Green marketing tools for fruit growers associated groups: Application of the Life Cycle Assessment (LCA) for strawberries and berry fruits ecobranding in northern Italy

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Title: Green marketing tools for fruit growers associated groups: application of the Life Cycle Assessment (LCA) for strawberries and berry fruits eco-branding in northern Italy

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Abstract: In recent years, interest in environmental issues has increased and, in particular, it has been firmly established the idea that consumer choices can actually affect the environmental performance of the different production systems.
In the fruit and vegetables sector, retailers are among those who have been able to respond more quickly to this challenge, mainly using third-party certification and private eco-branding. However, there are other players in the sector that can have a pro-active role in the differentiation of their product, including producer groups, as stakeholder with direct experience of the product from the outset. Associated groups of agricultural producers of food growers can be encouraged and supported to include in their marketing practices eco-friendly information regarding their production systems. Eco-labelling could support these coops in differentiating their products to better position themselves in the market.
This paper presents how the use of LCA methodology combined with the calculation of the carbon dioxide offsetting of the same production system using the IPCC method, can help to integrate environmental content (green) into the Delizie di Bosco di Piemonte brand of cooperative Agrifrutta. At the aggregate level, the application of LCA methodology to the supply chains considered has been able to quantify the emissions from the strawberries and berry fruits marketed under the "Delizie di Bosco del Piemonte" brand. For the year 2013 the total emissions of brand products, according to the GWP impact category, amounted to 209 t CO_2 eq. The results for the emissions calculated for 2013 have been fully offset within the cooperative, through the sequestration of CO_2 performed by 21 hectares of chestnut trees on the farms owned by the members of the Cooperative.
It discusses the need of further investigation on the way to combine effectively an eco-label with a corporate brand and how to improve of the label credibility by an appropriate and balance communication.

Highlights

Eco-branding is a challenge for associated groups of agricultural producers

LCA combined with carbon dioxide offsetting is proposed as a green marketing tool

Product differentiation for fruit and vegetables sector can be pursued using eco-labels

Eco-label is an opportunity to create a more environmental friendly agricultural system

The total emissions of brand products have been fully offset by the sequestration of CO_2

Abstract

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1. Introduction

In recent years, interest in environmental issues has increased and, in particular, it has been firmly established the idea that consumer choices can actually affect the environmental performance of the product system. This applies to that part of sustainability relevant to them, relating to the use and management of the product and its waste (Tascione and Ray, 2012). Increasingly, this also seems to apply to the effects of the actions of consumers on primary production. Consumers, in effect, may play an important role in improving the food supply chain, as with their choices at the time of purchase, they may reward or penalise a product on the basis of the more or less sustainable methods by which it was obtained (Grunert, 2011).
Although consumers say they are willing to reward a product considered environmentally friendly according to their standards (Klaus et al., 2011), the history of organic products shows that positive attitudes do not always translate into purchases (Thøgersen, 2000). One of the main difficulties to create the conditions for an actual purchase is certainly disclosure by companies, especially in terms of information provided on food labels (Erskine and Collins, 1997). Labelling is an important tool to communicate the characteristics of the products to consumers, including sustainability (Banterle et al., 2013). However, the amount of information that can be placed on the label is limited and it does not always have a positive influence on the effectiveness of communication (Wansink and Hasler, 2004).
Over the past three decades, labels and brands in-store and on-pack have been the most frequently used means of communicating sustainability information related to food. According to the cataloguer ecolabelindex.com (2014), about 432 labelling systems are in existence in 246 countries, of which 147 include rules for food / drinks. The common goal of all these systems is to increase transparency along the food supply chain and inform consumers in an effort to push them towards sustainable consumption.
Such a proliferation of different markings is not, however, always positive. When there is a lack of standardization and regulation of the industry, manufacturers are tempted to make trivial, misleading or even deceptive green marketing claims, undermining consumer confidence to such an extent that the "sustainable consumer" is not satisfied with the information available and tries to find out more, referring to websites, newspapers, television programs, education or advertising (Banterle et al., 2013).
Environmental product markings can be classified and divided in various ways. There are two main categories of differentiation: the existence of a compulsory or voluntary system and the presence or lack of independent certification (granting rights to use the mark). An example of mandatory labelling is that of the EU for energy, for example for the evaluation of the energy consumption of appliances on a scale from A to F, where A indicates the minimum energy consumption and F the maximum. With regard to voluntary labelling, the International Standards Organisation (ISO) uses three categories, namely Type I, II and III. Type I refers to third-party certifications with schemes involving the use of a logo associated with the certified products. This type of label is commonly referred to in the literature as an eco-label, although the term used in this paper is expanded to include all systems of environmental declaration labelling of products.
Type II labels are based on self-declaration of producers, importers, distributors or retailers, while those of Type III provide quantitative environmental data on the product as the result of an independent evaluation (Horne, 2009). Voluntary tools and the use of labels derived from voluntary tools were already considered in the early 1990, as a potentially effective policy tool to allow important results to be achieved such as the acquisition of new market shares or increased market shares through the differentiation of products based on their sustainability attributes (Boer, 2003; Orsato, 2009), but without overloading companies with excessive liens and encumbrances (Blanco et al., 2009; Darnall and Sides, 2008; Gusmerotti et al., 2012; Khanna and Damon, 1999). In the last few years they have been increasingly adopted worldwide to communicate and demonstrate the sustainability of the production processes, in a more or less effective and truthful manner

depending on the case, (Kilian et al., 2012; Rubik et al., 2008), thus guiding consumers in their purchasing decisions.
Rex and Baumann (2007) point out that Coop Sweden declared that, as a result of consumer choice of ecological food products in 2004, in the country, the amount of pesticides used in food production was reduced by an amount equivalent to 14,000 kg and the amount of synthetic fertilisers by 1,000,000 kg. Always in Sweden, a survey has shown that the change in the purchase of household cleaners reduced the use of chemicals by 15% after the introduction of eco-labels, in which it was shown that the surfactants used had been replaced by biodegradable ones. It is important to note that these results were achieved through a combination of efforts such as advertising campaigns associated with the use of eco-labels.
In the food sector in particular, the development of the green market and the challenge of transforming the production steps in "best practices" to sustainably reshape supply chains has been run especially by large retailers through the use of two tools: third-party certification and eco-branding (Anstey, 2009; Chkanikova and Lehner, 2014; European Commission, 2008, 2009, 2010, 2011a, b; Jones et al., 2009).
While some research (Anselmsson and Johansson, 2007; Burch and Lawrence, 2005; Chkanikova and Lehner, 2014) has demonstrated over the years how the establishment of private eco-branding has encouraged the efforts of food retailers to stimulate the demand for and supply of sustainable products, little is said of the creation of eco-branding by associated groups of agricultural producers. The marketing offices of these entities, which in Italy are mainly in the form of cooperatives, are the contact point between agricultural production, particularly fruit and vegetables, and national and international retailers. Even in the case of cooperatives, the creation of an eco-label can mean a competitive market strategy based on product differentiation (Orsato, 2009). As already noted for private branding used by retailers (Burch and Lawrence, 2005) and for associated producer groups, this tool could be an opportunity to encourage the adoption of innovative practices and processes and a way of accelerating attainment of certain sectors of the market with regard to traditionally branded products. For eco-labels to actually be useful to the growers association, it is necessary that the information is conveyed in clear and engaging messages (Peattie and Crane 2005) with a focus on the environmental characteristics of food products that it is in the common interest of consumers to protect (protection of the environment and biodiversity, fish stocks, the heat balance of Earth's atmosphere through the control of greenhouse gases, the quality of workers' conditions). Currently this is a challenge, as it requires a thorough understanding of complex issues relating to sustainability, the development of indicators and metrics for each product, the ability to anticipate future trends of sustainability, in-depth knowledge of the customer (retailers) and purchase responses by consumers.

2. Methods

2.1 Conceptual framework and aim of the study

It is therefore necessary that all players in the supply chain, from primary producer, are involved in processes related to sustainability's communication and implementation, possibly in a proactive manner and not just as part of a gear. To achieve this end, it is important to identify appropriate tools, capable of reaching a compromise between the market demand, the assessment of sustainability and the need for clear and effective communication.
Aim of the paper is to address the challenge and the advantages related to the creation of eco-branding by associated groups of agricultural producers.
Moving from the initiative of the Cooperative Agrifrutta, who decided to increase the green content of its brand "Delizie del Bosco di Piemonte", it has been discussed how the LCA methodology combined with the calculation of the carbon dioxide offsetting of the same production system using the IPCC method, produce data and information that fits with this purpose and fulfils the market demand, the assessment of sustainability and the need for a clear and effective communication.
The research work has therefore been divided into two stages:

- a close examination of the current situation in terms of sustainability of the agricultural and food sector of the Cooperative, leading to the development of a protocol that quantified the impacts of supply chains of strawberries and berry fruits with the application of LCA (Life Cycle Assessment);
- the calculation of the carbon offsetting of the same production systems. The choice of the eco-balance approach in this context assumes that, unlike other productive sectors, agriculture has the undeniable advantage of performing functions, which not only relate to emissions but also to carbon offsetting. The farming businesses within the Cooperative present interesting features from the point of view of interactions between small businesses, scattered over an area with a high proportion of forest, mainly chestnut, owned by the same farms. Given this spatial specificity, it was assumed local emissions could be offset and the farm considered as a closed system that can, on the one hand, reduce emissions of production and, on the other hand, compensate for excesses through the sequestration of carbon dioxide provided by chestnut trees.

The paper has potentially interesting and valuable consequence for supply chain stakeholders, interested in the creation of an eco-label both as a competitive market strategy based on product differentiation in a globalized and highly competitive market such as the fruit and vegetable sector and as an opportunity to encourage the adoption of innovative practices and processes toward a cleaner production.

2.2 Contextualisation of the study: Agrifrutta and the "Delizie di Bosco del Piemonte" brand

The research work exhibited here fits within the eco-branding experience of the Agrifrutta Cooperative that produces fruits and vegetables in a large region of Cuneo at the foot of the mountains (Piedmont - Italy).
The strawberries and berry fruits, including raspberries, blueberries, blackberries and red currants have been marketed for a number of years under the brand name "Delizie di Bosco del Piemonte", which aims at their recognition and the differentiation on the domestic and non domestic markets emphasising the strong local link with the territory. These products play an important role in the economy of the agricultural ecosystems of the Piedmont areas of Cuneo, which extend along the western alpine ridge between the Alpes-Maritimes and the Cottian Alpes. Of the 193 companies which are members of the Cooperative, mainly small and medium-sized family farms, about a third is involved in the production of strawberries and berry fruits, with contributions by each type of product ranging from a few hundred kilos to over 10 tonnes. There is a growing interest in this product category, especially by those consumers looking for healthy products, which in the case of berry fruits are derived both from their intrinsic nutritional properties and the sustainable farming methods adopted.
In 2012, the governance of the cooperative decided to strengthen and connote in the environmental sense the image of the Delizie di Bosco del Piemonte brand, to convey to the consumer the continued commitment of the cooperative to improving the sustainability of farming methods for the production of strawberries and berry fruits, through the quantification of environmental impacts and remedial / compensatory measures.
The combination of the two methodologies proves to be useful for the Cooperative to communicate the environmental impact of each product of the brand to consumers and ensure the good behaviour of the member farmers, who, aware of the impact caused by the fruits production chain under consideration, will provide for emissions offsetting.

2.3. LCA of the chains of strawberry and berry fruits

The use of LCA, performed according to ISO14040 (ISO 2006b), is an established technique used for years for the assessment of environmental impacts associated with a product throughout its life cycle (Lee et al., 1995). Within the LCA model all impacts are measured by functional unit and are thus connected at the time of consumption to that unit (Nissinen et al., 2007).

Although the application of LCA is most prevalent at the level of a single product or a single business, its use to quantify the environmental impacts of a whole 'products category' is not an uncommon practice. In particular, in a food business context where the qualification systems of the product, often involving many producers, are committed to meeting preconceived requirements according to pre-set specifications, as in this case study, LCA can be a viable technique for determining environmental thresholds (Andersson et al., 1998; Carlsson-Kanyama, 2009; Cellura et al., 2012; Milà I Canals et al., 2009; Mouron et al., 2006). Several LCA studies have been conducted in the production of fresh produce in the EU and especially in Italy, to provide a tool to address local policies for improving their sustainability along the supply chain. These studies are designed primarily to assess the "Eco profile" of a product and to identify the phases, along its life cycle, that contribute significantly to the overall environmental impact. The aim is to investigate the potential for the improvement of the product's environmental attributes and to propose the implementation of corrective or offsetting measures (Beccali et al., 2009; Cellura et al., 2012; Girgenti et al., 2014; Salomone and Ioppolo, 2012). By making reference to this framework, in this study, the LCA was used to assess the consumption of natural resources and the environmental impacts associated with the production of varieties marketed under the brand name "Delizie di Bosco del Piemonte", including strawberries, raspberries, blueberries, blackberries and red currants. Since it has been assumed in the Agrifrutta system a similarity of vegetative habitus, growing characteristics and agricultural techniques in the supply chain for the blackberry and the raspberry and in that one of the red currant and the blueberry, the LCA was limited to strawberries, raspberries and blueberries, directly involving a representative sample of producers who belong to the cooperative to detect input and output of raw materials and extrapolate the productive processes related to the three supply chains.
The methodology involves the assessment of the global warming potential (GWP) according the midpoint method of the International Panel of Climate Change (IPCC) and of non-renewable energy (NRE). To do this, it has been assessed the impact of the following categories:

- IPCC GWP 100a: weighted sum of the amount of greenhouse gases emitted by the system (kg CO_2 eq);
- NRE - Impact 2002 + v. 2.04: that is the primary energy demand for the entire life cycle of a product resulting from non-renewable sources (primary MJ).

The data refer to the harvest of 2013. For strawberries, the cycle analysed began in August 2012 and ended in June 2013. In the case of raspberries and blueberries, multi-year crops, 2013 was considered as the base year but the inputs of the system are divided by the number of the hypothetical length of the production cycles.
The same system boundaries schema has been used for strawberry, raspberries and blueberries have been used as shown Figure 1. It also illustrates the main operations, input and disposal scenarios for the three phases of nursery, field and from post-harvest to the point of sale, interspersed by transport. The approach is considered as the "cradle to grave", as the supply chain is analysed from the nursery to the consumer, taking into account the waste produced at each stage. The use phase is not included in the system, i.e. transport from the supermarket to the home of the final consumer, however, disposal of the packaging is taken into consideration.

Fig.1 System boundaries for the application of LCA to strawberry, raspberry and blueberry supply chains

To analyse the data, it has been used the Sima Pro 7.3 software, produced by Pré Consultants. The databases used for the inventory were Ecoinvent 2.2 and LCA Food.
For each supply chain the data were then normalised through mass balance as a function of the initial assumptions and finally processed according to the two categories of impact.

2.4. Offsetting emissions from supply chains of strawberries and berry fruits

ISO 14064 defines absorber as "a physical unit or process that removes at least one GHG from the atmosphere". Inside the companies participating in the cooperative, for the most part characterised by high crop diversification, it has been quantified the storage capacity of CO_2 and the

compensation that can be generated on the farms by the presence of woody crops of tall trees such as chestnut trees, using the IPCC Guidelines (Ic) to a high level of precision (Tier 3). The IPCC methodology is currently the most widespread for the calculation of CO_2 absorbed and deemed the most reliable in the literature review conducted (IPCC, 2006). To this end an inventory of emissions was prepared according to the provisions of ISO 14064 encompassing methods for the quantification of direct and indirect emissions and absorption.
The organisation brings together emissions at the level of installations on which there are financial and operational controls. GHG sources and absorbers are associated with each of them. Indirect emissions result from the consumption of electricity. Direct emissions are derived from plants, power systems, vehicles owned or controlled by the company. The study considered emissions from the combustion of natural gas and subsidised diesel.
As a reference case for the methodology, it has been used the case of the Winery of Monte Vibiano Vecchio (Cotana et al., 2010), the first Italian farm to offset their own emissions of greenhouse gases, using only internal initiatives and activities, without, therefore, acquiring emission reduction credits from third parties.
For the definition of the absorption coefficients to be applied to the specific case, the most recent studies in Piedmont and the in the rest of Italy were compared and the most representative scenarios were selected with environmental characteristics and carbon offsetting close to that defined in the project (Various Authors, 2011a; Various Authors, 2011b), which is characterised mainly by micro-afforestation with deciduous trees and shrubs in areas characterised by substantially zero current absorption as defined for the LULUCF (Land Use, Land-Use Change and Forestry) of the Kyoto Protocol (Art. 3.3 and 3.4).
It was decided to take the measurements of the absorption coefficients that have been developed by the Istituto per le Piante da Legno e l' Ambiente [Institute for Wood Plants and the Environment] (IPLA SpA) on the "For-est" model. The model is used by the Istituto Superiore per la Protezione e Ricerca Ambientale [Superior Institute for the Environmental Protection and Research] (ISPRA) for national calculations for the purposes of reporting and verifying the commitments of Italy under the Kyoto Protocol. The data used as precautionary reference value are incidental to an absorption of 10 t ha-1 year-1 of CO_2 (Romano et al., 2011). This model is able to determine the amount of CO_2 stored (stock) in the five components of forest ecosystems defined for this pool from the IPCC Guidelines, namely the biomass living above ground and below ground (living biomass), the deadwood, the forest litter and the soil organic matter (soil), starting from the inventory data of the growing stock (m3) and applying specific coefficients to the pool and forestry category, as well as a dimensionless constant factor for converting the dry weight of the biomass into carbon of 0.5 (50%).

3. Results

3.1. LCA of the strawberry supply chain

Taking into consideration the impact of the three different phases of strawberry supply chain of "Delizie di Bosco del Piemonte", it is possible to highlight that in the nursery the most consistent impact is due to the use of the polystyrene cells, in addition to the category of fertilisers, which also includes peat as cultivation substrate (Fig. 2a). In the field phase (Fig. 2b), the use of a hose for irrigation and the PVC material used for mulching, account for the most significant impacts.

Fig. 2- Characterisation of the main impacts of the production chain - [a] nursery: 1 strawberry plant (UF) for transplant - [b] field: 250 g strawberries (UF) transferred to the Cooperative's store - [c] post-harvest: 250 g strawberries (UF) to the point of sale

In the post-harvest phase (Fig. 2c), the incidence of the phases in the nursery and in the field, taken as a whole, is respectively 59% for GWP and 66% for NRE.
The impact categories considered prevalent in post-harvest represent in percentages the remaining part of the impact (Fig. 2c and Tab. 1).

Table 1. Impacts related to the functional unit, 250 g punnet strawberries, to the point of sale

PE punnets and PE plastic film used for packaging represent, together, over 30% of both the GWP and the NRE.

Taking into consideration the impact of the whole strawberry supply chain, it is possible to show how the GWP (IPCC) accounts for 0.138 kg of CO_2 eq and uses 3,699 MJ of non-renewable energy (Tab. 1).

3.2. LCA of the raspberry supply chain

Taking into consideration the impact of the three different phases of raspberry supply chain of "Delizie di Bosco del Piemonte", it is possible to highlight that in the nursery the most consistent impact is due to the disposal of the plastic material used for the implementation of the plant material (Fig. 3a). In the field phase (Fig. 3b), fertilisation with the use of a hose for irrigation and PVC material used for mulching, account for the most significant impacts.

Fig. 3 - Characterisation of the main impacts of the production chain – [a] nursery: 1 raspberry plant (UF) for transplant- [b] field: 125g raspberries (UF) transferred to the Cooperative's store - [c] post-harvest: 125g raspberries (UF) to the point of sale

In the post-harvest phase (Fig. 3c), the impact of nursery and field, here taken as a whole, is respectively 46% for GWP and 43% for NRE.
The impact categories considered prevalent in post-harvest represent in percentages the remaining part of the impact (Fig. 3c and Tab. 2).

Table 2. Impacts related to the functional unit, 125 g punnet of raspberries, to the point of sale.

Punnets in PE and PE plastic film used for packaging represent respectively 30% and 9% of the GWP and 35% and 15% of the NRE.
Taking into consideration the impact of the whole raspberry supply chain, it is possible to highlight how the GWP (IPCC) is represented by 0.053 kg of CO_2 eq and has a requirement of 1.119 MJ of non-renewable energy (Table 2).

3.3. LCA of the blueberry supply chain

Taking into consideration the impact of the three different phases of blueberry supply chain of "Delizie di Bosco del Piemonte", it is possible to highlight that in the nursery the greatest impact is attributable to the use of the PE cover and to fertilisers, which also includes peat as cultivation substrate (Fig. 4a). In the field phase (Fig. 4b), fertilisation, together with the use of a hose for irrigation and PVC material used for mulching, account for the most significant impacts.

Fig. 4 - Characterisation of the main impacts of the production chain – [a] nursery: 1 plant of blueberry (UF) for transplant - [b] field: 125g blueberries (UF) transferred to the Cooperative's store - [c] post-harvest: 125g blueberry (UF) to the point of sale

In the post-harvest phase (Fig. 4c) the impact of nursery and field, here taken as a whole, is respectively 38% for GWP and 36% for NRE.
The impact categories considered prevalent in post-harvest represent in percentages the remaining part of the impact (Fig. 4c and Tab. 3).

Table 3. Impacts related to the functional unit, 125 g punnet of blueberries, to the point of sale

Punnets in PE and PE plastic film used for packaging are, respectively, 29% and 9% of GWP and 35% and 15% of the NRE.
Taking into consideration the impact of the whole blueberry supply chain, it is possible to highlight how the GWP (IPCC) is represented by 0.055 kg of CO_2 eq and has a requirement of 1.123 MJ of non-renewable energy (Table 3).

3.4. The offsetting of emissions from strawberry and berry fruits supply chains

The measurements were conducted at monitoring stations in the province of Cuneo, in the area where the Cooperative is located. The area is characterised by forest dominated by chestnut trees. The most updated available data of 2006 show an increase of 2.99 t C ha-1 year-1 for a chestnut tree managed under similar conditions to those under examination, which correspond to those of a managed chestnut grove of tall trees for fruit production, where, on some occasions, the forest is exploited to maintain productivity, therefore, it is provided as a precautionary reference value for the expected scenario, that of an absorption of 10 t ha-1 year-1 of CO_2 (2,99x3,66 = 10.94).
The data considered refer to the 2013 production, the reference year of the study. Production is related to the amount of product sold under the "Delizie di Bosco del Piemonte" brand in totality, which is including blackberries and red currants in addition to strawberries, raspberries and blueberries. The data for these last two species were obtained, as in the case of LCA, assuming that the blackberry supply chain can be considered similar to that of raspberries and red currants can be considered analogous to blueberries.

Table 4. - Calculation of the offset emissions of products under the "Delizie di Bosco del Piemonte" brand.

The comparison of calculated emissions and estimated absorption of a chestnut tree (Tab. 4) shows that the surface area of chestnut trees needed to absorb emissions of the supply chains is 21 ha.

4. DISCUSSION

The case study described provides some interesting insights to evaluate the application of LCA methodology at the level of individual products and “product aggregation”, i.e. business clusters to include the information already conveyed by the brand, with elements derived from the environmental assessment. First, the LCA study on products of the Delizie di Bosco del Piemonte brand was a useful tool to support decision making on measures to improve the environment of the Agrifrutta Cooperative, optimising them with a perspective of incremental implementation. Taking the individual steps of the supply chain into account, it may be assumed that there could be some improvements. For the nursery phase, across the supply chains concerned (strawberries, raspberries and blueberries directly and blackberries and red currants indirectly), it has been assumed a reduction in the volume of substrate used (mainly peat), the production and transport of which consumes the most energy considering the low weight per unit volume that characterises such a material.
In the field phase, the major impacts both in terms of energy and GWP and of NRE are related to all those agronomic operations, which use plastics derived from fossil fuels such as irrigation (hose), mulching and covering. It is recommended that innovative action be taken in regard to these items by experimenting with and possibly introducing biodegradable plastic materials. Currently these materials have a greatly restricted use due to the fact that they are currently not durable, which makes them suitable for shorter production cycles such as those of vegetables. Moreover, when biodegradable materials are used, although the literature shows their lower impact (Razza et al., 2010), you still also need to consider the entire production process of such materials and emissions during bio-degradation. Replacing existing materials with biodegradable and / or compostable ones is, however, to be taken into consideration for the future as, in addition to environmental advantages, the Cooperative could decrease costs by using them for mulching thereby reducing labour costs for removal. The phase at which action can be taken to obtain the

greatest environmental benefits is that of post-harvest. Given that it is technically unthinkable to dispense with the use of packaging of strawberries and berry fruits for sale through large distribution channels, possible solutions mainly focus on the replacement of PE materials with biodegradable and compostable materials, such as PLA or MaterBi®, allowing the disposal of the entire pack as organic waste.
At the aggregate level, the application of LCA methodology to the supply chains considered has been able to quantify the emissions from the strawberries and berry fruits marketed under the "Delizie di Bosco del Piemonte" brand.
For the year 2013 the total emissions of brand products, according to the GWP impact category, amounted to 209 t CO_2 eq. The results for the emissions calculated for 2013 have been fully offset within the cooperative, through the sequestration of CO_2 performed by 21 hectares of chestnut trees on the farms owned by the members of the Cooperative.
The emission calculation and compensation has thus allowed the Cooperative governance to implement a model for future sustainable development strategies starting from objective data. These considerations are necessary considering the increase in the production and sale of such products, which rose from 292.6 tonnes in 2012 to 441.9 tonnes in 2014, with current estimates for 2015 standing at more than 500 tonnes of product. Considering the strong growth in sales of brand products, an increase in emissions is conceivable and thus the supply chain must be optimised so as not to miss the undeniable advantage of being able to provide the consumer with high quality products, characterized by a strong link to the area of origin and "zero impact".
Using the approach taken to carry out the research, the Agrifrutta Cooperative may disclose to the consumer in a transparent manner the characteristics of its brand products "Delizie del Bosco di Piemonte" and valorise local production and local resources. The chestnut forests, as well as characterising the agro-ecosystem in which strawberries and berry fruits are produced, are the means by which CO_2 sequestration takes place.
For this approach (LCA and IPCC compensation) there is no specific certification and, at the present time, the cooperative does not have environmental certification or an eco-label but the research carried out can nevertheless lead to self-declaration of a product with "Zero Impact" and possibly the use of green credits, following the scheme of type II voluntary labelling, which was inspired by an objective assessment of environmental loads carried out by a third party of type III.
The decision to offset emissions through virtuous management of existing woodland areas as well as contributing to climate change mitigation in situ, can be an opportunity to improve the management of forests, specifically chestnut, and protect the environment in view of the socio-economic development of rural and mountain areas in general. In fact, the benefits achieved by the proposed model can go beyond the single supply chain examined or the individual case study. This path may be adopted by other local companies active in the entire agricultural sector of the region and expand "like wildfire." The image of products obtained from one district with zero impact will be a highlight of the Piedmont fruit and vegetable production system for the benefit of producers and consumers.
An added value of the supply chain and the brand taken into account could therefore be based on environmental sustainability, calculating and offsetting emissions, with a view to future environmental certification, in order to enhance the corporate image by promoting and selling strawberries and berry fruits with "Zero Emissions".

5. CONCLUSION

It is obvious that neither eco-labelling nor environmental information is a goal in itself, but they are means of creating a system of production and consumption that is more environmentally friendly and that means creating a greener market. Voluntary labelling schemes are inherently imperfect, but if they are managed through information coming from a standardised methodology such as the analysis of the life cycle, they can be properly contextualised and understood. It is important to remember the production phase is a ring emblematic of the food system and can be an important point in the definition of new models of production and consumption.
However, further investigations definitely need to be carried out as already pointed out by Koos (2011) and namely how is an eco-label combined with a corporate brand effective in reaching the

consumer, in summarising the relevant content of the product and its environmental impact. The challenge is to overcome the risk of creating confusion among consumers with an information overload consequence of the large amount of compressed information that labels seem to incorporate and the wide number of different logos indicating environmental sustainability available in the market (Ginon et al., 2014).
Moreover, as already noted by Larceneux et al. (2012) it is necessary to study further the effectiveness of co-branding (combined producer-retailers, manufacturer certification of third-parties, retailers and third-party certification). In any case, the fundamental requirement is that consumers find the label credible. To achieve this it is necessary for manufacturers, retailers and government agencies to work together for the development of clearly defined eco-labels able to catch the consumers attention, placed in a prominent position on food and supported by appropriate communication.

6. ACKNOWLEDGEMENTS

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Figure 1
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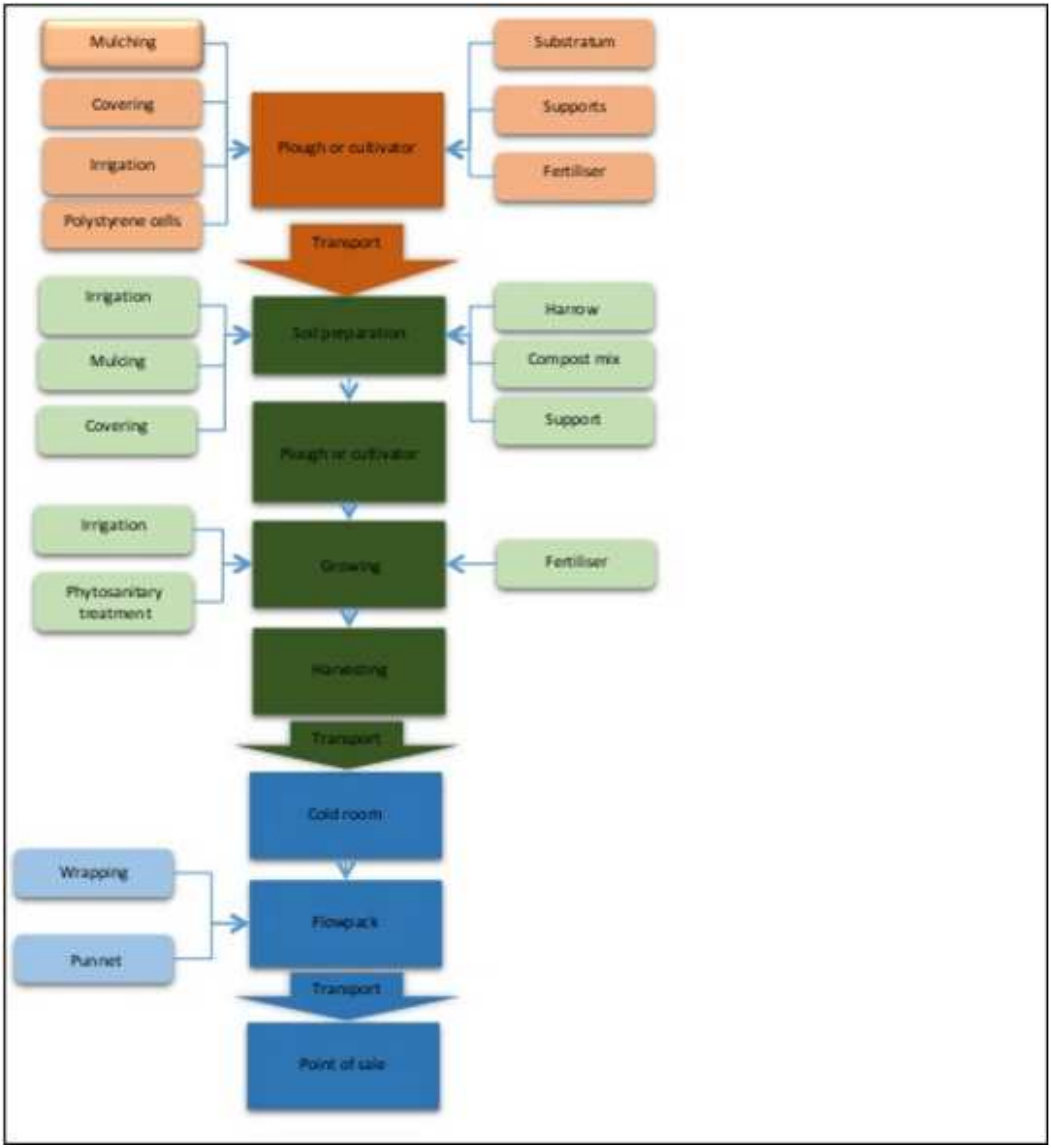

Figure 2/strawberry

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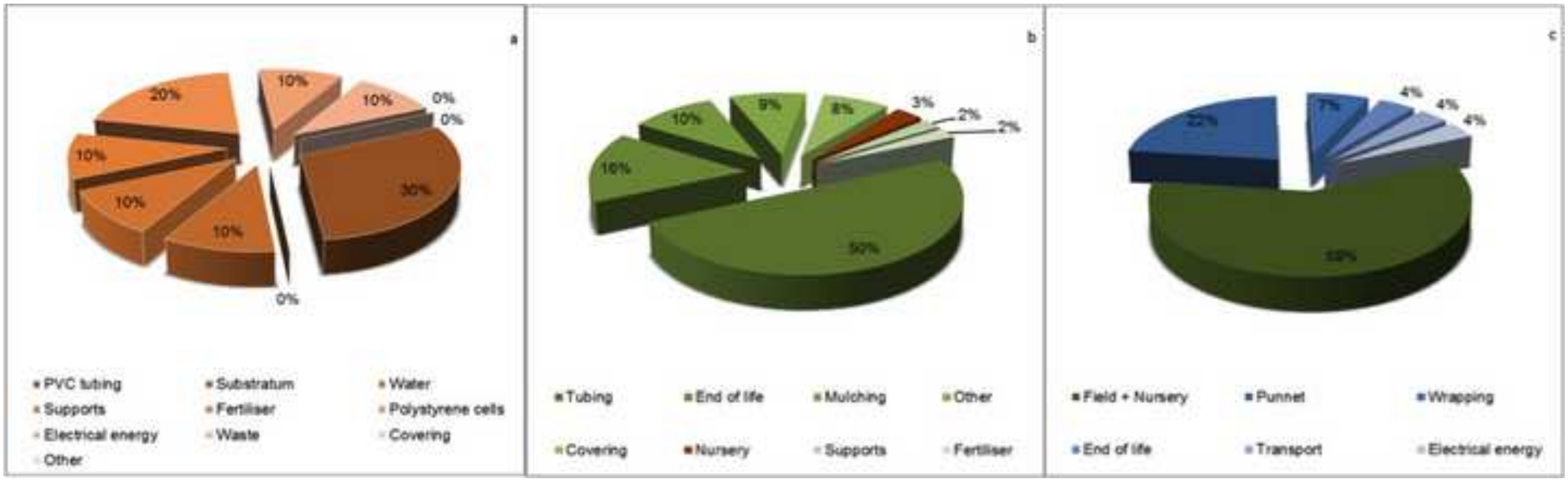

Figure 3/raspberry

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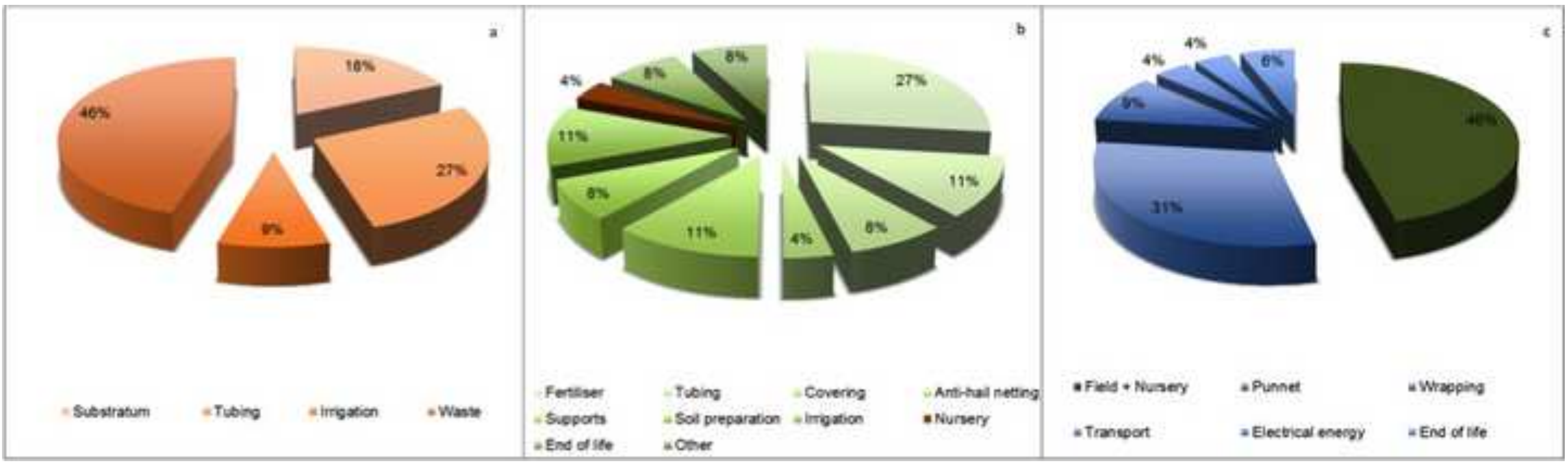

Figure 4/blueberry

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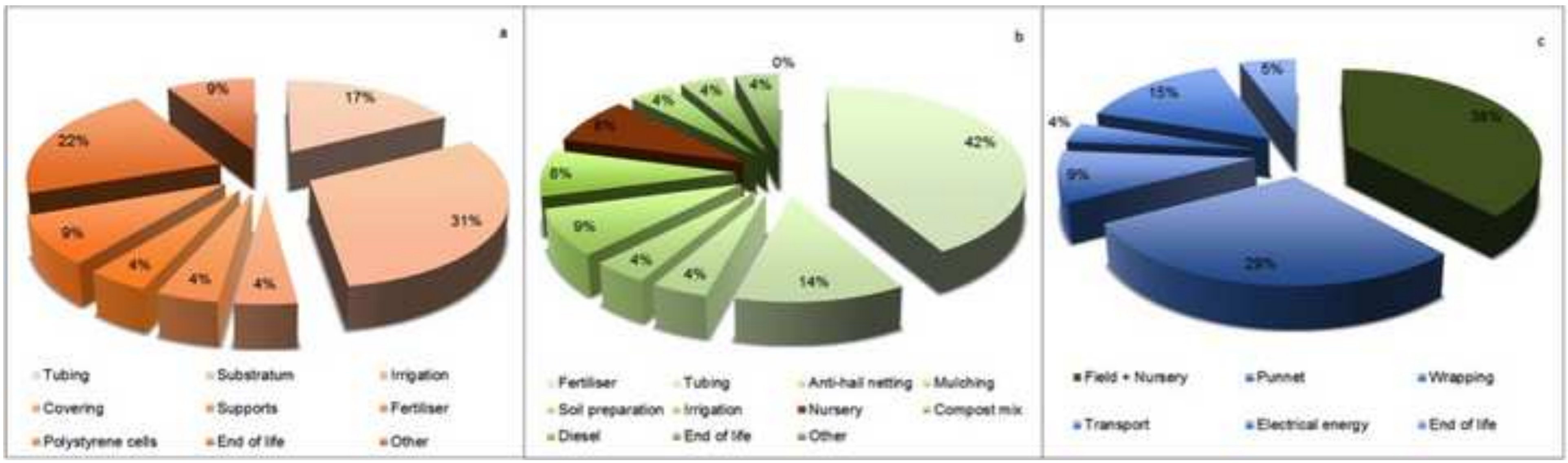

Table 1/strawberry

Input	Impact category	
	Non-renewable energy MJ UF-1	IPCC GWP 100a kg CO_2 eq UF-1
Strawberry (nursery+field)	2.425	0.081
PE punnet	0.789	0.031
PE Plastic Film	0.332	0.010
End-of-life	0.005	0.006
Transport	0.080	0.005
Electricity	0.070	0.005
Total	3.700	0.138

Table 2/raspberry

Input	Impact category	
	Non-renewable energy MJ UF-1	IPCC GWP 100a kg CO_2 eq UF-1
Raspberry (nursery+field)	0.481	0.024
PE punnet	0.395	0.016
PE Plastic Film	0.166	0.005
Transport	0.040	0.002
Electricity	0.035	0.002
End-of-life	0.002	0.003
Total	1.119	0.053

Table 3/blueberry

Input	Impact category	
	Non-renewable energy MJ UF-1	IPCC GWP 100a kg CO_2 eq UF-1
Blueberry (nursery+field)	0.404	0.021
PE punnet	0.395	0.016
PE Plastic Film	0.166	0.005
Transport	0.040	0.002
Electricity	0.116	0.008
End-of-life	0.002	0.003
Total	1.123	0.055

Data File

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