue across all three chains is pesticide management through environmentally-friendly agricultural practices, or the use of resistant varieties to cope with phytosanitary risks. There are a number of voluntary sectoral or collective French labels matching these requirements. The AB organic label is pointed out by professionals: *“there are constraints, but also value added on the product”* (Chairman of a wine co-op). “Haute Valeur Environnementale” (HVE, or high environmental value, is another official and voluntary environmental certification for farmers. Wine co-ops, supported by their national union, are increasingly interested in this label, as stated by the professionals interviewed. “Agri Confiance” is also a certification for agricultural cooperatives covering production quality and respect for the environment with regard to animal welfare, social, ethical and economic impacts. It was nevertheless mentioned less frequently in the interviews and is less used.

Specific French standards are currently expanding. Interviewees underlined their increasing use, driven by their customers (BtoB relationships) or consumers. One manager said, *“In today’s world, consumers are asking for more environment”*. In this sphere, “Vergers éco-responsables” is a collective label operated by the French National Pears and Apples Association. Furthermore, “Vignerons engagés” is the first French CSR and sustainability certification in the wine sector. “Viticulture Durable en Champagne” incorporates HVE and the specific requirements of Champagne, whereas “Terra Vitis” is a certification concerning vine or wine growers³ and their production. One manager said, *“The social aspect is not just about the wine growers... it is about creating a local link so that our environment, our families and the businesses in our area can also make a living from our activity.”* As far as the mango industry is concerned, we found no evidence of specific private standards.

3.1.2. Governance

Apples and mangoes for processing are mainly sourced from discarded fruit from the fresh market. The dominant form of governance relating to these transactions is therefore the market (grower and processing associations, collective interview). In contrast, in more specific segments such as baby food, hybrid forms dominate. Two managers said, *“When apples go to conventional processing, we allocate discarded fruit; no contract with processors are signed beforehand. In our cooperative, only growers dealing with baby food processors have contracts”* The hierarchical form of governance is marginal. There

³ Vine growers refers only to grape producers and wine growers refer to farmers producing grapes and then wine.

are leading apple puree processing firms in the retail market, while mango purees are not strongly associated with specific brands. Concerning the asset-specificity of raw materials, most apples and mangoes are not process-specific varieties in contrast to the grape-wine supply chain.

French puree processors are mainly supplied with apples both domestically and from other EU countries. They import mango puree, instead of fresh mango, to blend and sell under their brands or under supermarket brands. In La Reunion, there is only one company that sources directly from local mango growers, although a large proportion of mango puree is imported from India and the Philippines. According to professionals, product differentiation through brands is also evident in the case of apples. Information on the origin of mangoes is rare, except for fair-trade products.

In the French wine industry, free marketing of raw materials (grape purchases) is very limited, with wine co-ops having played a central role in production (40-50%)⁴ for more than 70 years in order to reduce transaction costs for small-scale vine growers (Jarrige, 1998) and regulate their wine quality. The ICV deputy manager said, “*They gather numerous vine growers within a specific territory*”. That is why hybrid forms are particularly important, all the more so as wine merchants can be considered either as hybrids (decentralization of certain groups) or hierarchies (centralized family businesses). Moreover, the bulk wine market represents between 40% and 50% of transactions in terms of volume in France⁵, but is highly segmented (varietal wines, PGI, PDO) and is not a global market, as underlined by the professionals. Finally, independent wine estates can mostly be considered as hierarchies, increasingly selling their wines through diversified channels.

This analysis leads us to synthesize the main features of the three food chains in table 3 below.

Table 3. General characteristics of the food chains studied

Food chain	Product specificity				Governance (mostly)	Institutional framework
	Processing	Brand	Raw material	Origin (mostly)		
Apple	Medium	Medium	Low	Domestic	Market-hybrid	Medium
Mango	Medium	Low	Low	Foreign	Market	Low
Wine	High	High	High	Domestic	Hierarchy-hybrid	High

Wine and apple chains are traditional in France. In the wine chain, the asset-specificity of raw materials (varieties) and of the final product (brand) is higher and its

⁴ Source: La Coopération Agricole – Vignerons Coopérateurs <https://www.lacooperationagricole.coop/fr/la-cooperation-agricole-vignerons-cooperateurs-corporate>

⁵ Source: statistics on wine estate sales from DGDDI (2017/2018 to 2019/2020) https://www.douane.gouv.fr/la-douane/opendata?f%5B0%5D=categorie_opendata_facet%3A471

institutional framework stronger. At the other extreme is the mango chain, with apples occupying an intermediate position.

3.2 Mapping of the signs observed in the external data

Figures 2, 3 and 4 show the representation of signs with an occurrence higher than 5. The size of nodes correlates to the occurrence of each sign: the higher the frequency the bigger the circle, square and triangle. The distance between nodes indicates the correlation between the signs: closer nodes indicate greater correlation. The connections between nodes are represented with continuous, dashed and dotted lines according to the p-values specifying the minimum p of Haberman's residual to establish adjacency, with 0.5 meaning probable coincidence and 0.05 and 0.01 meaning statistically probable coincidence (Escobar, 2015).

3.2.1 Apple chain

Figure 2 shows the rather fragmented mapping of the apple puree sector, with more than 20 signs. A first group of health-related signs stands out, in particular Nutri-Score. Nutri-Score was implemented in France in 2017 by the Ministry of Health, within the framework of European Regulation no. 1169/2011. This label provides a 5-letter nutritional scale from A to E, A indicating good nutritional quality. Most of the apple products in our sample have a Nutri-Score of A, which is strongly correlated with the terms "Sans sucre ajouté" and "Sans additifs". Nutri-Score B and C are less frequent; the latter being linked to artisanal production with a higher sugar content.

The second group of standards that appears to be relevant relates to the environmental dimension. This mainly includes the certified organic labels ("Agriculture Biologique", "Bio-dynamie") and the Forest Stewardship Council (FSC) label which is highly correlated with "Vergers éco-responsables" certification and the "Agriculture Responsable" claims. Claims such as "Sans Résidus de Pesticides" are more isolated. This may be a strategy to avoid drawing consumers' attention to a controversial aspect. Social labels relating to the well-being of farmers exist, but are less common. Goods produced by families and farmers in local territories are mentioned, albeit rarely.

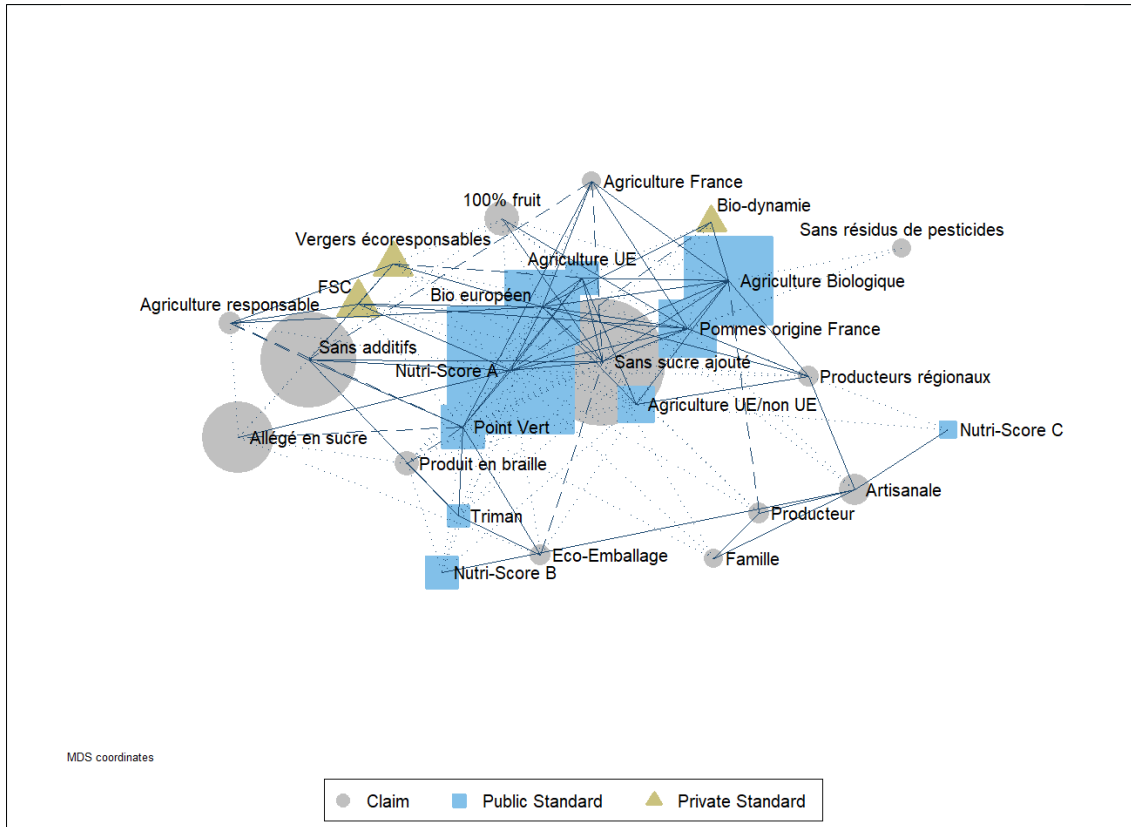


Figure 2. Network coincidence mapping of apple puree signs

3.2.2 Mango-apple chain

Figure 3 shows the case of mango and apple purees. The diagram is relatively simple with very distinct signs. A puree made of 100% mango is rarely sold to consumers, and is instead sold as a blend with apples. As an exotic fruit, the number of products in the sample is much more limited. The first dimension to stand out concerns health and quality. Health claims such as “Sans sucre ajouté” are the most prominent in our sample. Claims relating to product quality, such as “Sans additifs” or “100% Fruit” are less present.

The second dimension that stands out relates to the environment. It is found in the terms “Bio” and “Agriculture biologique”. The “Point Vert” label – which means that the company selling the product contributes financially to the collection, sorting and recycling of packaging – also relates to the environmental dimension of sustainability. Organic standards are strongly correlated here with fair trade standards, such as Max Havelaar certification for mango products. Social claims, such as “Producteurs-Paysans” or “Petits Agriculteurs”, appear in the sample, although too rarely to be shown in the diagram. As apples and mangoes correspond to globalised supply chains, the origin of the products – French, European or extra-European – is nevertheless also indicated, although the specific country of origin of mangoes is rarely mentioned.

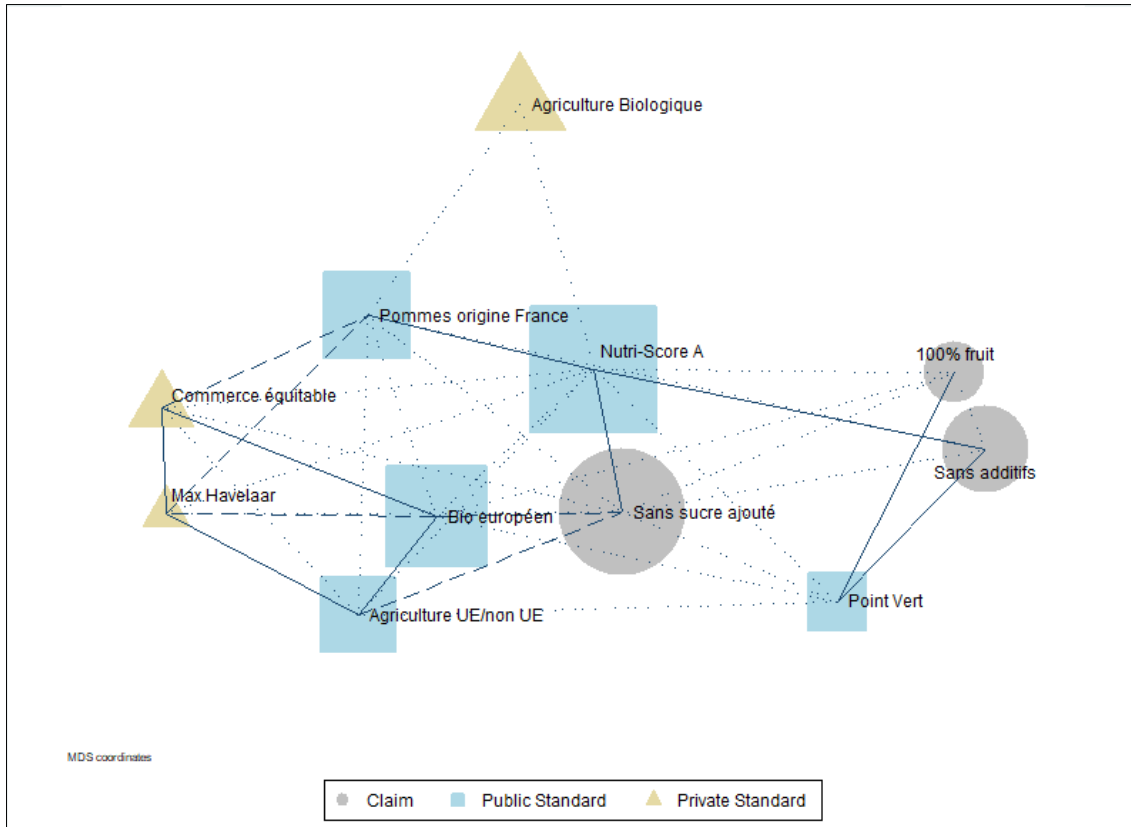


Figure 3. Network coincidence mapping of mango and mango-apple puree signs

3.2.3 Wine chain

Figure 4 shows the wine-labelling map. With more than 30 claims and labels, it is a mosaic of scattered signs, primarily reflecting the density and complexity of messages for wine consumers. This striking dispersion is counterbalanced by the concentration of information in ten main points that can be divided into three groups.

The first group concerns quality and origin labels, which are the most frequent: French AOC/AOP (Controlled Designation of Origin/ Protected Designation of Origin) and, to a lesser extent, IGP (Protected Geographical Indication). These types of wine represent more than 70% of total production in France. Moreover, these indications are strictly regulated and mandatory, explaining their prevalence on packaging. They are not explicitly sustainability labels and do not generally include specific sustainability criteria. However, their values rely on economic and social aspects through terroir, territory and traditional practices. Indeed, AOC is particularly strongly correlated with quality signs relating to wine processing methods (“Vendange à la main”, “Méthode traditionnelle”) and the producers (“Vignerons”), who are often deeply rooted in tradition. AOP (European level) relates more to sustainable viticulture indications and HVE certification.

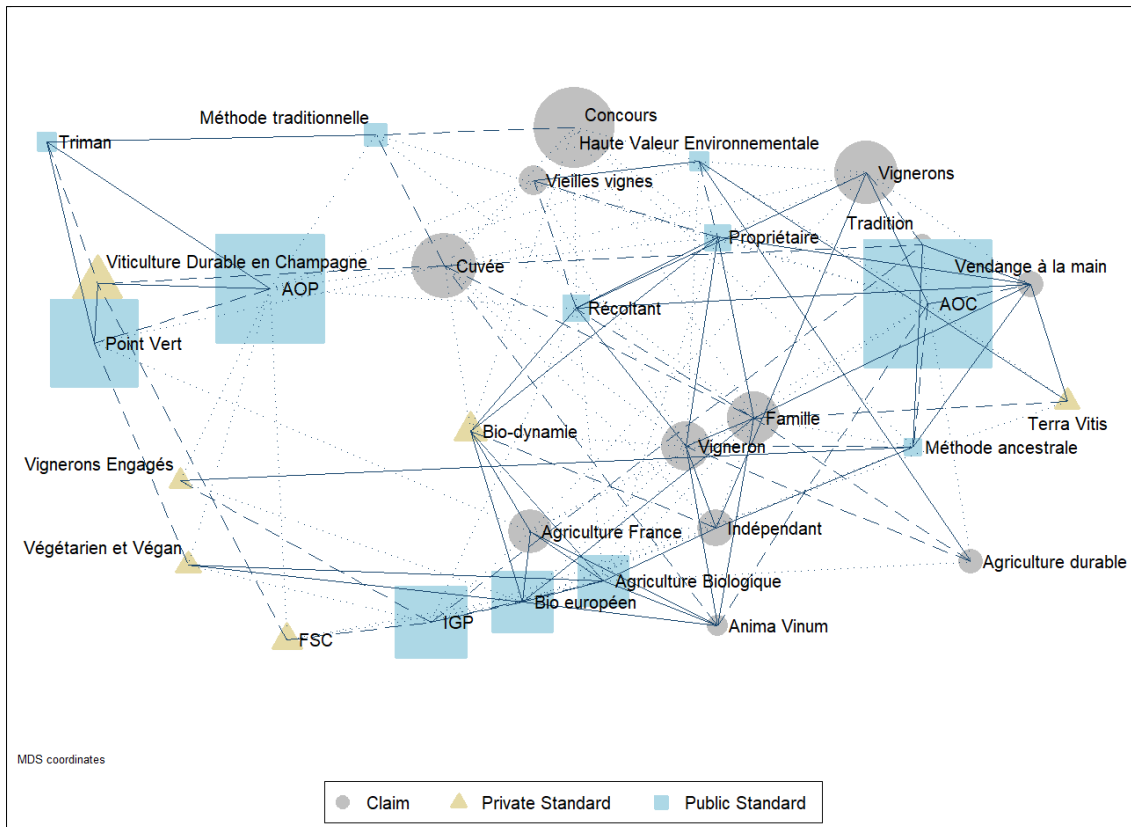


Figure 4. Network coincidence mapping of wine signs

The second group relates to organic, or even biodynamic, agriculture and organic wines, certified at the national and European levels. These signs are very strictly regulated and can concern the label itself (“Bio”, “Agriculture Biologique”, etc.). The importance of this label reveals the increasing demand for and production of such environmentally-friendly wines. These labels are directly or indirectly associated with small-scale wine firms, and especially wine estates, as well as social aspects such as “Vigneron”, “Indépendant”, “Famille”, “Récoltant” or “Propriétaire”. This can be explained by the predominance of small or medium-sized wine estates in this category. We note here that there is no mention of natural wines, despite their current expansion. It has recently been recognised in France (charter approved by fraud control administration since March 2020), and so was not present in the database we worked on.

The third group deals with recycling and is not related to the product but to the packaging, in our case glass bottles. It indicates that firms pay taxes for collection, sorting and recycling. It is a cross-cutting indication signalling that wine firms are highly recycling-oriented.

Social aspects are particularly present in this map. Wine producers are frequently mentioned, in the plural when referring to collective organisations (“Mise en bouteille par Union des vignerons”, “Mise en bouteille par Groupement des vignerons”, “Vignerons réunis”) and in the singular when it comes to an independent producer. Family production is also highlighted, possibly anchored in traditional values. These indications seek to inform the consumer about the people behind the production of a bottle, while generating confidence in the quality of the product.

Another very interesting point in this map is that several indications refer explicitly to sustainability (e.g. “Agriculture durable”, “Vignerons Engagés”), and can be closely associated with AOP or IGP. They are nevertheless infrequent. “Haute Valeur Environnementale” and “Terra Vitis” are correlated with these signs, even if they deal more with integrated viticulture thanks to precise standards and certification. In this case, labels overlap and can lead to confusing messages for consumers.

3.3 Comparison of apple, mango and wine chains

We compared the main public and private standards appearing in our BtoB and BtoC data, according to sustainability dimensions (Table 4).

Table 4. Main standards in the sample according to sustainability dimensions

Standards	Apple			Mango			Wine		
	Econ.	Soci.	Envr.	Econ.	Soci.	Envr.	Econ.	Soci.	Envr.
Agri-Confiance							✓	✓	✓
Vignerons Engagés							✓	✓	✓
FSC	✓	✓	✓				✓	✓	✓
AOP/AOC/IGP							✓	✓	
Commerce équitable/Max Havelaar				✓	✓	✓			
Agriculture Biologique		✓	✓		✓	✓		✓	✓
Bio-dynamie		✓	✓					✓	✓
Vergers Eco-Responsables		✓	✓						
Bee Friendly			✓						✓
Point vert			✓			✓			✓
Triman			✓						✓
Nutri-Score		✓			✓				
HVE			✓						✓
Terra Vitis								✓	✓
Viticulture durable							✓		✓
Méthode Ancestrale							✓	✓	
Méthode traditionnelle							✓	✓	
Origin (EU/non-EU agriculture)	✓			✓					

Econ.= Economic; Soci.=Social; Envr.=Environmental; ✓ Public standard ✓ Private standard

Most of the standards target economic efficiency. However, this summary refers to direct indicators which are objective specifications, such as guaranteed minimum price for farmers (Commerce équitable), and not market outcomes (higher market prices for organic products). To illustrate this point, some indicators used by Vignerons Engagés are economic, such as mutualisation of employment to improve seasonal jobs; social, including financial contributions to local cultural heritage; and environmental, such as use of renewable energy. For Vergers Eco-Responsables, they can be social, e.g. safer use of agrochemicals or environmental, such as traceability of agricultural practices, verified by a certified technician. We have not identified any direct economic indicator, although the enhanced reputation capital favours its positioning in the market.

In our sample, comprehensive sustainability standards are few, private and mostly present in the wine chain. Public standards address specific dimensions, mostly environmental and social. The wine chain displays a higher number of standards, followed by the apple chain which is more environmentally oriented. The mango chain shows considerably fewer but more comprehensive standards, thanks to the fair trade guidelines due to the origin of raw material (South-North transactions).

Characterised by foreign origin, low asset-specificity, an institutional framework and market-oriented governance, the mango chain has few sustainability standards (only 5). In contrast, the wine chain, with its domestic origin, high processing level and asset specificity, complex institutional framework and governance structure shows numerous (14) well-balanced sustainability standards (28% are global ones). The apple chain is in-between in terms of characteristics (namely medium brand-specificity and an institutional framework, with a market-hybrid oriented governance) and number (10), with a single comprehensive private standard.

Discussion and conclusion

This article explored the interconnections between the characteristics of supply chains on the resulting sustainability signalling by comparing three fruit-based chains (apple and mango purees and wine). At the BtoB level, standards coordinating transactions relate to quality (chemical, physical and organoleptic) and food safety which are, mostly, not signalled to consumers. This is in line with the relevant empirical literature relating to quality and food safety standards and governance (Ménard, 1996,2004; Codron et al., 2005; Raynaud et al., 2005; Raynaud and Sauvée, 2000).

Although all three food chains in our study are fruit-based, they differ in how they signal sustainability at BtoC level. Various factors explain these differences: product-related specificities (linked to the level of processing, brand, raw material and origin); governance of the transactions and the strength of the institutional environments.

Concerning the product specificity, the greater the level of processing, the more labels and claims are used to create segmentation and increase differentiation (Olper et al., 2014), raising the brand specificities and the reputation capital (Raynaud and Sauvée, 2000; Codron *et al.*, 2005; Ménard and Valceschini, 2005). Moreover, as the asset specificity rises, tighter, hierarchical and hybrid modes of governance are chosen to protect transactions (Williamson, 1996). However, differences in products with the same level of processing and low raw material specificity (apple and mango purees) can mostly be explained by institutional factors. The strategic stakes are higher for apples, mostly domestic in origin, while mangoes are mostly foreign-sourced. This has strong implications at both country and chain level. Stronger institutional frameworks are developed to protect and promote strategic food chains (North, 1990; Porter, 2008), both by public authorities and private actors through standards (Ménard and Valceschini, 2005). The relations between these variables at the institutional environmental, governance and firm levels have feedback effects because changes in one level generate adaptive changes on the others, as described by Williamson (1996).

Managerial implications

Our study has a number of managerial implications. First, assessing the attributes of the products is costly and difficult to measure, although it is fundamental in extracting the full value and calculating the mutual benefits from the exchange. Consequently, standards reduce quality uncertainty and information asymmetry. Second, reputation linked to standards remains an important trigger for certification. Firms seek to transform regulatory constraints and voluntary standards into competitive advantages by signalling their performance to buyers.

Even if our research does not assess the performance of these sustainability signalling strategies, it can give agrifood firm managers some direction for their

sustainability strategy. Thanks to our results, and more particularly the comparison between the three chains, managers aiming to be market leaders should target the less-used sustainability pillar(s) facilitating differentiation. Those aiming to follow the main trends should be inspired by existing sustainability signs.

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References

- Akerlof G. A., 1970, “The market for “lemons”: Quality uncertainty and the market mechanism”, *Quarterly Journal of Economics*, vol. 84, n°3, p. 488–500.
- Asioli D. *et al.*, 2017, “Making sense of the “clean label” trends: A review of consumer food choice behavior and discussion of industry implications”, *Food Research International*, n° 99, p. 58–71.
- Banterle A., Cereda E. and Fritz M., 2013, “Labelling and sustainability in food supply networks: A comparison between the German and Italian markets”, *British Food Journal*, vol. 115, n° 5, p.769-783.
- Brundtland Commission, 1987, “Our Common Future: Report of the World Commission on Environment and Development”, *World commission on environment and development*, United Nations.
- Carbone A., 2017, “Food supply chains governance”, *Agricultural and Food Economics*, vol. 5, n° 3, p. 1–23.
- Caswell J. A., Bredahl M.A. and Hooker N.H., 1998, “Agricultural & Applied Economics Association: How Quality Management Metasystems Are Affecting the Food Industry”, *Review of Agricultural Economics*, vol. 20, n° 2, p. 547–557.
- Caswell J. A. and Mojduszka E. M., 1996, “Using informational labeling to influence the market for quality in food products”, *American Journal of Agricultural Economics*, vol. 78, n° 5, p. 1248–1253.
- Codron J., Giraud-Héraud E. and Soler L., 2005, “Minimum quality standards, premium private labels, and European meat and fresh produce retailing”, *Food Policy*, vol. 30, n° 3, p. 270–283.
- Dankers C., 2003, *Environmental and Social Standards, Certification and Labelling for Cash Crops*, Rome, FAO.
- Darby M. R. and Karni E., 1973, “Free competition and the optimal amount of fraud”, *The Journal of law and economics*, vol. 16, n° 1, p. 67–88.
- Elkington, J., 2013, “Enter the Triple Bottom Line”, in: *The Triple Bottom Line*. Routledge, p.23–88.
- Escobar M., 2015, “Studying coincidences with network analysis and other multivariate tools”, *The Stata Journal*, vol. 15, n° 4, p. 1118–1156.
- FAO, 2014, *Developing sustainable food value chains - Guiding principles*, Rome, FAO.

- Fulponi L., 2006, ‘Private voluntary standards in the food system: The perspective of major food retailers in OECD countries’, *Food Policy*, vol. 31, p. 1–13.
- Gereffi G., Humphrey J. and Sturgeon T., 2005, ‘The governance of global value chains’, *Review of international political economy*, vol. 12, n° 1, p. 78-104.
- Grunert K. G., Hieke S. and Wills J., 2014, ‘Sustainability labels on food products: Consumer motivation, understanding and use’, *Food Policy*, vol. 44, p.177–18.
- Jarrige F., 1998, ‘Ancienne institution, nouveaux enjeux, la coopération agricole aujourd’hui. Réflexions sur le cas des coopératives vinicoles du Midi’, in Miclet G., Sirieix L. et Thoyer S., (eds), *Agriculture et alimentation en quête de nouvelles légitimités*, Paris, Economica, p.49-100.
- Lampridi M. G., Sørensen C. G. and Bochtis D., 2019, ‘Agricultural sustainability: A review of concepts and methods’, *Sustainability*, vol. 11, n° 18, 5120.
- Ménard C., 1996, ‘On clusters, hybrids, and other strange forms: the case of the french poultry industry’, *Journal of Institutional and Theoretical Economics*, vol. 152, n° 1, p. 154-183.
- Ménard, C., 2004, ‘The Economics of Hybrid Organizations’, *Journal of Institutional and Theoretical Economics*, vol.160, n°3, p. 345–376.
- Ménard C., and Valceschini E., 2005, ‘New institutions for governing the agrifood industry’, *European Review of Agricultural Economics*, vol. 32, n° 3, p. 421-440.
- Meemken E.-M., Barrett C. B., Hope C. M., Qaim M., Reardon T. and Sellare J., 2021, ‘Sustainability standards in global agrifood supply chains’, *Nature Food*, p. 1–8.
- Miranda-Ackerman M. A. and Azzaro-Pantel C., 2017, ‘Extending the scope of eco-labelling in the food industry to drive change beyond sustainable agriculture practices’, *Journal of environmental management*, n° 204, p. 814-824.
- Nelson P., 1970, ‘Information and consumer behaviour’, *Journal of political economy*, vol. 78, n° 2, p. 311–329.
- North D. C., 1990, ‘Institutions, institutional change, and economic performance’, *Economic Perspective*, vol.5, n°1, p. 97–112.
- OIV, 2021, *State of the world vitivinicultural sector 2020*, Paris, OIV.
- Olper A., Curzi D., and Pacca L., 2014, ‘Do food standards affect the quality of EU imports?’, *Economics Letters*, vol. 122, n° 2, p. 233-237.
- Pavez I., Codron, J. M., Lubello, P., & Florêncio, M. C., 2019, ‘Biosecurity institutions and the choice of contracts in international fruit supply chains’, *Agricultural Systems*, vol. 176,102668, p. 1-11.
- Pavez I. and Bouhsina Z., 2020, ‘The effect of quality uncertainty and asset specificity on the coordination of fruit supply chains’, in *Academy of International Business Conference*, AIB Oceania Chapter, Auckland, New-Zealand, p. 25.
- Porter, M. E., 2008, *On Competition*, Harvard Business Press.
- Raynaud E. and Sauvée L., 2000, ‘Signes collectifs de qualité et structures de gouvernance’, *Économie Rurale*, 258(1), p.101–112.
- Raynaud, E., Sauvée, L. and Valceschini, E., 2005, ‘Alignment between quality enforcement devices and governance structures in the agro-food vertical chains’, *Journal of Management and Governance*, Vol. 9, n° 1, p. 47-77.
- Saïsset L.-A., Cheriet F. and Couderc J., 2017, ‘Cognitive and partnership dimensions in merger processes in agricultural cooperatives: the case of winery cooperatives in Languedoc-Roussillon’, *International Journal of Entrepreneurship and Small Business*, vol. 32, n°1/2, p. 181-207.
- Saïsset L.A. and Codron, J.M., 2019, ‘Hybrids in the french apple industry: Opportunistic and cognitive differences between a cooperative and an investor-owned group’, in *Design and Management of Interfirm Networks*, Springer, p. 239–266.

Sebhatu S. P., 2009, "Sustainability Performance Measurement for sustainable organizations: beyond compliance and reporting", *11th Quality Management and Organizational Development*, vol. 2006, p. 75–87.

Tashakkori A., and Teddlie C., 2003, "Issues and dilemmas in teaching research methods courses in social and behavioural sciences: US perspective", *International journal of social research methodology*, vol. 6, n° 1, p. 61-77.

Torma G. and Thøgersen J., 2021, "A systematic literature review on meta sustainability labeling – What do we (not) know?", *Journal of Cleaner Production*, vol. 293, p.126-194.

United Nations, 2015, *Transforming our world: The 2030 agenda for sustainable development*, General Assembly, Seventieth session. NY, United Nations.

Williamson O. E., 1973, "Markets and Hierarchies: Some Elementary Considerations", *The American Economic Review*, vol. 63, n° 2, p. 316–325.

Williamson O. E., 1996, *The mechanisms of governance*, Oxford, Oxford University Press.

Annex: Translation of main terms

French

Agriculture Biologique
Agriculture Durable
Agriculture Responsable
Allégé en sucre
AOC
AOP
Artisanale
Bio
Bio-dynamie
Bio Européen
Commerce équitable
Concours
Cuvée
Famille
Haute Valeur Environnementale
IGP
Indépendant
Méthode Ancestrale
Méthode traditionnelle
Mise en bouteille par Groupement des vignerons
Mise en bouteille par Union des vignerons
Petits Agriculteurs
Point Vert
Pommes origine France
Producteur
Producteurs-Paysans
Producteurs régionaux
Propriétaire
Récoltant
Sans additifs
Sans résidus de pesticides
Sans sucre ajouté
Veilles vignes
Vendange à la main
Vergers éco-responsables
Vignerons
Vignerons engagés
Vignerons réunis
Viticulture Durable en Champagne

English

Organic agriculture
Sustainable agriculture
Responsible agriculture
Low-sugar
Controlled Designation of Origin
Protected Designation of Origin
Artisanal
Organic
Bio-dynamic agriculture
European organic
Fair trade
Competition
Cuvée or vintage
Family
High Environmental Value
Protected Geographical Indication (PGI)
Independent
Ancestral method
Traditional method
Bottled by wine growers' Group
Bottled by wine growers' Federation
Small-scale farmers
Green Dot
French apples
Producer
Peasant producers
Regional producers
Owner
Harvester
No additives
No pesticide residues
No added sugar
Old vines
Manual grape harvesting
Eco-friendly orchards
Wine growers
Sustainable wine-growing
United wine growers
Sustainable viticulture in Champagne