A study case about a traceability system in the fruit and vegetable chain*

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Corrado Giacomini, Maria Cecilia Mancini
Sezione di Economia Agroalimentare – Dipartimento di Economia
Università degli Studi di Parma – Via Kennedy 6, 43100 Parma
corrado.giacomini@unipr.it mariacecilia.mancini@unipr.it

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Abstract

Over the last few years, the demand of safe food by the consumer has become the main priority.
In Italy, an important chain is represented by fruit and vegetable sector. For this sector, as it happened for some others, the assurance of traceability along the chain could become a basic element to face the competition of the market.
This paper is divided into two parts. The first part focuses on the current national legislative framework about fruit and vegetable products, with special attention to the problem of quality control of products, in particular relating to the tests of phytochemical residues carried out by the Ministry of Health annually.
The second part analyses a case of traceability in the fruit and vegetable sector with the purpose of identifying those company strategies that can make a control procedure and a consumer's information policy convenient.

Key words: traceability, quality, safety

1. Introduction

In recent years the consumers' demand for hygienically safe food products has been given absolute priority.

The serious situations which have emerged lately in the food sector have unsettled consumers and caused devastating economic repercussions in the areas involved, so much so that it was necessary to have EU legislators intervene to ensure stricter regulations for agri-food productions.

So far the fruit and vegetable sector has remained untouched by major scandals which have concerned mainly the meat sector - beef and other meat- and therefore no special restrictions or regulations have been introduced in this area by legislators, however one wonders how long such privileged treatment can be expected to last and whether it is justifiable. Let us not forget that the fruit and vegetable sector has in the past generated alarm after tests were conducted on phytochemicals. Residues in fruit and vegetable products, giving rise to feelings of apprehension, which, especially in view of the new trends in the nutritional habits of consumers, have to be dispelled. Operators in the fruit and vegetable sector are well aware of the fact that the reputation which this sectors enjoys with the public opinion and the growing appreciation reflected in nutritional education campaigns highlighting the beneficial effects of eating fruit and vegetables must be supported with something more than the requirements provided by the law. For this reason the private initiative promoted by producers and associations of producers has started projects to ensure, through a process of standardisation

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and traceability of operations, a marked reduction of the health risks associated with the rationalisation of productive activities and, in general, of the whole supply chain.

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The second part analyses a case of traceability in the fruit and vegetable sector with the purpose of identifying those company strategies that can make a control procedure and a consumer's information policy convenient.

2. Remarks about the levels of pollution in Italy's fruit and vegetable production

The fruit and vegetable sector is one of the major agri-food sectors in Italy, with approximately two million people employed, in primary and connected activities, a production of 23.6 million tons and a volume of business of 18 billion Euro for the year 2000. As regards the overall production for the year 2000 there was a 5% reduction compared to the previous year, while some varieties registered significant increases: that was the case with citrus fruit with production up 17% on 1999 figures.

Price fluctuations brought about a decrease of the gross marketable production and, as a consequence, of the volume of business of the entire sector, side activities included, which went from 8.6 billion Euros in 1999 to 8.2 in the year 2000. On the other hand, in 2000 the sector achieved the best import/export balance in the last five years, reaching 963 million Euros, with a 50% increase with respect to 1999.

In Italy overall consumption of fruit and vegetables in 2000 was 9.5 million tons and, according to figures produced by research companies, 60% of the population eat fruit and vegetables every day.

When we look at these data, which confirm the fact that consumers choose these products because they are healthy and fresh, we are faced with the problem of residues of the chemicals used in productive activities and present in the peel and pulp of fruits.

During the eighties, the growing influence exercised on consumers by the ideas and messages from green and ecological movements and the repeated cases - highly emphasised by newspapers - in which fruit available on the market was found to have values of residues exceeding the limits allowed by the law[1], increased the concern of the population so State and Regions issued provisions aimed at increasing and reorganising monitoring activities applied to the level of residues in food products and at promoting the use of phytopathology control techniques with low environmental impact (organic, guided and integrated) (Giacomini, 1997).

Since 1980 the National Health Service, coordinated by the Ministry of Health, has been carrying out methodical monitoring of phytochemical residues in food products and, with ministerial decree of 23 December 1992, the national legislator has prepared a plan for the implementation of inspections at the regional level and in self-governed provinces, with an indication of the minimum number and type of samples.

[1] These are some of the articles appeared on daily newspapers during the 80s: "Poisoned fruit" (*La Stampa*, 7.10.87), or "Toxic apples" (*l'Unità*, no. 63,1989), or, once more, "Poisoned apple" (*Il Sole 24 Ore*, 15.3.89), "Fruit with solvents" (*Resto del Carlino*, 10.3.89) and "Grapes and cyanide" (*La Repubblica*, 16.3.89).

This measure, in line with the European programme for official inspection of fruit and vegetables, cereals and products of vegetable origin[2], makes it possible to produce data collections that are increasingly complete and able to be used to obtain feedback and suggestions for inspections in future years as well as to guide citizens in their choice of food.

If we examine the results of the inspections carried out in Italy in 1991, 1995 and 2000 (Table 1) we can note a slight fluctuation in the incidence of irregular samples which is always within the percentage range of 2.0-3.9 out of the total number of samples analysed.

Table 1: Number of samples and percentage of irregularities found in fruit and vegetables in Italy (1991, 1995, 2000)

	1991		1995		2000	
	No of samples	% irr	No of samples	% irr	No of samples	% irr
Fruit	387	3.7	4,375	3.2	4,188	2.5
Vegetable	214	4.0	3,803	1.9	3,813	1.4
Total	601	3.9	8,178	2.6	8,001	2.0

Source: Ministero della Sanità, Osservatorio Nazionale Residui

In November 2000, the European Commission published[3] data about pesticide residues found in the fruit and vegetable sector in the year 1998 in EU countries and in Norway (Table 2).

This national trend is confirmed also by data supplied by the Emilia Romagna region, one of the major producers of fruit and vegetables.

Considering the significance of the sector in this region, since 1990 one of the priority objectives has been the reduction of the risks deriving from the use of chemicals in agriculture, with the allocation of substantial resources and anticipating the Ministerial Decree of 23/12/92 which requested testing of 4370 samples of fruit and vegetables from all over the country and assigned to the Emilia Romagna region the task to analyse 465 samples.

[2] Directive 86/362/EEC and the subsequent directive 90/642/EEC fixed maximum allowed levels of pesticide residues in vegetable products. Member states are required to check that these levels in agricultural products are observed using the method described in directive 89/397/EEC on official inspection of food products and directive 93/99/EC concerning additional measures for official inspection of food. Samples must be collected in conformity with directive 79/700/EEC. In addition to national monitoring programmes, the Commission established with the Recommendation of 97/822/EC that each Member State shall participate in a monitoring programme coordinated by the EU. Article 7 of Directive 86/362/EEC and article 4 of directive 90/642/EEC, modified by Directive 97/41/EC, establish that Member States must report to the Commission the results of monitoring programmes for pesticide residues carried out both as part of the national programmes and in the EU coordinated programmed. As of April 1st 2000 a new Monitoring Regulation (Reg.(EC) 645/2000) is in force which provides detailed rules for the application of directives 86/362/EEC and article 4 of directive 90/642/EEC.

[3] European Commission Health & Consumer protection directorate general, Monitoring of Pesticides residues in Products of Plant origin in the European Union and Norway – 1998 Report, November 2000

Table 2: Results from 15 countrywide monitoring programs for pesticide residues in the fruit and vegetable sector (1998)

Country	no of samples	no of irr. samples	% irr.
B	1,920	143	7.4
DK	2,000	63	3.2
D	6,040	292	4.8
EL	1,164	52	4.5
E	2,932	70	2.4
F	--	--	--
IRL	285	13	4.6
I	8,498	107	1.3
L	210	8	3.8
NL	4,938	293	5.9
A	321	10	3.1
P	446	15	3.4
FIN	2,442	68	2.8
S	3,225	70	2.2
UK	732	-	-
Norway	2,686	63	2.3
EU14 + Norway	**37,839**	**1,267**	**3.4**

Source: European Commission Health & Consumer protection directorate general

The Emilia Romagna Region has provided for the implementation of the national plan established by Ministerial Decrees no. 26/4/96 and 2/10/97 by approving circular no.21 of 14/7/97.

Table 3: Number of samples and percentage of irregularities found in fruit and vegetables in Emilia Romagna (1995, 1997, 2000)

	1995		1997		2000	
	no of samples	% irr	no of samples	% irr	no of samples	% irr
Fruit	1,564	3	1,380	2	1167	4.8
Vegetables	1,056	1	909	2	640	2
Total	2,620	2	2,289	2	1,807	3.4

Source: Regione Emilia-Romagna, Assessorato alla Sanità

3. The concept of traceability

The concept of "traceability" has been in use in voluntary regulations for quite some time; in 1987 the first edition of the ISO 9000 regulations (at the time referred to in Italy as UNI EN 29000) came out and traceability was included among the requisites that producers had to comply with. Now in the third edition of these regulations, traceability is defined as the "ability to retrace the history, the use or the location of a given item"[4]. The same regulation also points out that the term traceability, when referred to a product, can relate to the origin of materials and components, the history of the processes used on the product and the distribution and location of the product after delivery. This concept is reiterated in regulation

[4] UNI EN ISO 9000 Quality management systems - Principles and terminology, December 2000

UNI EN ISO 9001:00[5], item 7.5.3, which states that "when traceability is a requirement, a company must have control of and register products by univocal identification."

Today, in the light of the food scandals which have occurred in recent years, one cannot fail to see that the main limit of traceability as defined above lies in the application of this concept by companies. One can understand how, from the point of view of companies, it is fair to limit the obligation to ensure traceability to the company's sphere of responsibilities but it is also true that, from the consumers' perspective, it is necessary to extend the system of traceability to the whole supply chain.

To satisfy this need, in April 2001 UNI[6] published a voluntary regulation[7] on supply chain traceability, which fills the gaps left by the regulations approved to date, where traceability is requested not only "inside" each organisation but also "between" organisations which have a role in producing, distributing, marketing and supplying a product.

Traceability as defined above has important consequences on the processes involved, first of all in terms of organisation. To evaluate the amount of changes required for this purpose one must consider, in addition to the starting situation of the production units involved, the characteristics of the sector considered and the type of traceability requested, which can be total or partial. If total traceability is required, one must be able to identify with accuracy and certainty, the origin of a lot, meaning a product or set of products made from one or more raw materials of the same origin, with no mixing between raw materials of different origins in terms of both space and time.

Requisites of this kind call for significant efforts all along the supply chain, both upstream and downstream. In the first case, one must be able to provide evidence for the phases of production or cultivation of the raw materials which made up a given production lot, including also feeding and vaccination of livestock or plant protection treatment, conditions of treatment (temperature, state of health, …) conditions of livestock or crop transport and, where applicable, storage. In the downstream section registration is required for all the activities regarding reception and unloading of raw materials, processing phases (formulation, treatment, production parameters), microbiological controls, documentation relating to physical-chemical composition, origin of packaging, storage and distribution conditions. Throughout all of the activities involving the various players in the supply chain the imperative conditions applies of no mixing between different lots and uninterrupted traceability.

Very often traceability as described above is not economically feasible. In the fruit and vegetable sector innumerable examples can be mentioned: for instance, as far as tomato processing is concerned it is not reasonable to assume that the factory lot printed on the package of the finished product will correspond to the raw material brought in by one individual farmer, as no one farm can supply all the produce required by large processing facilities. A similar argument can be made for the sector of processed fruit (jams, fruit juices, etc.) and fresh fruit, where it is difficult to maintain traceability both at reception and during storage in cold rooms.

For this reason companies apply what is referred to as partial traceability which makes it possible to have an approximate indication of the origin of a lot according to the date and time of arrival or to the duration of an operation.

The reorganisation required by the traceability system implies two main burdens for the companies involved: increased production costs and the need to redefine contract terms with supplying firms.

[5] UNI EN ISO 9001 Quality management systems – Requisites, December 2000
[6] Ente Nazionale Italiano di Unificazione
[7] UNI 10939:2001 Designing and implementing a traceability system

As previously mentioned, the increase in costs is strongly influenced by the existing facilities and by the level of traceability that one chooses to implement; on the basis of these variables it may be necessary to adopt a new information system or simply to reorganise activities using identification systems and manual registrations (for example labelling materials and recording information on forms).

If we consider the whole supply chain, the second aspect concerning revision of contract terms with suppliers acquires greater relevance. This burden is going to apply with increasing frequency, as in modern distribution companies carry out inspections at their suppliers' premises to ensure that the procedures adopted comply with the requirements they have imposed. Faced with this evolution in their relationship with distribution, producers have started to respond by voluntarily undergoing certification by officially credited agencies who verify that all the elements required to ensure traceability of products are in place.

On the other hand, traceability provides a valuable opportunity for the companies involved. First of all it contributes to improved management of production and stock, through identification, registration and standardisation of the activities involved; secondarily, it serves as a means of communication with intermediate customers, in particular, modern distribution and end consumer. Faced with ever more demanding and pressing requests for a guarantee of product quality, the presence of a traceability system represents a powerful competition instrument which adds value to the product and makes it possible to transfer additional costs to the buyer, who has shown to be willing to pay for this "product plus".

4. Traceability in the fruit and vegetable sector: a case study

The traceability model under examination is the model adopted by a co-operative of fruit and vegetable producers, located in the province of Modena, which certified in the 1999-2001 period both the quality system in accordance with the ISO 9002/94 standard, and the environment management system in accordance with the ISO 14001 standard.

Figure 1 : Model fruit and vegetable supply chain

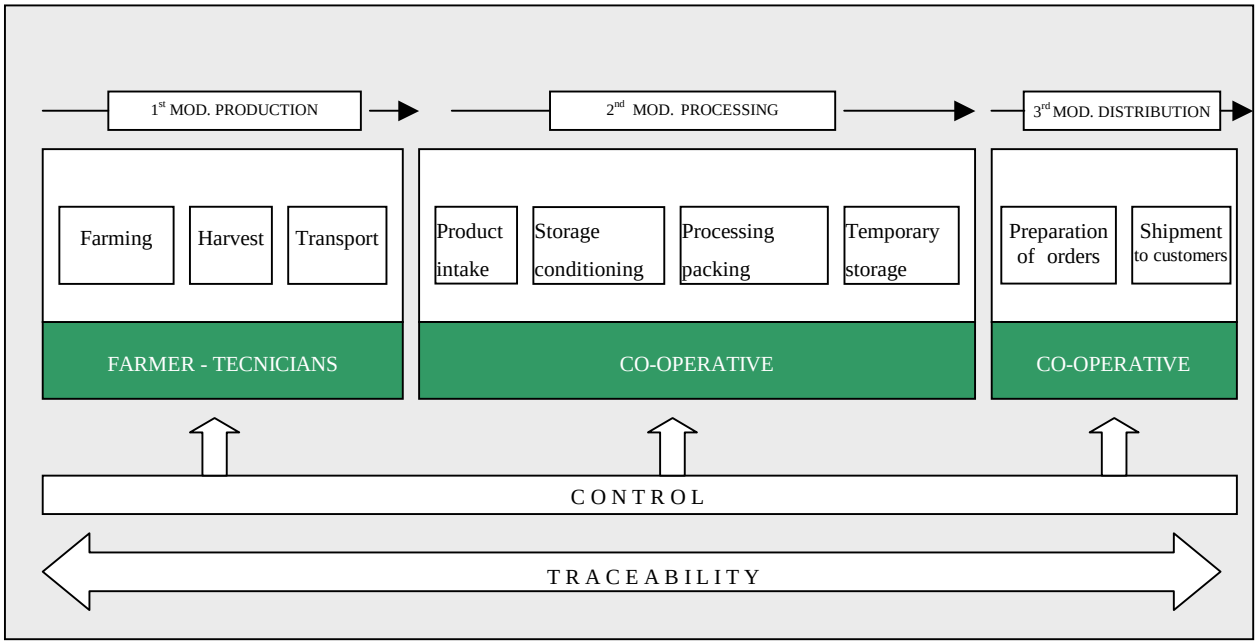

Figure 1 shows the macro steps of a "model" fruit and vegetable supply chain to assure product traceability. It also shows the concept, mentioned several times, according to which

traceability cannot be limited to the respect of specific rules at a specific stage of the supply chain, but it requires the participation of all the actors up and downstream. It represents the macro steps of a "model" fruit and vegetable supply chain through which product traceability must be assured.

This diagram also applies to the case under examination: the activities that are necessary for the product from the field to the sales outlet are described and combined into three modules, namely farming, processing warehouses and distribution. The first module is under the farmer's control, whereas the second and third modules are controlled by the co-operative. After defining the field of application of the traceability system, it is necessary to proceed with a detailed analysis of the activities and instruments used to implement the traceability concept.

In the case under examination, the key implementation instrument is the computer system made up of four programmes, which are integrated to manage all the company processes and the in-field farming step. The interest of the co-operative in creating a system like this dates back to 1996, when the co-operative developed three completely new programmes with the help a company specialised in designing customised software. These three programmes aimed at managing coop members' activities, quality control of products and activities carried out inside the plant, and they were subsequently interfaced with the existing accounting programme. The beginning of 1997 saw the introduction of the software relating to coop members' activities and to quality control, and the programme for the management of in-plant activities was added a year later. Today, the complete system is made up of a Scanner System, that allows the management of agricultural produce up to its delivery into the plant, a Laboratory Information Management System (L.I.M.S.), for the control of process quality and, in particular, for testing chemical residues in fruits and vegetables, and a Bar Code System, whose field of application covers intake, processing and packing of product. These programmes are interfaced with UNIFORMA[8], which manages the administration and accounting activities on an AS 400 system.

The co-operative also used a databank, FITOGEST, that contains all the names of antiparasistic agents sold in Italy with the relevant information on composition, field of application, contraindications and dosage allowed and M.A.R.[9]

4.1 Analysis of activities and traceability system of the co-operative

Using the subdivision into modules shown in figure 1, the traceability system envisages, first of all, the involvement of the agricultural activities carried out by the coop members. At this stage, the fundamental documents for traceability purposes are:

- personal and cadastral data of all the coop members, stored in the UNIFORMA programme;
- the land journal, filled in by farmers, where the treatments carried out are recorded;
- the FITOGEST databank;
- the production standards, according to which the products delivered by the farmers are classified, stored by the Scanner System. At present, the co-operative uses four reference standards: Integrated Pest Control Standard of the Emilia-Romagna Region (QC), Standard in accordance with Reg. (EEC) 2078/92 and successive amendments, Organic Production Standards and a Standard drawn up by one client of the co-operative belonging to the Mass Distribution sector[10].

[8] UNIFORMA is the accounting and administration software modified by CONERPO to be adjusted to specific activities carried out by co-operatives. It was purchased by this co-operative in 1993.

[9] M.A.R. = Maximum Allowed Residue

[10] The product features may not to be classified in any of the four reference standards. In this case the product can be classified as traditional, or, if not conforming with the laws in force, as an illegal product.

The results of the analytical tests on residues of pesticides, managed by LIMS that sends and receives data via the Internet to external Test Laboratories.

By using the Scanner System, it is possible to automatically input the data relating to pest control treatments carried out by the farm by means of a scanner that reads special optic forms. The programme that is interfaced both with UNIFORMA, from which it receives personal and cadastral data of the coop members, and with the FITOGEST databank, from which it receives all the names of antiparasistic agents sold in Italy, checks the data input vs. the requirements imposed by the standards. This programme also provides the information needed for processing the request for seeking certain active principles within LIMS, which, after sending the data to laboratories and receiving analytical results, processes the necessary data for making up the Batch History. This is a file where each individual batch is associated to one of the Standards set by the co-operative, namely:

- illegal products (FL), when they do not comply with the Italian legislation;
- traditional product (PT), when they do not comply with the integrated pest control standards;
- product bearing the Emilia-Romagna Controlled Quality brand (PA); when batches comply with the integrated pest control standards of the region, are delivered following the end of the absorption time of the phytochemicals used, the test of the pesticide residues has been carried out on 10% of phytochemically homogeneous batches, the maximum allowed residues of the individual active principles are <30% of the limits imposed by the law, the summation of active principles having similar activities are <100% (insecticides, fungicides, acaricide) in the GPI production area for recognised species;
- organic product (BI), for batches conforming with EEC Regulation 2092/91 and successive amendments, with Maximum Allowed Residue of the individual active principles, that are not allowed and/or not declared, not detected by means of tests carried out for every type of supply;
- product with minimum features imposed by the standards of the client mass distribution chain (GDO) not complying with these standards.

Once the product has been delivered to the delivery place the second activity module starts. The latter is managed by the Barcode System that allows to control the “labelling and identification at intake” and the “warehouse management” of the product. The minimum identification unit is one pallet or one bin that have been defined as the “handling units” in the “Product Identification and Traceability” of the company Quality System.

The “labelling and identification at intake” step is integrated by UNIFORMA, from which personal and cadastral data of the coop members is taken, and by Scanner System, which has previously stored the data contained in the Batch History. The person in charge of intake, besides the normal accounting procedures relating to the product delivery to the plant, draws up and prints a batch identification label bearing a bar code, which will be attached to each “handling unit”, to assure the traceability of the batch within the plant until the product enters the processing line. The labelled product is stocked in refrigerated storage rooms after a brief stop for carrying out the sampling procedures.

The “warehouse management” step, controlled by the same BarCode System programme, also envisages the use of AS400, which can provide customers’ personal data, list of packs that can be used and coding of Species and Varieties. The BarCode System stores all the data relating to the products in stock. The product traceability during this stage, for example when transferring it from a room to another, is possible making sure that every time there is a handling operation not specified in the bar code of the original batch label, the destination cause (e.g. new destination room) and all the labels of the product, concerned by this handling, are read by means of an optic reader that stores the product handling operations and

the relevant time references[11] . For this purpose, every room is identified by a label with a bar code attached onto the room door.

Going on with the analysis of the flow chart (Figure 2), the traceability system is kept in place during processing by identifying every processing line by means of a bar code near the infeed point. All the batches of products that are cultivated according to Integrated Pest Control or Organic Farming methods, are processed separately with respect to other products and in particular with respect to the PT product that is processed along separate lines or during separate work shifts. During all production processes (e.g. product adjustment, gauging of semi-processed products, etc.), the traceability system is assured by the reading of the identifying bar code of the processing line and of the labels involved in the processing and, therefore, by the printing of a new label with the bar code. This label, that is attached to the product being processed, allows for a recording of the new "life span" the product has undergone. Similarly, also the finished product is identified by a label whose bar code can retrieve all the operations and handling of that production batch.

The management of the third module, or better the steps for preparation of orders and shipment to customers, is based on the same concepts and instruments described for the first two modules: the person in charge of the load preparation line prepares the pallets of products by referring to the bar code both for reading customers' orders and for recording the number of pieces taken from each label. The data relating to the products prepared is then sent to the Weighing Centre and, from there, to the Shipment Office that prints the transport documents. These documents contain, for each item, the batch identification codes that are the starting point for product traceability.

The history relating to the data collected in this way is stored in the BarCode System, which can be referred to both to trace every single pack of product sold or ready for shipment back to the farm that delivered it and vice versa, i.e. from the farm to the finished packs through all the activities that the batch underwent during delivery, handling, post-harvest treatments, refrigerated storage, gauging, packing and shipping.

5. Traceability and company strategy

The case under examination is characterised by some features that are particularly interesting with regards to choices and strategic objectives that the company has pursued by introducing the traceability of the various stages of production, conditioning and distribution of the processed fruit and vegetable products.

The company is a co-operative located in the province of Modena that is made up of approximately 500 farmers and its turnover is about 21 million Euros ,70% being accounted for by pears, prevalently of the Abate variety, and the remaining being cherries from the typical Vignola area and plums. Implants have recently been renovated and the company is highly computerised both for the administrative management and for the control of processing procedures. As already mentioned, during the last two years, the company has obtained the ISO 9002/94 and ISO 14001 certifications. From the commercial point of view, the management has chosen not to sell the products bearing company brands through wholesale channels, but to prevalently supply the mass distribution chains applying their private labels, and processing the product up to packaging and piecing – upon request –ready to be put on the shelves (packs and trays). Only a part of the production is distributed bearing the brand of

[11] In the event of a handling from a room to another, the procedure does not foresee the replacement of the original label; however, the computer programme stores the new destination room and the time references of the operation carried out.

fruit produced following the Integrated Pest Control Scheme of the Consortium (CONERPO) - of which the co-operative is a member – that provides for its distribution on domestic and foreign markets.

The co-operative already decided in 1996 to introduce a traceability system that was characterised by the fact that the centre of the entire process that assures product traceability is the co-operative itself, which is the controller from the production module (Figure 1). The co-operative has a computer archive containing all the personal and cadastral data of the members and, through six experts employed by it, the co-operative supervises all the cultivation operations, in particular the treatments with antiparasistic agents, that are stored in the "Scanner System" programme. The "LIMS" programme instead stores the results of the tests carried out by the external laboratories to prove the Maximum Allowed Residues. The computer processing of the data relating to the handling unit (pallet or bin) delivered by each member with the limits fixed by the FITOGEST databank and with the type of production standards adopted, after checking Maximum Allowed Residues and absorption times of the phytochemicals used, enables the co-operative to arrange separate batches, already at intake, based on the product type: FL, PT, PA, BI e GDO.

The choice made by the co-operative to follow and check the characteristics of the products starting from the member's land is not an isolated case, because it is closely linked to the considerable support that the Emiglia-Romagna region has given to the spreading of products cultivated with integrated pest control schemes.

Since the early 80's, the Emilia-Romagna region started integrated pest control plans to reduce the use of synthetic substances (fertilisers, antiparasistic agents, herbicides, etc.) in growing fruit and vegetables.

With the law No. 29/92 "Enhancement of agri-food products from the Emilia-Romagna region obtained with environment and consumer friendly techniques", the region pursued its more comprehensive objectives of spreading integrated pest control methods. Based on this law, the Emilia-Romagna region requested and obtained the patent for the collective brand "Controlled Quality (QC), Environment and Consumer friendly Integrated Production". Upon request, this brand can be licensed to farmers, their associations or consortia that undertake to comply with specific production standards and consent to the audits envisaged by the law[12]. To have an idea of the effort made by the region to support the spreading of this brand, already in 1995 the planted land (including vines) using integrated pest control techniques exceeded 24,000 hectares and the region contributed to pay the costs of 153 technicians in charge of the spreading of the operations established by the standards and of the control of they implementation for all the crops involved (including extensive cultivations). The region also contributed to pay the costs borne by the farms for land tests, use of useful organisms (insects, mites, etc.), chemical analyses, etc.

With the enforcement of regulation No. 2078/92 at the regional level, the spreading of integrated productions benefited from further incentives that, in the fruit and vegetable sectors following the enforcement of the new fruit and vegetable OCM (Reg. No. 2200/96), saw the inclusion in the Operative Programmes (OP) drawn up by each Producers' Organisation (PO) of public financing destined to contributing to the cost of technicians and to farms adopting integrated pest control techniques. In the year 2000, the horticultural land to which the Emilia-Romagna integrated production standards apply covered a surface area of 14,000 hectares and that of the fruit land approximately 26,000, covering respectively, 23 % and 17 % of the total area cultivated with vegetables and fruit in the region.

[12] The recent regional law No. 29/99 has extended the possibility to be licencees of the QC brand to all the producers who comply with the standards and undergo the audits envisaged by the law, irrespective of the fact that they reside within the Emilia-Romagna region.

The introduction of traceability in the co-operative under examination and especially the role played by the co-operative in co-ordinating the entire supply chain, from production to distribution, confirms (Green, 2001) that the introduction of this control system requires a suitable degree of organisation on the part of the company concerned, which also needs to be of an appropriate size to support the investments required. The individual farm member rarely could autonomously adopt or simply participate in a system of traceability like the one described above without the technical and organisational support of its co-operative. Organisation and size are also the conditions that have enabled the co-operative to develop, through the support of external consultants, specific software packages that are, when interfaced amongst themselves, an essential instrument to follow the product from the growing stages to the delivery to the customer.

The experience of the Emilia-Romagna region in spreading integrated productions that formed the basis for the introduction of the traceability system by the co-operative under examination, as well as by other co-operatives of the CONERPO group – the largest fruit and vegetable consortium at a national level – shows that the traceability applied to the production of a specific area requires an institutional intervention capable of involving all the links of the agricultural supply chain. Institutional intervention does not only mean the role carried out by the region, but also the role played by professional organisations, such as CONERPO and the mentioned co-operative, that contributed to spreading the culture of quality in the area where they operate.

After the approval of the (EEC) Regulation 1760/00 imposing that meat being sold is to be labelled with all the data required to assure traceability, many farmers consider that this control procedure is more of a burden rather than an opportunity.

The co-operative under examination started in 1996, despite the contribution of public institutions, to set up the necessary computer and organisational systems to introduce traceability along the entire supply chain, besides focusing on a further quality enhancement of its production through the process certification in compliance with ISO 9002/94 and the environment certification in compliance with ISO 14001 recently obtained.

In its strategy for product commercialisation and value enhancement, the co-operative has acknowledged the difficulty in having one's own brand established with mass distribution chains that prefer to focus on their private labels as a means to make consumers loyal and to compete with other distribution chains. In particular, it is often mass distribution chains that impose their supply chain standards to suppliers. These standards imposed at the production stage are an integration instrument affecting the supply capacity and competitiveness significantly, especially when mass distribution chains impose the organisational systems to be adopted with the production[13] . These are the reasons why the QC regional brand has been unsuccessful with mass distribution chains. The same is true for production that has shown disbelief that an institutional and collective brand, such as QC, can add value to a product when these characteristics of the distribution chains' supply are applicable.

Instead traceability is a supply segmentation instrument and, therefore, a competitive factor in that it meets the distribution chains' demand towards a consumer who wants to be increasingly reassured of the hygiene and safety of the products purchased. Traceability service offered by the co-operative, certifications obtained (ISO 9002 and 14001) and the other services for distribution chains (application of private labels, packing into packages supplied by the customer and/or into packages to be put on shelves, piece sizes, etc) are elements that add value to the product and that enable the co-operative to improve its

[13] One of the most important European distribution chains, also present in Italy, offers to those suppliers with whom it has developed a relation of partnership the software required to assure the traceability of the products it purchases from them.

competitiveness with respect to other competitors. By way of example, the co-operative under examination has succeeded in supplying products to mass distribution chains like Casino and Carrefour that require full traceability from suppliers, but they have accepted the co-operative's standards because it has shown to have the organisational and technical skills required without having to undergo organisational bounds imposed by them. In fact, mass distribution chains who sell fresh products under their own label need suppliers who can fully guarantee the quality of the product delivered, because consumers count on the products bearing the label of the distribution chain they are loyal to. For this reason, with private label products mass distribution chains either impose supply chain standards to suppliers by piloting and controlling the production supply (Green, 2001) or tend to develop the so called "third generation private label products" where they are involved directly at the production stage starting their own industrial activities. In fact, the current policies of mass distribution chains aim at moving private label products from lower shelves, where it is located amongst lower price references, to upper shelves where it becomes a product that attaches quality to the distribution chain producing and distributing it.

Traceability for the co-operative under examination does not only represent an instrument to complete its quality segmentation policy and to improve its competitive positioning, but it is also an important organisational tool to control production processes. The labelling of the minimum handling units (pallet or bin) from the intake to the storage into designated rooms, then processing lines until the moment of delivery assures the control of the entire handling of product inside the plant and of processing times with evident positive repercussions on cost organisation and control. The assessment of the convenience of the investment on traceability needs to compare specific costs[14], which in the case of the co-operative under examination are mainly attributed to the development of the necessary software, with the advantages obtained on the commercial and organisational levels.

6. Some final considerations

The case under examination highlights that traceability must not be seen simply as a reaction to the food crises that has recently occurred, and hence a burden that farmers must support to regain consumers' trust, but as an interesting opportunity to segment the supply and improve the competitive positioning of the company adopting it. Furthermore, introducing the traceability of the production means reducing the risks of integration deriving from the supply chain standards imposed by mass distribution chains, while improving the competitiveness of the company offering it. Traceability is not only part of quality policies, but it is also its completion in that it implies the responsibility of the producer through the information identifying him/her. This is the reason why traceability can reduce the information asymmetry between supply and demand, however, it is necessary that this occurs on a large area basis through a collective action supported at the institutional level.

[14] The main cost headings borne are (in Euros):

Software	88,831
Purchase of optic readers	5,165
Inputting of data on plant treatments *	4,132

* annual cost

Besides the headings specified in the table, there are the costs for an extra employee for the weighing centre and the costs for training on how to use the new software.

The software packages developed by the co-operative have been successively purchased by the Conerpo consortium to be installed in the member co-operative.

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Figure 2: Traceability model of the cooperative