
Environmental and Social Sustainability in the Fresh Fruit and Vegetables Supply Chain: A Competitiveness' Asset

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Abstract

The concern for products that meet the requirements of sustainability is a key factor that drives consumers and can be the engine of a successful economy in the food businesses. In the specific case of the fresh fruit and vegetables, more than ever, sustainability understood as a greater focus on the social and environmental performance of the product and of its supply chain, can be considered as a tool to counter the consumer's disaffection. The communication of the product's sustainability can indeed represent a tool to bring out the fruit and vegetable products from the anonymity, a strategy to will make it 'remember', relying not only on the traditional values recognized to the segment, but also on a set of the supply chain attributes that can differentiate it. However, how to get effectively to the consumer by using a multidimensional and complex concept as the product's sustainability of the product, how to make the sustainability attribute a factor to be considered in the final purchasing choices, how to involve the different stakeholders in the building of a sustainable supply chain (regardless of its length) are still open discussion topics. After presenting the main sustainability certification and communication tools adopted till nowadays for the fresh fruit and vegetables supply chain, the chapter investigates the relative potentialities and criticisms in order to turn them into a real competitiveness' asset.

Keywords: Sustainability, Fructiculture, Certification, Stakeholders, labels

1. Introduction

Even in one of the most important food categories—fresh fruit and vegetables—there is a current trend whereby consumers are increasingly looking for a sustainable form of trade. The agri-food industry¹—and the fruit and vegetable sector in particular—must meet requirements that vary geographically and over time as a result of changing technology and consumer behaviour.

Eating habits have always been an important element of culture [1]. Numerous models have been adopted by different scientific disciplines to describe the choices and behaviour of food buyers [2–6]. Whereas in the past food choices were largely dictated by the necessity of satisfying a basic physiological need, nowadays the motivation is more social in nature [7], suggesting that external factors can affect what we choose to eat [8]. Of these new requirements, the ‘emotional’ aspects (security, love, esteem and self-fulfilment) are undoubtedly among the most interesting when it comes to understanding changes in food consumption [9,10]. Sociodemographic variables no longer seem sufficient to explain the behaviour of the modern consumer, who instead must be viewed with a multidisciplinary approach that takes additional aspects into consideration. This evolution has spawned the modern consumer of fruit and vegetables, who is more conscious of environmental sustainability and socio-economic issues and relies on these factors to inform his or her choices. More specifically, factors such as the type of product, its qualitative aspects, packaging [11] and distribution channel, although very different from one another, have become fundamental in guiding the purchasing behaviour of consumers [12,13]. Now more informed consumers tend to buy products that can be classed as sustainable, a definition that over time has become multidimensional [14]. This information is particularly relevant for the credence attributes of fruit and vegetables, which cannot be ascertained even after the consumption experience. These include, for example, aspects such as the local provenance of the product, how organic it is, producer support and respect for workers’ rights [15]. In this case, the consumer’s decision is based solely on how much confidence he or she has in the information on the label, the brand or other elements that help to build the product’s reputation by sharing some of its extrinsic qualities. As a result, the information asymmetry is reduced and the credence attribute becomes a search attribute, which means that some information may be known to consumers before they buy, regardless of the consumption experience.

The increased focus on social and environmental balance and how to convey these aspects properly thus have considerable implications for the fruit and vegetable supply chain. To differentiate or promote new products, consideration must be given to the use of natural resources, as well as minimising the impact of farming on the environment and on the local community, how and where the produce is grown, the characteristics and socio-economic and environmental impact of processing, the health benefits of the product, its distribution channel, and finally waste recycling and management. Meeting these consumer expectations requires an industry-wide commitment to maintain, improve and promote the qualitative aspects of

¹ Defined as a group of activities between companies and sectors linked by business relations designed to add value to food on the journey from field to fork.

the product and producer, which in turn becomes an incentive for corrective action and improved performance by supply chain actors. The purpose of this paper is therefore to describe those instruments that have been developed thus far within the fruit and vegetable supply chain, discussing their main benefits, limitations and drawbacks.

2. An overview of certification schemes and communication tools for F&V

To address this growing demand for sustainability in a way that is appropriate and commensurate with the consumer's needs, a wide variety of schemes have been developed over the past decade—both in the fruit and vegetable supply chain and elsewhere—that differ in terms of their objectives, structure and operating methods. These consist of optional certification tools (voluntary product certification and standards), as well as self-declaration. The main examples are listed in **Table 1**. These schemes are not intended to demonstrate compliance with legal requirements. However, when used by operators to facilitate the transition with other actors in the fruit and vegetable supply chain by indicating conformity with legal requirements, it is clear that this type of tool cannot be used to differentiate products on the market.

2.1. Certification and standards

With regard to F&V certification schemes, a special arrangement whereby a certificate is issued by a third party guarantees compliance with a certain number of characteristics or attributes of the product or its production method or system, as defined in a standard. These include a wide range of initiatives at different points along the food chain (either before or after leaving the farm, along the entire food chain or in part of it, in all sectors or in a particular market segment).

	Tipology	Standard of reference	Key features
Integrated production	Voluntary third-party certification	UNI 11233	Selection of agronomic preventive measures and biological/physical/chemical methods are carefully selected and balanced taking into account the protection of health of both farmers and consumers and of the environment
Supply chain traceability	Voluntary third-party certification	ISO 22005 (2008)	Traceability
Quality management system	Voluntary third-party certification	ISO 9001	Minimization of harmful effects on the environment, conformity to applicable regulatory requirements, achievement of improvement of environmental performance

	Typology	Standard of reference	Key features
Social responsibility	Voluntary third-party certification	SA 8000	Ethics
Food security management system	Voluntary third-party certification	ISO 22000 (2005), HACCP (FAO/OMS <i>Codex Alimentarius</i>)	Food security
Good Agricultural Practices (GLOBALGAP)	Voluntary third-party standard	<i>Chain of Custody Standard</i>	The certificate covers the process from farm inputs like feed or seedlings and all the farming activities until the product leaves the farm
British Retail Consortium (BRC)	Voluntary third-party standard	<i>BRC Global Standard Food</i>	Senior management commitment and continuous improvement, hazard and risk analysis, quality management system, site and building standards, vehicle operating standards, facility management, good operating practices, personnel
International Food Standard (IFS)	Voluntary third-party standard	GFSI Global Food Safety Standard	Senior management responsibility, quality and food safety management systems, resource management, production process, measurements, analysis, improvements and food defence
Eco management and Audit Scheme (EMAS)	Voluntary third-party certification	UNI EN ISO 14001	Environmental efficiency
Self-declared environmental claims	Type II environmental labelling	ISO 14021	Environmental: defined once for once, for example recyclable
Environmental Product Declaration (EPD®)	Type III environmental labelling	UNI ISO 14025:2006	Environmental: quantified product life cycle environmental performance information

Source: Re-elaboration with permission from Tecco et al. [16].

Table 1. Summary of the main certificates and other tools used in the fruit and vegetable supply chain.

Their use is particularly apt, given how complex the operator's commitments are, set out in detailed standards that require periodic verification.

Among the voluntary standards certified by third parties, Global Gap (until 2007 EurepGap), an initiative of the Euro-Retailer Produce Working Group (EUREP), is currently one of the initiatives with the most members in Europe and worldwide [17]. Certification is based on compliance with Good Agriculture Practices (hence the acronym GAP) for agricultural produce of plant origin. This addresses consumer expectations in terms of food safety, traceability, the environment and health and safety of workers. The protocol can be adopted

for individual phases or for the entire supply chain, with a module-based certification system in which option 1 is for farms, while option 2 includes quality system management by commercial farms and F&V packaging, which take place downstream of agricultural production.

In addition to third-party certification, certification schemes may use labels or logos (the latter sometimes registered trademarks) as a communication tool. The labels used fall into the following classifications and descriptions of the International Standards Organisation (ISO):

- Type I label (ISO 14024)—often referred to as an eco-label², this is awarded by third parties in the public or private sector which operate independently of the producer. They involve the use of a logo associated with the certified product. These are based on a multi-criteria system that analyses each stage of the product life cycle, identifying the threshold values to be met;
- Type III label (ISO 14025)—in this case, an accredited third-party certification body analyses the entire product life cycle based on parameters previously established by a life cycle analysis (LCA); this system can be used with any type of production. The aim was to inform consumers by providing elements enabling them to compare functionally similar goods and services.

In the case of the Type I label used in the fruit and vegetable supply chain, the majority of organic production logos and the European environmental quality logo (Ecolabel) fall into this category for the primary sector. The other label in this category is the carbon neutral label; this is becoming increasingly widespread, especially among operators who produce and market tropical fruit.

In the case of AgroFair, the first farming cooperative in the world to market tropical fruit such as bananas and pineapple under the fair trade and welfare banner, the goal has been to extend fair trade and welfare recognition through additional certification demonstrating zero-emissions production. A similar approach has been taken by Dole Costa Rica to comply with environmental strategies defined according to the Costa Rica Carbon Neutral Strategy 2021 [18].

The EPD[®] (Environmental Product Declaration), a document that quantifies a product's environmental performance through appropriate categories of parameters calculated with LCA methodology, is considered Type III labelling. One example of the application to the F&V supply chain is Italian apples, produced under the aegis of the Italian Association of Apple Producers (Assomela). Here, an LCA was used to quantify the environmental impacts associated with the life cycle of apples in relation to the 2012, 2013 and 2014 harvest [19].

2.2. Self-declaration

Another scheme in the fruit and vegetable sector is self-declaration. Membership of these schemes is through self-declaration or selection by the operator of the scheme. Self-declaration

² The use of the term 'ecolabel' for this category can be confusing, since the European Union also has an Ecolabel scheme.

is generally regarded as suitable for relatively basic information concerning particular environmental aspects of the product, such as the absence of substances that are harmful to the environment, recycled content or biodegradability. It is also based on the use of a label or logo, although no external bodies are involved.

The labels used for this scheme are again covered by the ISO classification and are described as follows:

- Type II Label (ISO 14021)—Self-declared environmental claims. This is effectively done by the producers, importers and distributors of the products [20]. According to ISO 14021, self-certification must include clear information that is not misleading or open to misinterpretation, and which can be certified if necessary (for example, if asked to produce the documentation certifying the label, these must be supplied).

There has been widespread uptake of this tool in the fruit and vegetable supply chain for the self-certification of organic production, in parallel with the development of Participatory Guarantee Systems [21].

3. Benefits distribution of voluntary socially and environmentally responsible behaviour along the fruit and vegetables supply chain

The use of such schemes offers potential across the fruit and vegetable supply chain in terms of increased competitiveness, which benefits producers, intermediaries and end consumers.

Actors' categories	Benefits
 <p data-bbox="225 1219 315 1246">Producers</p>	<ul style="list-style-type: none"> • Increased market access, market share and profit margins for certified products • Increased efficiency • Reduction in transaction costs • Enhanced reputation and image • Emphasis on uniqueness and local provenance • A guarantee that supports the continuity of distribution agreements • Enable premium price obtaining • IGuarantee of compliance with certain standards
 <p data-bbox="173 1547 367 1574">Intermediaries/retailers</p>	<ul style="list-style-type: none"> • Protection in terms of product liability and reputation • Reduced civil liability risk • Enhanced reputation and image • A closer partner (supplier) relationship

Actors' categories	Benefits
 Consumers	<ul style="list-style-type: none"> • Obtain reliable and trustworthy information on product characteristics and processing • Reduction of information asymmetry

Source: Authors' elaboration.

Table 2. Benefits of regimes according to the actors' categories.

However, the distribution of these benefits within the fruit and vegetable supply chain is linked to the methods and frequency with which such tools are used by operators, as well as their visibility.

For this purpose, it is worth considering a further distinction, which allows the tools to be classified according to the type of relationship created: *Business to Business* (B2B), in the case of business-to-business relationships where the final recipient of the information is internal to the supply chain, or *Business to Consumer* (B2C), for relationships between distributors and consumers (**Table 3**).

Audience	B2B		B2C	
				
Type of attestation:	Certification (third-party attestation)		Self-declaration	
Objects of specific requirements	Mostly management systems	Mostly products (including services) and processes	Product and processes	
Content of requirements	Baseline and above baseline	Mostly above baseline	Mostly above baseline	

Source: Authors re-elaboration with permission from European Commission [22].

Table 3. Classifications of schemes according the kind of audience.

B2B tools are not shared with end consumers, who are often unaware of their existence. GlobalGAP, International Food Standard and ISO 22000 certification are all B2B standards

whose goal in the fruit and vegetable supply chain, as well as in the food industry as a whole, is to facilitate trade between industry operators by offering assurances to buyers based on certifiable standards that form the basis of a common language on which to build trade relations.

B2C certification is a useful tool to show the market (customers, consumers, public opinion in general) that the products meet the stated requirements. The choice of requirements is therefore strategic for the success of the product and the certification, as the product takes on associations and becomes recognisable depending on the information conveyed.

Supermarket distribution, as the most important retail channel for fruit and vegetable produce with a market share of between 60 and 90%, depending on the Member State³ [23], is the party that relies the most on the use of such schemes, both as a recipient of information via B2B certification, and as a provider of information to its own customers with B2C tools. By consulting the database of best practices in environmental and social sustainability, developed as part of the Retailers' Environmental Action Plan (REAP)⁴ and adopted by leading European retailers, we can see how the initiatives taken by Delhaize Group, Eurocoop, Mercador, Kaufland and Rewe Group in the F&V supply chain signal an approach designed to support and communicate improvements in production and consumption systems, using certification as a dual means of assurance and communication. The intention of minimising the impacts of direct activities throughout the F&V supply chain is apparent, for example in the preference for products that wherever possible satisfy the requirements of the green economy, in the priority given to products that meet certain production standards, and in the optimisation of transport efficiency.

The use of B2C tools currently prevails in Europe [24]. The use of certification schemes that cover both applications using trademarks is also growing. The label used by Coop Italia for its own-brand fresh produce (**Figure 1**) is a good example of this combined approach. Quality assurance and product safety are certified by third-party controls that focus on four complementary aspects:

1. the provenance of products from integrated farming;
2. chemical residues 70% below the legal limits;
3. the absence of post-harvest chemical treatment;
4. strict control from field to point of sale.

In the F&V supply chain, therefore, it seems fairly obvious that environmental and social sustainability has now become an asset for competitiveness, especially in supermarket distribution, due both to its role as a hub or bottleneck [24] within the F&V supply chain, and for its ability to respond more quickly to this challenge, seizing the advantages [25] through third-party certification and the private label.

³ More so in northern Europe than in the south.

⁴ The outcome of this project, launched by the European Commission in 2009, was the construction of a multi-stakeholder platform to facilitate the virtual exchange of such actions among European supermarket operators. http://ec.europa.eu/environment/industry/retail/reap/browse-by-category_en.html



Figure 1. Coop logo on fresh produce.

4. Drawbacks of the status Quo across the fruit and vegetables supply chain

Looking then at the distribution of benefits among stakeholders and the relationships between them along the F&V supply chain, it is possible to present this synthetically, as proposed in **Figure 2**.

As well as demonstrating the dominant position of the retailer as a major beneficiary of the voluntary adoption of socio-environmental responsibility behaviours, the diagram shows the subordinate position both of producers and consumers in relation to the retailer.

As confirmation of the general trend observed in the spread and effectiveness of corporate sustainability strategies [26], even in the fruit and vegetable supply chain, the competitive outcome appears to be closely related to the mechanisms that link the various stakeholders and their sustainability enhancement actions.

Despite the predominance of B2C tools and the development of multi-information labels (**Figure 1**), a segmented communication strategy is emerging within the sector, as well as a lack of multidimensional cross-cutting tools with a 360° approach to sustainability.

The diversity and fragmentation of the fruit and vegetable production system, coupled with inconspicuous own-brand policies, lead to a situation in which the adoption of responsibility behaviours in terms of sustainability, and the resulting product differentiation is mostly dictated by the demands of supermarket chains [27], instead of being designed from the ground up to showcase the unique aspects and local nature of the production system. While this ensures that producers meet high standards and encourages the renewal of retailer distribution agreements, at times even securing a premium price (net of expenses and additional costs), the level of visibility and recognition of producers among final consumers



Figure 2. Illustration of the benefits distribution resulting from the voluntary adoption of socio-environmental responsibility behaviours and the reciprocal position within the F&V supply chain. Source: authors' elaboration.

remains low. The situation is even more complicated for producers who must join several schemes to fulfil their buyers' requirements. Producers who do not participate in the main certification schemes (through choice or due to difficulties inherent in the country of origin, in the case of the tropical fruit sector) face the risk of exclusion from the market. Non-adoption can therefore translate as a market barrier.

Even the act of purchasing 'sustainable' produce is beset by a series of difficulties linked to effective communication, from consumer motivation/education to the knowledge-action gap and behaviour-impact gap problems [28].

Strict communication rules require information to be presented clearly and concisely, given the limited space on the label. This physical limitation can lead to distortions, misleading consumers in a context where the meaning of sustainability attributes could be ambiguous for the end user [29]. On the one hand, the complexity of sustainability risks being reduced to a few synthetic messages/actions with purely cosmetic content [30]. In cases where compliance is certified with minimum requirements or by self-declaration, doubts may arise over the credibility of the information or the transparency of the requirements envisaged.

On the other hand, more information in a single label can be confusing, given the consumer's gaps, thus defeating the very purpose of the label [20,31]. Where the consumer is more socially and environmentally motivated, the buying decision will be more informed and the buyer more likely to use the information on the label correctly. In other words, the communicative effect of the label does not influence the 'average' consumer, but tends to work mainly with consumers who are already motivated [29]. Behavioural change is difficult when the information given is too complex to decipher or is based on conflicting values: in these situations, consumers have a tendency to seek refuge in their usual buying habits [28].

Furthermore, it is now known that discrepancies exist between the expected (stated) behaviour and the observed (actual) behaviour of consumers when making a purchase, fostering the creation of a gap between knowledge and action (the 'knowledge-to-action gap'). This inconsistency is linked to the fact that the judgement and selection criterion for a sustainable

product have to compete with contingent factors influencing the intrinsic and extrinsic opinion of the product, such as sensory quality, nutritional value, price, brand and quantity, in which the sustainability of the product and/or the production process is merely seen as one of many final characteristics of the product category. A choice seen as sustainable does not always have the desired effect, leading to a gap this time between behaviour and impact (the 'behaviour-impact gap') [32]. In this case, information and cognitive barriers prevail alongside rebound effects [33] attributable to the presence of negative external factors within the supply chain or its interaction with the outside world. This risks having a marginal or zero effect on the commitment of parties who have adopted environmentally and socially responsible behaviours [32] and those who support them by buying their products.

5. Future challenges

Although in recent years certification schemes, as a means of private regulation and communication of the corporate sustainability commitment, have diverged enormously to increase the transparency of results and the disclosure of actions taken by producers in terms of their operating processes, significant efforts still need to be made before these become a win-win strategy for stakeholders in the fruit and vegetable supply chain. The greatest obstacle is fragmentation, in the sense of a compartmentalized and linear vision of the supply chain and an interpretation of sustainability based on size and components.

The predominance of a vertical approach represents a drag on the harmonisation process. The lack of horizontal relationships leads to unfair competition and undermines the effectiveness of these tools, especially for the end user.

While the general objective is to improve the sustainability of the fruit and vegetable supply chain, a systemic approach is needed in which—according to Nash's game theory—the best result is achieved when each stakeholder in the supply chain does what is best for itself and for the group at the same time. These represent the preconditions for a transition from the social responsibility of individual enterprises to that of an integrated supply chain or territory (depending on our point of view), in keeping with a social responsibility approach in which competitiveness derives not only from the ability to respond to the market, but also from a commitment to achieve adequate levels of sustainability guaranteed throughout the supply chain and to contribute to the economic development of the local area. In this sense, the supply chain builds and adds value, providing content and relational continuity for market transactions.

In this respect, power should be redistributed along the value chain and more consideration given to each end of the supply chain—that is producers upstream and consumers downstream—to respond to the needs of the fruit and vegetable sector by anticipating its needs.

The challenge is therefore to embrace and increasingly involve in this education and communication process the 'custodians' of sustainability, in other words operators engaged in day-to-day farming, who manage agricultural production inputs and control more or less consciously the impacts for the end consumer.

It is essential therefore that producers, individually or—better still—through producer organisations, as stakeholders with direct experience of the product on the ground, succeed in having a more active and visible role, so that socio-environmental responsibility behaviours are targeted as a worthwhile and strategic competitive advantage. The potential in terms of the reservoir of capital that can be tapped is considerable, ranging from human and organisational to relational and symbolic capital [26].

To communicate the potential for innovation and the creation of added value for the final market—and so for products that meet the ‘green and social requirements’—the consumer must also be fully equipped to decipher the information contained in the label and to recognise its objectivity and verifiability.

This approach means adopting new mechanisms for coordination between stakeholders, with appropriate forms of control such as industry codes of conduct [34,35], collaborative practices such as participatory certification systems aimed at building trust, cross-cutting assessments and analysis tools for the sector, using F&V life cycle analysis not only to assess the environmental impacts, but to consider their social [16] and economic implications. The life cycle thinking approach is part of the broader theoretical framework of life cycle sustainability analysis (LCSA) [36–38]. It paves the way for the construction of an interdisciplinary methodology aimed at combining and integrating the assessment of sustainability issues.

All of these developments are desirable, even when examined as part of the transition towards an increasingly circular economy within agri-food systems [39].

6. A meaningful case study: *Delizie di Bosco del Piemonte*

In the light of these initial points and considerations, below is a summary of a green marketing initiative [25], that we consider significant, both because it is promoted directly by a group of small producers in an upland area in the Province of Cuneo (in the Piedmont region of northwest Italy), and because the marketing content is designed to convey to the end consumer the multidimensional nature of sustainability practices and responsibility (both environmental and social). The Agrifrutta cooperative, a member of the Ortofruttalia producer organisation (PO), in a bid to bolster its image and promote its small-fruit production, decided to reduce the environmental impact of its cultivation techniques, simultaneously quantifying the actions taken so that compensatory measures could be adopted if necessary. First and foremost, the production processes and practices related to cultivation and post-harvest management of strawberries [40] and small fruits [41] were analysed and evaluated using the life cycle assessment (LCA) tool. The relevance of this technique consisted of the possibility of evaluating all phases of the strawberry and small-fruit production process as interrelated and interdependent, and of having an objective evaluation and quantification method to analyse the different components of the impacts associated with strawberry and small-fruit production.

This has effectively meant a renewed approach to the existing production/commercial system, resulting in the adoption of new practices more suited to reducing the environmental/social

impact (such as reducing the volumes of substrate used in the nursery, and using biodegradable and compostable films for mulching and packaging), communicated to consumers by creating the 'Delizie di Bosco di Piemonte' brand (Figure 3).



Figure 3. Agrifrutta cooperative logo for strawberries and small fruit.

Following the impact assessment of production supply chains, a form of carbon offsetting was proposed through the development of silvicultural systems properly managed by the same small-fruit producers (Figure 4).



Figure 4. Offsetting scheme for the strawberry and small-fruit industry adopted by the Agrifrutta cooperative.

Indeed, unlike other primary sectors, agriculture is not only a source of carbon dioxide emissions, but has the undeniable advantage of being able to perform CO₂ sequestration, thus enabling internal carbon offsetting. The differentiated production model of the farms considered, which rotate different crops each season and comprise areas of woodland, pasture or meadow, makes them natural holders of a 'green credit' and thus able to offset fully the carbon dioxide generated in their production cycle. This allows them to create an environmental business plan which forms the basis for the conservation of the characteristic landscape and agro-biodiversity of the production area. The approach taken has prepared the ground for producer members and various industry stakeholders to forge stronger ties with the local area, and to leverage this to build a reputation capable of establishing new and lasting agreements with communities, distribution channels (supermarkets) and end consumers. The brand has

strengthened the image of the product and the producer community. Creating a brand addressed the requirements imposed by a new market structure that requires ever greater product differentiation. It has also raised its profile in national and international markets, emphasising its close links with the surrounding area; even in national and international supermarket distribution, the cooperative's products can be identified and recognised, and thus distinguished from similar products.

The decision to offset emissions through management of existing local areas, as well as contributing to climate change mitigation, is also an opportunity to improve woodland management, environmental protection and the development of rural and mountain areas.

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