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TRACEABILITY

COLEACP

PIP

FOR SUSTAINABLE DEVELOPMENT OF
THE ACP HORTICULTURAL INDUSTRY

Following the example of the other training manuals produced by COLEACP PIP programme, training manual 2 has been designed and written by the PIP Training Unit of the programme. **Bruno Schiffers**, professor at Gembloux Agro-Bio Tech and head of the unit, is the author of all chapters in the manual.

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TRACEABILITY

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Chapter 1

Goals and components of a traceability system

1.1. What is traceability?

1.1.1. Concept definition and implications

From an etymological standpoint "**traceability**" is related to the word "trace" which, figuratively, means a "mark left by an event". “To trace” can also mean "to indicate the path to be followed" or "to draw contours". Use of the word "traceability" to describe the process of identifying the origin of a product and reconstructing its movements from production to distribution is fairly recent.[1] Born in the mid 1980's, traceability was the answer to a basic logistics problem: it guaranteed control over the flow of goods within a chain of partners and enabled significant savings.

According to the ISO 8402:1994 standard, traceability is defined as: *"The ability to trace the history, application or location of an entity or activity or of similar entities or activities by means of recorded identifications*."

The ISO 9000:2000 standard defines traceability as "*The ability to trace the history, application or location of that which is under consideration*."

It is a process that **makes it possible to find the trace** of the various steps and locations a product has passed through from its creation through to its final disposal. In other words, traceability makes it possible to identify the following for a product:

- All of its manufacturing steps
- The sources of its components and their suppliers
- The places the product and its components have been stored
- All controls and tests carried out on the product and its components
- The equipment used to make and handle the product
- Direct customers who bought the product.

Traceability has two key characteristics:

- ✔ It is **intentional**: recorded identifications are the result of a system organised to ensure the consistent collection and recording of identifications.
- ✔ It has **several uses**: to track history, locate entities and find operations. These uses combine and define the organisation of the identification system.

Traceability is **a concept** applicable to many business sectors including chemicals, pharmaceuticals, automotive, research, testing laboratories, etc.
It has become a requirement for more than purely logistics reasons: relationships of trust with consumers, regulatory and legal requirements, standardisation, recalls of defective products, e-commerce, etc.

[1] The word has only been included in some French dictionaries since 1998.

Traceability is **a tool** intended to enable tracking of a product throughout a production and distribution chain, from raw materials supplier to end-consumer.

The traceability process is based on:
- Identification of the companies involved (supply chain partners)
- Product identification
- Identification of logistics units (pallets, containers, etc.)
- Information flows and data exchange.

In the agri-foods industry, it has become a factor in guaranteeing food safety.

Given the increasing complexity of flows, it is no longer sufficient to set up traceability in production companies alone. It must be present **throughout the entire food chain**.

Safety is the result of a **global**, **integrated** and **partner-oriented** approach throughout the entire chain. In order to guarantee good traceability, every operator in the chain must identify their products in a unique way and record their destinations and the links between incoming and outgoing products in databases.

In order to achieve this, each link is responsible for ensuring that **data is correct** and for guaranteeing that they are accessible to other operators in the chain.

Consumer safety is not an issue for confrontation. It's a matter of **cooperation** between all involved. This collaborative approach implies:
- Dialogue between supply chain partners (information exchange)
- Use of a common language (e.g., international codes).[2] The adoption of common standards leads to improved inter-company communications.

The "Coca-Cola® affair" (withdrawal of millions of cans following consumer complaints) proved that it isn't enough for a producer to have a good traceability system. Although the Atlanta-based company and its European subsidiaries did have a traceability system in place, the sale of their products was forbidden by the Belgian and French governments because wholesalers and retailers were not able to trace their commercial exchanges.

Recorded information provides detailed knowledge, immediately or after the event, to support analysis, decision-making, monitoring, etc. With this information, it is possible to

[2] Used by more than 800,000 companies worldwide, the EAN.UCC system is an international standard for codification (consumer units, logistics units and companies), automatic identification (EAN-13, ITF 14, UCC/EAN 128, etc.) and computerised data exchange. EAN communication standards enable the automation of data entry and processing, faster information exchange with improved reliability and lower transaction costs.

take either preventive or remedial action on an entity or batch of entities in the event of danger.

However, in the end, traceability is simply a system that provides results and information. It cannot ensure product safety alone and does not enable either decision-making or the evaluation of results obtained.

1.1.2. Track and trace

Traceability seeks to achieve two different and complementary goals. It therefore implies at least **two different concepts**:

- Traceability of a **product's logistics**: the ability to **locate** a product in space and time. *Tracking* meets operational goals: physical tracking of an entity through to its final destination or the end of its life cycle (for example, spare parts for aeroplanes or technical products requiring regular maintenance). It can be used in the event of product withdrawal or recall if there is a threat to health.

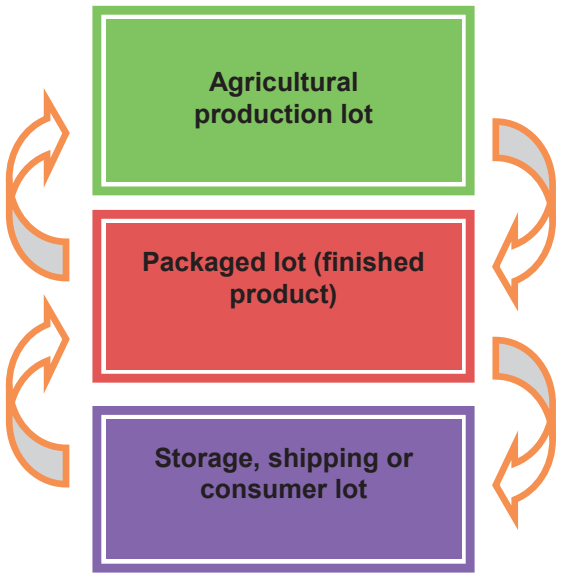
Tracking answers the questions: "Where?" and "When?" "

- Traceability of a **product's contents**: the ability to provide all **information** about the life of a product (origin of seeds or seedlings, growing operations, the inputs used in production, animal feed, veterinarian services, phytosanitary treatments, processing operations, etc.); tracing to know the uses or composition of a food (the substances used to make it). ***Tracing*** is qualitative. It is used to find the cause of a quality problem, to verify the conformity of the stated characteristics of a product (organic agriculture, *fair trade*, etc.) or the product's itinerary. It works backward from the point-of-sale to the producer (and, potentially, to the plot on which the fruits, vegetables or potatoes were grown).

Tracing answers the questions: "What?", "With what?", "How?", "By whom?", and "Why?"

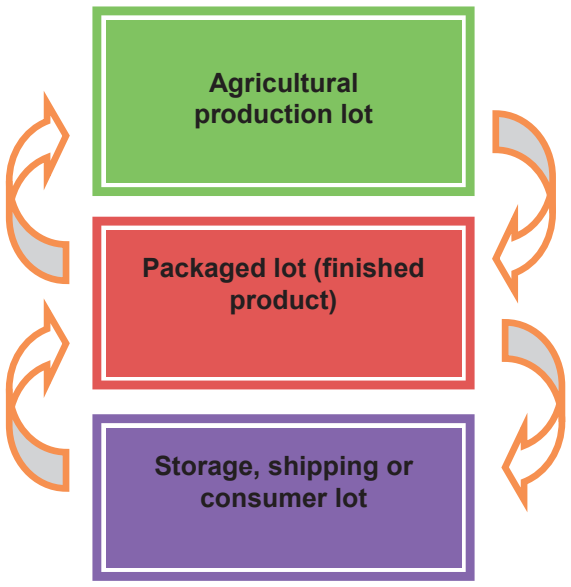
Product traceability:

Information is inter-linked to provide lot history.



Data traceability:

The documents and recorded data at each step of the lot's life are linked thanks to unique identifications.

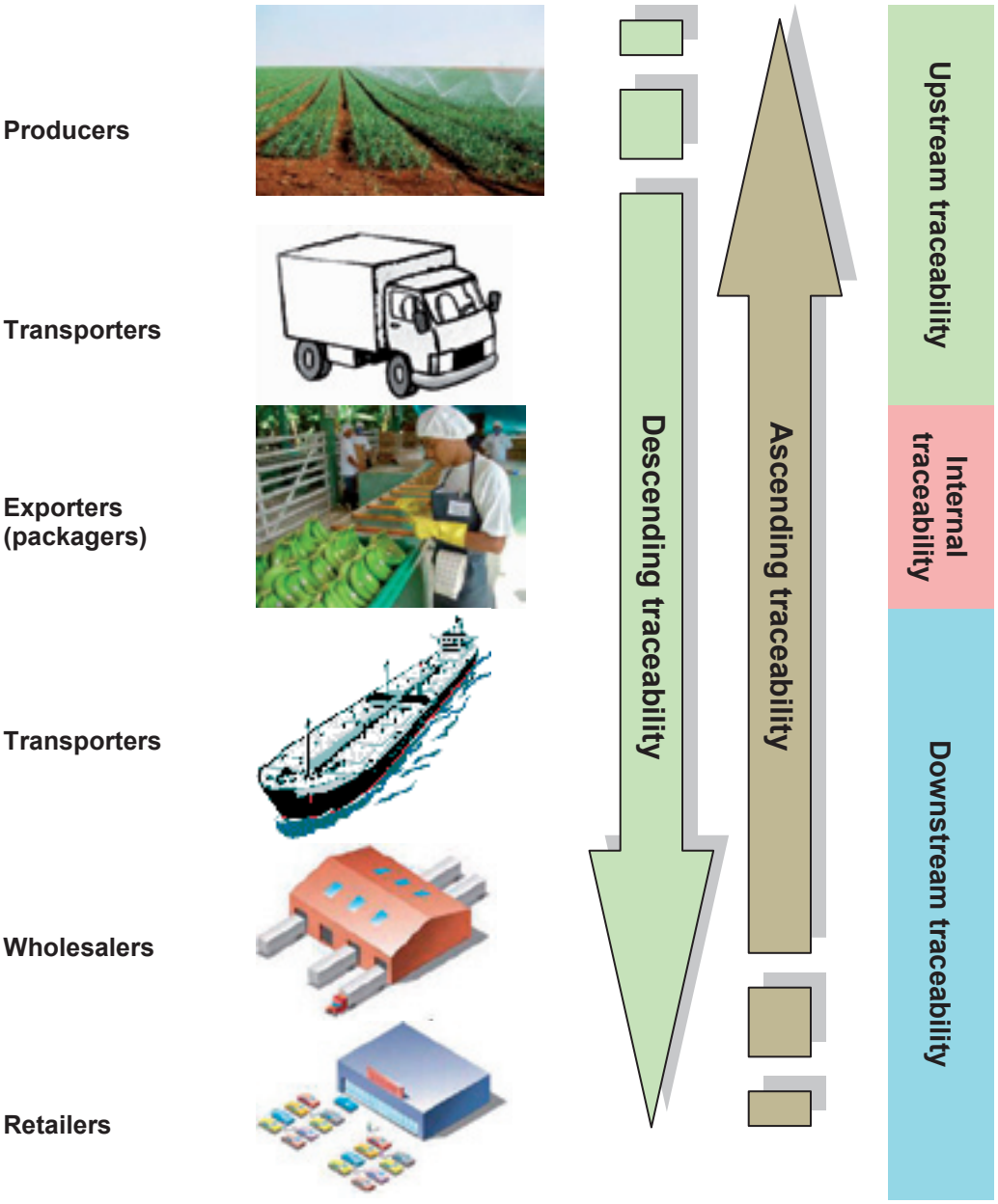


1.1.3. Traceability directions

Traceability ("trace" or "track") can be used **bi-directionally**:

- **Descending traceability (downstream)**: makes it possible to find the destination of a lot or product unit at every step of the product life cycle The associated data must make it possible to follow the chain from upstream to the finished product
- **Ascending traceability (upstream):** makes it possible to find the production and packaging history and the origin of a lot at every step of the product life cycle starting with the lot or product unit. The associated data must make it possible to follow the

chain upstream from product to raw materials. Ascending traceability helps **make an observed result understandable** (e.g.: exceeded MRL in a batch of fruit) to find its causes.



1.2. The purposes and objectives of traceability

1.2.1. The purposes of traceability

The traceability of activities is "*the ability to ensure the tracking, if possible in real-time, of activities (and of information related to the activities) and of information flows (associated with physical flows within the logistics chain) linking activities. Activities traceability must enable companies to combine the data collected this way to reconstruct a picture of the entire process in question (through a network of inter-related flows and activities)"* (ROMEYER, 2001).

The basic principle consists in linking information flows to the physical flows and activities of a given process.[3]

Traceability has **two complementary purposes**:

- **Safety**: to ensure product conformity with rules and requirements. The purpose is to prevent excesses and anomalies, to understand them, to deter any irrational use of inputs, to deter theft, hijackings and counterfeiting, to monitor behaviour and practices, to ensure compliance with the cold chain, etc.
- **Implementation**: to monitor operations or chains and the successful completion of industrial, logistics and administrative sequences.

According to WANCOOR (2008) there are **four main categories** of traceability:

Tracing	***Tracking***
Safety	
Tracking of intrinsic product characteristics (food and medical safety, etc.).	Fight against counterfeiting, hijackings
Implementation	
Tracking of commitments (ethical, standards, procedures, administrative operations, sustainable development, etc.), of behaviour, of practices, etc.	Operations piloting and reliability (tracking of files, products, vehicles, orders, deliveries, etc.).

[3] By process, it is meant: "*A set of activities inter-linked by meaningful information flows (or materials carrying information: the flow of products in the factory is a materials flow; these materials carry information) that combine to create a significant and well-defined material or immaterial product*."

Examples of cases of applied traceability (from WANCOOR, 2008)

Tracing	***Tracking***
Safety	
Preventing and managing risks: - Tracing products and services - Tracing procedures - Tracing events *Food products, fertilisers, pesticide products, additives, biocides, spraying equipment maintenance, etc.*	Tracking of a process or service to ensure its quality, that deadlines are met and that special rules are implemented. *Product batches used, machines used, intermediaries involved in the process, waste management handling, sub-product follow-up, etc.*
Implementation	
Tracing operations *Administrative files (quality manual, logs, etc.), equipment maintenance logs, audit and inspection reports, training certificates, CVs, etc.*	Tracking of operations or objects for customer information and to improve the quality of services. *Product shipments, lots created, luggage (in airports), documents, deposit packaging, etc.*

1.2.2. The main purposes and benefits of traceability

A traceability system must meet many objectives:

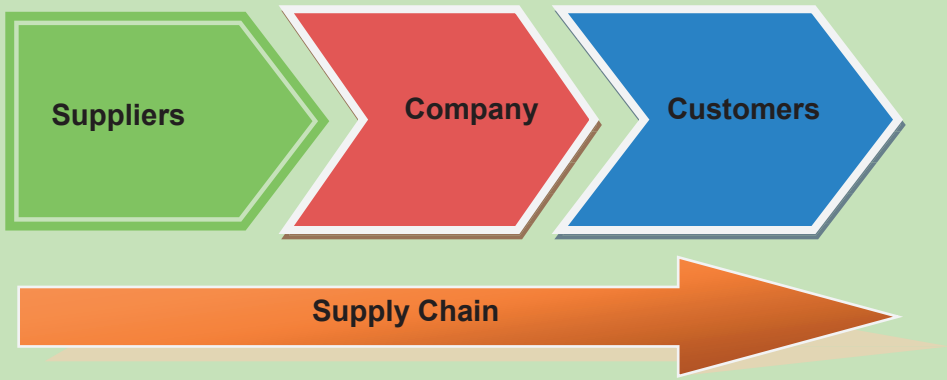
- Regulatory compliance
- Greater efficiency of processes
- Communication with suppliers and customers
- Commercial benefits
- Financial benefits (e.g.: reduction of inputs used and theft).

Traceability must enable those involved **at every level** of the process and the chain:

- To **follow the flow of production:** Raw materials (animal feed, raw materials, inputs used), foodstuffs, their ingredients and packaging. From the agri-foods standpoint, a traceability system is a system that ensures that suppliers and the batches of raw materials used to manufacture each lot of finished product are known.
- To identify the **documentation required** to be able to track every operation and follow every production, transport, packaging, processing, storage and shipping step
- To ensure adequate coordination between the various players involved (small producers, "merchants", transporters, exporters, etc.)

To ensure that everyone involved knows, at a minimum, their direct suppliers and customers and more if possible.

Traceability and the "Supply Chain"



The traceability of direct customers and suppliers is important to every company.
The concept of a production chain is important.
It isn't an industrial chain in the strict sense of the word but rather a chain of steps that combine to make a given product.
This can sometimes lead to the ***identification of players involved from outside the actual production chain***[4] *(e.g.: a supplier of phytosanitary products).*

Traceability must also make it possible:

- **To follow the chain backwards to be able to react as quickly and as far upstream as possible,** to withdraw products, to recall products and/or take any defensive measures needed. The **impact of an event will decrease** as the effectiveness of traceability and the vision companies have on product lots increases.
- **To guarantee product authenticity** and the characteristics that result from the production method described on the label (e.g.: "organic" products, fair trade products, products sold under a special "label", products from controlled and guaranteed sources). The implementation of food traceability makes it possible to **add value to niche products** (regional products, products guaranteed free of GMOs, products without allergens, etc.). As a result, there is also a commercial motivation for manufacturers.

1.2.3. The information and transparency objective

The public authorities have an **information and transparency obligation to consumers**.

Although food has never been as safe as it is now, and although risks really are lower than in the past, incidents are possible despite the many measures taken. Management procedures must be implemented for non-compliant products, notably **procedures for recalls, withdrawals and notification** of the authorities.

[4] For example: an ink manufacturer (chemicals chain) may supply a customer who makes wood crates (wood chain) with inks intended for printing on the crates (fruits and vegetables chain).

If required, it should be possible for the public authorities to activate an **alert system** in the event this isn't done by the company or organisation involved and legally responsible for bringing the products to market.

RASFF or *Rapid Alert System for Feed and Food* is managed by the European Commission. It links all of the competent authorities monitoring foodstuffs in the European Union. RASFF has been in place since 1979 and its legal basis is found in Regulation (CE) 178/2002.

It provides a quick way to **inform** the EU monitoring authorities of the existence on the market of foodstuffs that are:

- Non-compliant with food legislation
- Unhealthy
- Dangerous to public health

Users can search for alert data in a **database**. These data, called "notifications", are also viewable by other countries and their operators located outside of the European Union, whether they are shipping or receiving goods.

The number of "notifications" exchanged by the system has increased consistently over time, reaching about 3000 in 2008.

For more information, go to: *http://ec.europa.eu/food/food/rapidalert*

When an "alert" is given, **products at risk can be searched for** in order to withdraw them from points-of-sale and to inform consumers so that they can return defective products if they have purchased any.

In the event of a product alert on an exported product, the health authorities of the importing country must be informed to enable them to take action. Agricultural attachés and veterinarians working at embassies are responsible for liaising with local health officials in other countries.

Traceability is a daily event. End-consumers and professional customers appreciate having traceability information on item location (*track*) and characteristics (*trace*). Increased product *tracking* functionality and heightened safety expectations have increased the level of requirements. Guaranteeing the traceability of a product is no longer enough to make a difference: access to information must be facilitated, more detailed and precise data provided and new functionality offered.
Traceability in "reactive" mode will gradually give way to "on demand" traceability. It will become increasingly important to **prove the truthfulness** of ethical commitments, ingredients (allergens, GMOs, sources, etc.) and statements about sustainable development made by companies.

1.2.4. The ethical objective: traceability and sustainable development

We now have an obligation to, on one hand, monitor the use of natural resources and take into account **product life cycles** and, on the other, to monitor **the circulation and use of hazardous products** in order to guarantee the quality and composition of products.

Traceability is therefore doubly interesting within the framework of sustainable development.

A **traceability system is based on the analysis of a product's life cycle**. Likewise, in order to measure the impact of a product on the environment and on health, it's necessary to understand its entire life cycle (*Product Life Cycle Management*), from design (eco-design) through disposal (deconstruction, recycling). This is also true to meet the requirements of an Environmental Management System like ISO:14001 which require taking a look at product life cycles.

What's more, counterfeit phytosanitary products can lead to the contamination of product development chains because of products that don't comply with regulatory quality standards.

Traceability and sustainable development are very closely linked. Traceability is an indispensable lever for sustainable development.

1.3. Approaches to traceability

1.3.1. The "customer" approach

The **first purpose** of traceability is to **prove** (thanks to product and process histories) that there is a **match with customer requirements** which, generally, relate to:

- The making of the product: where, when, how and with what the product was made
- Compliance with specifications: management, monitoring, audit
- Crisis management: finding and withdrawing defective or dangerous products from sale
- Communication: reassuring concerned consumers following food and health scares

In addition to establishing trust with consumers, traceability enables **development of the product's production** and distribution chain. It provides added value to the product.

Lastly, traceability has become a key element of logistics chain management, from production through distribution, and for tracking product quality.

This is a key **element for marketing differentiation** because consumer demand for information is very strong.

The data collected during a survey ordered by the European Commission showed that, for 46% of those surveyed (56% in France), fraud and cheating that threatened food safety was the second greatest concern.

The diversification of product sources, resulting from **trade globalisation**, has added an additional source of concern in that the origin of the product is "distant" and counterfeiting is becoming generalised in all industries. What's more, quality and authenticity are 75% of the reason French consumers make a purchase.

(*CREDOC, Centre de recherche pour l'étude et l'observation des conditions de vie - 2003*).

1.3.2. The "food safety" approach

Food-related health threats can occur at any step of the agri-food chain. It is therefore essential that appropriate controls and communication be implemented throughout the process. A weak link can compromise the safety of food products. This can be a serious

threat to consumers and can have costly repercussions for suppliers. Food safety is, therefore, the joint responsibility of all involved in the agri-foods industry. **Consumers demand food safety**. Following crises such as the so-called "mad cow" episode, the need has become even more acute and regulations have been strengthened.

A traceability system must make it possible to **reliably find products and product history**. In fact, in the event of a problem, it's necessary to have an organised recording system in place to:

- **Find products** (lot or product unit) along the entire product life cycle to be able to **withdraw** and/or **recall** them if need be
- Have the most complete manufacturing history possible for the product
- Facilitate **transparency** between every link in a chain
- **Communicate** relevant information on the making of products and on their specific characteristics to the authorities, customers and commercial partners
- Find and **store information** about a given product/process and determine the respective responsibilities in the event of a problem.

Organised traceability ("a traceability system") makes it possible to **record the entire history of a product in writing** and/or to locate it at every step and operation of animal feed or foodstuffs manufacturing, processing, distribution and maintenance **from primary production through consumption**. **We now speak of traceability from "plough to plate"**. It facilitates identification of the causes of non-conformity and, if need be, enables withdrawal and/or recall of the non-conforming product.

1.3.3. The "regulations" approach

Since 1 January 2005, a rule has required that EU countries implement **labelling** and **identification procedures for products** sold by farmers, producers and first importers to the EU to enable and facilitate their traceability when they are put on the market. The main purpose is to be able to initiate a **withdrawal and/or recall procedure for products in the event of a food crisis**. The quality of traceability will enable targeted and precise withdrawals. It will also **limit the extent of recalls** and ensure the removal of holds on products that are not involved.

❒ Operator traceability requirements

These are defined for the most part in **Regulation (CE)178/2002**.[5] It defines traceability as "*the ability to retrace, through all production, processing and distribution steps, the progression of a foodstuff or of a substance intended to be incorporated or that could be*

[5] Regulation (CE) 178/2002 defines the general principles and provisions of food legislation, creates the European Food Safety Authority and sets procedures for food safety. Official Journal of the European Communities, L31/1, 1.2.2002.

incorporated in a food product." Compliance with regulations means that operators must be able to identify their **direct** suppliers and customers.

It should be pointed out that "***substance that could be incorporated***" means any compound that can be directly (e.g. wax applied to fruit) or indirectly (e.g.: pesticide product residues, products resulting from their decomposition or metabolites; substances that migrate from packaging or inks; traces of biocides or hydrocarbons, etc.), enter at any time into the "composition" of a product and, therefore, transit into the food chain.

As a result, traceability must cover raw materials, packaging, inputs used, cleaning products, disinfectants, veterinary medicines, technological additives, etc.

Photo Maud Delacollette

It is therefore recommended that producers **keep records** and **archive** their data.

- **Incoming log**:
  - Type of incoming product
  - Product identification
  - Product quantity
  - Date of receipt
  - Supplier identification
  - Other data required by legislation

- **Outgoing log**:
  - Type of outgoing product
  - Product identification
  - Product quantity
  - Delivery date
  - Purchaser identification
  - Other data required by legislation

In addition, it should be possible to reliably establish the **relationship** between incoming and outgoing products.

These data should be kept for the entire validity period of the product in question (minimum two years). **Primary production** (producer level) data should be kept for at least **five years**.[6]

❒ **Traceability requirements for a competent authority at the national level**

These requirements are defined in the principles of the "*Codex Alimentarius*". They cover the context, reason for being, design and application of product traceability as a tool that can be used by a **competent authority** and **within the framework of its inspection** and certification system for foodstuffs.

The product traceability/tracing tool can be applied to part or all of the steps of the food chain (from production to distribution) depending on the goals of the inspection and certification system for foodstuffs.

Product traceability/tracing is a tool that:

- Must be able to identify the origin of a product (upstream step) and its destination (downstream step) at any given point in the food chain (from production to distribution)
- *In itself* does not improve the results of food product safety unless it is combined with appropriate risk management measures and requirements. In this case, it can help to **significantly improve the effectiveness of these measures**
- Can help protect consumers against misleading commercial practices and facilitate commercial exchange based on the precise description of products.

European regulations state that an exporting country does not have to reproduce the same traceability/tracing "tool" as the one used by the importing European country. They also state that the importing country should accept any type of organisation in a third country (with or without this type of traceability tool) as long as the latter can provide the same level of protection to its consumers.

1.3.4. The "company management" approach

❒ **Traceability and company responsibility**

Traceability has **become a requirement in trade relations**. The current environment puts pressure on companies because of:

- Heavy competition between sources, products, claims
- Increasingly complex circuits (number of intermediaries) and logistics
- Distant supply points (North-South trade)
- Complex and fluctuating distribution schemes.

[6] Why require such a long data archiving period for perishable products? Note that in primary production, certain "crop operations" can have an effect over several years (e.g.: changes to the soil, use of fertilisers, soil disinfection, deep ploughing, etc.), and even over several decades (e.g.: planting of an orchard). The rule is that data should be archived for as long as necessary.

Companies are liable for their products.
They are liable for product deficiencies and their consequences (e.g.: food poisoning) in addition to any legal guarantees in place.

"Tracing" enables companies to contain a problem to reduce its impact and communicate with customers.

By keeping and using a history of products, of main processes used, of suppliers, of raw materials used, of incidents, of customer complaints, etc., companies can:

- Get a better understanding of products and a better handle on processes
- Improve practices and the overall operation of their organisation and of production processes (e.g. fewer inputs)
- Immediately correct the manufacturing process when non-compliant products are found and the identified cause is tied to the process
- Identify complementary training requirements
- Improve work station safety
- Track the effectiveness of corrective actions implemented
- Reduce the costs related to incidents, losses, theft and wastage (costs tied to alerts, withdrawals or recalls, repairs or damages, loans, penalties payable to partners, lawsuits, etc.)
- Improve management of business relations, of importers with exporters and of the latter with producers
- Reduce lot production costs (materials used, salary costs, etc.) not covered by income, insurance costs tied to company risk.

However, the stakes of traceability **are not solely "defensive": it is also a performance lever** for companies. The visibility it provides on current and past processes contributes to operational excellence and to supply chain management.

It can also enable a company to prove its claims about the origin of its products, its ethics, its compliance with the rules of sustainable development, the absence of GMOs, etc. It provides better services (real-time order tracking, ability to find a product, etc.) to customers. It limits the risk of losing markets when customers demand traceability.

❒ **What are the risks for a company that does not have, or loses, traceability?**

- Poor execution (particularly from a logistics standpoint) and, therefore, poor customer service.
- Being last in the chain, or a weak link. Not being able to make a (reliable) link upstream or downstream in a product traceability chain (due to lack of tools or practice) means being the last liable entity to be identified! And, therefore, the one automatically at fault
- Unclear sharing of risks and liability. Poorly defining liabilities and commitments to partners doesn't make them less important or lighten their consequences
- Potential loss of competitiveness against competitors who have reliable traceability. When competitors offer detailed tracking facilities and your company doesn't...the risk of being left behind increases
- Inability to deal with events

- Setting off a disproportionate reaction to an incident
- Inability to prove the truth of commitments made for products and services (ethical claims, organic products, labels, etc.)

1.4. What are the obstacles to and limits of traceability?

1.4.1. Technical limits

❒ **Traceability can only find items that have been previously defined and recorded**

In a **crisis situation**, the information communicated by an operator may not be fully authenticated. It may also be difficult to reconstruct the progress of information from one step to the next, particularly at break points between upstream points (raw materials) and processing or downstream at the wholesale stage when products are repackaged or heterogeneous batches are created.

Weak implementation can make the system unworkable. The **absence** of certain useful data (not recorded during the production or packaging steps), **loss of data** (destruction of media) or **information entry errors** can lead to the non-recall of a contaminated lot. This is an important point because the loss or breakdown of traceability **will negatively impact the effectiveness and speed** with which corrective actions can be implemented (withdrawal or recall of products).

If they suspect that the information is unreliable, importers may require the implementation authentication mechanisms by third parties (e.g.: **traceability system audit** or other procedures).

In this case, traceability obligations could penalise companies competing with foreign companies that are not subject to the same audit and inspection requirements, unless greater consumer confidence in the products compensates for the potentially higher resulting price (which is rarely the case in practice).

❒ **Traceability is not a tool for managing product characteristics**

Traceability **does not guarantee the healthiness** of foods and, consequently, should only be implemented as a complement to a food safety management system that applies risk analysis and prevention concepts throughout the production chain.

❒ **The weakest link in product traceability occurs upstream**

The weakness of this link is primarily due to the raw materials **supply method** when it is tied to one of the following situations:

- Small farm size (small producers), which means **a limited supply** of products deliverable at one time, or only over a limited time period and, consequently, a diversity of lots[7]

[7] When an exporter does not have enough products from certified sources, they can be tempted to complete lots to be shipped with available products harvested from non-certified producers.

- **Poor organisation** of producers and producer associations (the local market is not organised or regulated)
- Some operators buy products from local markets or from unplanned cropping. This also leads to a diversity of lots from unknown sources
- Use by some processing and packaging units of supplies from **intermediaries** that are often numerous and sometimes difficult to identify. This results in a range of quality levels from different sources[8]
- A **low level of** upstream-downstream **integration and a lack of contractual relationships** between producers and processors (sale to the highest bidder at harvest time).

❒ **Production methods can limit traceability**

They can also be a constraint on the implementation of traceability. For example, in pickle processing during which brine has to be added several times to maintain conditions favourable for ripening. The result is an end-product containing several salt batch "parts" that are very difficult to track down!

1.4.2. Economic and commercial limitations

These, like technical limitations, are tied to the intrinsic conditions of the chains and the products which affect their profitability.

In client-supplier relations, information exchange between partners must be designed to ensure that business relationships remain balanced: both must accept that certain data cannot be exchanged, notably when they are related to manufacturing processes (manufacturing secrets, "recipes"). There must be an **ongoing concern to maintain a balance between useful transparency and the confidentiality** of information of each entity in the chain.

Selecting a traceability system must take into account, on one hand, the relationship between the goal pursued and the effectiveness sought and, on the other, the cost of implementation compared to the **specific margin** of the product. It is the result of arbitration between the different requirements and, in particular, customer or consumer demands, technical feasibility and economic acceptability.

The **selection of a traceability system** must therefore take into consideration, on one hand, the relationship between the goal pursued and the effectiveness sought and, on the other, **the cost** of implementation compared to the product's specific margin. The result is an optimal equilibrium between different requirements and, in particular, the demands of customers and consumers (the propensity of the consumer to pay to "know more"), technical feasibility and economic acceptability (agreement on the part of economic operators to invest to "*gain the means to know more*") (ONUDI, 2007).

[8] A typical example is that of "pisteurs" in the mango production chain.

1.5. Traceability requirements

1.5.1. Regulatory safety requirements

Following the various **health scares** around by the world in the past few years (mad cow, foot and mouth disease, bird flu, melamine in Chinese powdered milk), food traceability has become a necessity to prevent the circulation of foods that could be harmful to consumer health. Legislators and standardisation bodies have put in place a number of regulatory and standards texts that require or recommend the implementation of traceability as an indispensable part of food safety.

❑ The basic requirements of European regulations

Since 1 January 2005,[9] European importers must be able to identify their food product suppliers and their customers. Traceability regulations are common to all chains and Member States of the European Union. The goals are:

- Product safety (with self-monitoring within companies)
- Product compliance with legal and regulatory requirements
- Cooperation with the competent authorities in the event of a health alert
- Trade transaction loyalty
- Information to consumers

Regulation (CE) 178/2002 sets the requirements for companies in the agri-foods sector, including import companies. It is important to note that these rules require traceability at every step of the chain with an **obligation to provide results but not to use specific methods**.

Producers are **free to choose** a traceability system and media suitable to their environment, the size of their company and the cost of implementing and maintaining traceability.

Article 18 of Regulation (CE) 178/2002 provides a **set of basic rules** designed to ensure that the market only contains safe foodstuffs and animal feeds:

1. The traceability of foodstuffs, of animal feeds, of animals used for food and of any other substance intended to be incorporated, or which could be incorporated in foodstuffs or animal feed, is established **at every step** of production, processing and distribution.

[9] Regulation (CE)178/2002 establishes the general principles and provisions of food legislation, creates the European Food Safety Authority and sets procedures for food safety. Official Journal of the European Communities, L31/1, 1.2.2002.

2. Operators in the food and animal feed sectors must be able to **identify everyone** who has supplied them with food, animal feed, food-producing animals or any substance intended to be incorporated, or which may be incorporated, in foodstuffs or in animal feed. For this purpose, operators must **have systems and procedures** that enable them to **put the information in question at the disposal of the competent authorities**, at their request.

3. Food and animal feed sector operators have systems and procedures that enable identification of the companies to which their products have been supplied. This information must be made available to the competent authorities at their request.

4. **Foodstuffs and animal feed** marketed in the Community, or which may be, **must be adequately labelled or identified** to facilitate their traceability. This is done using documents or data relevant according to applicable instructions contained in more specific provisions.

Other rules and directives also impose specific traceability requirements. We note:

- Regulation (CE) 1830/2003 on the use of **GMOs** (labelling and traceability): identification of GMO products and of GMO-derived products at every step to market. This information must be kept for five years.
- Directive 2003/89/CE on the ingredients of food products.

❑ Practical consequences for producers

The rules therefore require that producers be able to communicate precisely, and as quickly as possible, with **suppliers** and **direct customers**.

Given the requirement to identify any substance entering the food chain via their products, it also requires that producers know precisely the **composition of their products** (e.g.: raw materials batch numbers, inputs used) and that they implement **labelling** procedures for products to enable and facilitate their traceability when they are sold.

On the other hand, the rules do not provide any practical indications on how to record the information needed or on the length of time the recorded traceability data must be kept. **Reality is more complex** than would appear from simply reading the rules. To comply with the rules, and to be able to implement a withdrawal and/or recall procedure for products in the event of a crisis, producers must be able to provide all of the information requested (result requirement). The focus isn't on the precision of traceability results but on the ability to provide:

- The names and addresses of suppliers and the types of products supplied
- The names and addresses of customers and the types of products shipped
- The transaction and/or delivery date.

Although the rules do not specify the timeframe in which the traceability data must be provided to the competent authorities (e.g.: official monitoring services), the information must be transmitted **as soon as possible**. Lot numbers, volumes and quantities, and the detailed composition of the products must also be provided at the request of the authorities within a reasonable timeframe (which may differ from one State to another, but only by a few hours to a few days).

In order to meet this requirement, producers must set up an effective traceability system, have a withdrawal and recall plan and define procedures to inform the authorities. On-site controls will enable the competent authorities to check for the existence of these three items and ensure that they are working properly. In fact, producers have **a two-fold obligation**: for results and resources.

❑ **The impact of rules on packaging traceability**

Regulation (CE) 1935/2004 (in effect since 27 October 2006) is applicable to materials and objects intended to come into contact with foodstuffs.[10] It defines specific packaging product conformity and manufacturing rules. It requires traceability at every step (including for food packaging manufacturers) via suitable labelling or identification in order to facilitate monitoring, withdrawals and consumer information.

Moroccan tagine dishes officially banned in Australia!

Following a routine control, Australian health officials discovered that tagine dishes sold in shops contained high levels of lead and cadmium.

1.5.2. Regulatory safety requirements

Regulation (EC) 2200/96 on the common organisation of the market on fruits and vegetables provides an overview of rules for the classification of products by quality category as well as calibration, presentation and labelling rules for fresh fruit and vegetables. In 2004, **Regulation (EC) 907/2004** amended the marketing **presentation and labelling** standards applicable to fresh fruits and vegetables.

These regulations require that the following information be clearly and legibly provided on the label:

- Packager and/or shipper identity (plus, if available, their authorisation number to be able to identify them)
- The country of origin (and optionally, the region of production, or national, regional or local appellation)
- The nature of the product (only if the contents are not visible from outside the package)
- The commercial variety or type (based on the corresponding instructions of the EEC/UN standard)
- Size grade (if the product is classified according to its size)
- Product category or class

[10] It has been proven that toxic substances can migrate from packaging and seriously contaminate products that come into contact with them (e.g. Bisphenol-A which is used to make polycarbonate plastics, epoxy resins and PVC antioxidants. It is used to make baby bottles and has already been forbidden for this use in several countries). Another example is ceramic containers (teapots, tagine dishes) which leech heavy metals.

Complementing this legislation is **Regulation (EC) 2379/2001** (amending Regulation (EC) 1148/2001) which covers **controls for compliance** with the marketing standards applicable in the fresh fruit and vegetables sector (including EEC/UN standards[11]). This regulation was established to monitor the standards implemented in the fruits and vegetables sector, with the exception of controls carried out during retail sale to the end-consumer.

To be thorough, we should also mention Regulation (CE) 510/2006 on protected geographical indications and protected designations of origin of agricultural and food products.

1.5.3. International and national standards

Several international organisations have published traceability standards. The most important standards are those of ISO and *Codex Alimentarius.*[12]

❑ **The ISO 22000 standard**

The ISO 22000:2005 standard describes the requirements of a Food Safety Management System that can be **certified to demonstrate its ability to manage identified dangers**.
The goal is to harmonise practices globally, to promote mutual recognition of certificates between countries and to guarantee the on-going supply of safe products that meet both requirements agreed to with customers and regulations. This international standard takes into account the documents developed by *Codex Alimentarius* on HACCP and is compatible with ISO 9001:2000. It has been in place since September 2005.

The standard recognises that food product safety can only be guaranteed through the combined efforts of all those **involved** in the food chain:

- Farmers
- Animal feed producers
- Foodstuff manufacturers
- Transport and warehousing operators and sub-contractors
- Wholesalers, retailers, food services and restaurant operators
- Packaging equipment and materials manufacturers
- Cleaning products, additives and ingredients manufacturers
- Phytosanitary products, biocides, fertilisers and veterinarian medicines producers
- Service providers

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11 United Nations Economic Commission for Europe

12 The Codex Alimentarius Commission was created in 1962 after agreement between FAO and WHO, two UN institutions. It was the result of, on one hand, progress made in biological and chemical knowledge about food products which enabled a much finer analysis of their properties and, on the other, the use of new production techniques based on this new knowledge. The Codex has over 220 standards for individual foods or groups of foods.

The ISO 22000 standard is based on the "Deming wheel" principle and its PDCA (*Plan, Do, Check, Act*) continuous improvement loop which is now recognised as a simple and universal managerial behaviour principle.

The standard, which can be used as the basis for certification, requires that companies set up a traceability system in addition to PRP (*Pre-Requisite Programmes*) and HACCP.[13] With ISO 22000, the ISO standardisation system built a health safety management system that **integrates traceability**: the standard emphasises the **importance of communication** between the company and its customers, suppliers and employees to identify and manage all relevant dangers related to food security throughout the entire food chain.

Chapter 4 of the ISO 22000 standard covers general requirements, notably in terms of communication and the management of documents and records. According to the standard, the traceability system must enable the identification of the direct suppliers of inputs and the direct customers of finished products.

ISO 22000:2005 is the first standard of a family that includes ISO 22005, *Traceability in the feed and food chain – General principles and basic requirements for system design and implementation*.

❑ **Codex standards**

Codex Alimentarius published a **General Standard for the Labelling** of Pre-packaged Foods (STAN 1-1985) and a series of **Official Codex Standards (STAN)** on the quality and conformity of fruits and vegetables.[14] These product standards provide additional information on product descriptions, product composition and quality, authorised food additives, contaminants, hygiene, weights and measures (calibres), labelling rules - in accordance with the Codex General Standard for the Labelling of Pre-packaged Foods – and on monitoring analysis and sampling methods.

❑ **National standards**

Some countries, and notably those with trade relations with European Union countries, have also established traceability standards to align themselves with international requirements in this area (e.g. Moroccan standard NM 08.0.012).

1.5.4. Commercial requirements

European legislation has no legal force on territories outside of the European Union. However, for importers, EU regulatory requirements on traceability and product safety can translate into "commercial requirements" **imposed de facto on ACP exporters**.

[13] See PIP Manual 1 and 3 for more information on these topics.
[14] http://www.codexalimentarius.net/web/standard_list.do?lang=fr.

Many private standards covering various areas (health quality, fair trade, etc.) have one or more sections dedicated to traceability **in their specifications**. Among the goals of these sections is the intent, on one hand, to ensure **separation of certified and non-certified products** and, on the other, to provide support to producer-exporters in meeting traceability requirements that usually fit into the framework of private contracts with their European partners.

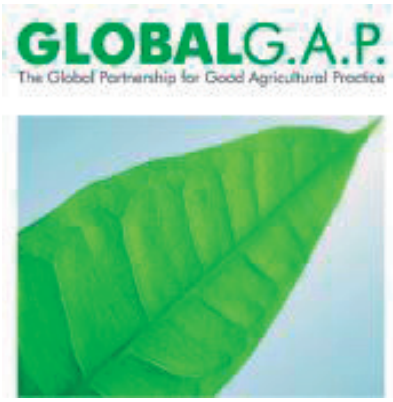
European operators (importers, buyers, retailers) usually ask that ACP exporters be able to trace the "history" of their operations and of their goods. Although internal traceability assuring the link between incoming and outgoing products is not required by regulations it is, however, often required by retailers. All producers must have data recording procedures that establish the **relationship between incoming and outgoing products** at every production, processing and distribution step. Given the complexity of crop operations and the great variation in contractual conditions between producers and exporters, companies producing fruits and vegetables must decide for themselves to what extent they want to, and can, actually go.

It must be emphasised that most traceability and labelling requirements are **part of private contracts** between European operators and their ACP export partners. It is a **voluntary approach**, based on the marketing strategy of the European importer or retailer and not strictly on regulatory imperatives.

It is recommended that, at a minimum, they be able to identify suppliers and incoming products **that may be a danger to health** (seeds, pesticide products, disinfectants, fertilisers, irrigation water, packaging, additives, etc.).

❑ GLOBALG.A.P. requirements

GLOBALG.A.P. is a **private sector** body that defines standards for the certification of agricultural products worldwide. Its goal is to establish standards for "**Good Agricultural Practice**" with different applications by product suitable for agriculture worldwide.



GLOBALG.A.P. is a so-called "***pre-farm gate*" standard** which means that its certificate covers the progress of the certified product, including agricultural inputs like forage and seedlings, and all agricultural activities, until the product leaves the farm.

GLOBALG.A.P. is a *business-to-business* label and is, therefore, **not directly visible to consumers**.

Generally speaking, GLOBALG.A.P. stipulates that any product that meets the requirements of GLOBALG.A.P standards, and is marketed as such, should be traceable and handled in such a way as to avoid any mixing with products that are not approved by the organisation.

Within their control points and conformity criteria[15] for all operations, GLOBALG.A.P. requires that producers have documented procedures to identify the type of event that might lead to a withdrawal, the persons responsible for taking decisions about a potential product withdrawal, the consumer information mechanism and the certification body (CB) GLOBALG.A.P. (if a sanction has not been issued by the CB and the producer or producer group recalled the products on their own) and the methods enabling inventory reconciliation. This control point is a **major requirement** of the standard and all procedures must be reviewed annually to guarantee their effectiveness.

The most recent version of the GLOBALG.A.P. standard (version 4.0, compulsory as of January 2012), describes a series of control points and **additional conformity criteria** for companies that are registered as having so-called "parallel" operations (that is, certified and non-certified production units within the same legal entity).[16]

In this case, **it must be possible to differentiate the products at all time**, all the way back to their original production unit. All certified products must be identified with a GLOBALG.A.P. number (GGN). The GGN number[17] is unique for every producer or any other legal entity in the GLOBALG.A.P. system. It can be used on the end-product and/or packaging at the point-of-sale.

Sales logs must be kept and must differentiate between the quantities of product sold with and without certification. Work procedures and instructions must **prove that orders for certified products are not filled with non-certified products**. All of these documents must prove that the **mass balance** of inbound and outbound products is met, for both certified and non-certified products

In its crop module, GLOBALG.A.P. mentions that traceability must facilitate food sales and enable customers to obtain targeted and valuable information on the products in question. As already mentioned, there must also be a documented identification and traceability system that enables products registered with GLOBALG.A.P. to be tracked back to the registered farm or, for a producer group, back to the group's registered farms, and to be traced to the immediate customer. Harvest information must **establish a link between lots and the data recorded** about production or the farms of specific producers.

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15 All applicable control points mapping to major requirements and to the QMS (Quality Management System) must be fully complied with.

16 Note that it is strictly forbidden to grow certified and non-certified products within the same production unit.

17 The GGN (*Global Gap Number*) is a 13-digit number. It is a unique number that belongs to the legal entity (e.g.: the producer) for as long as it exists.

❑ BRC requirements

The ***British Retail Consortium*** (BRC) is an **association** that brings together a large number of **retailers** in the United Kingdom.

In 1998, BRC responded to industry needs by creating the "*BRC Food Technical Standard*", intended to be used to evaluate food product processing units in order to assist retailers and owners of food brands in complying with European regulations in matters of food safety.

The standard includes **a set of specific requirements** for traceability in its 5th version. In summary, the overall goal of the BRC standard is to ensure that certified companies have an effective system for identifying and tracing product lots from the purchase of raw materials (base products, wrapping and packaging) through distribution of end-products to customers, including all processing steps.

Companies must also be able to trace their products within a practical timeframe. Among the various control points, we should note the **obligation for companies to test their traceability systems** in order to ensure that they are implemented from raw materials through to finished products and vice-versa. This is to be able to carry out weight assessment/quantity control. The standard also requires that product traceability be maintained and respected regardless of changes made to the product.

❑ GFSI recommendations

The "*Global Food Safety Initiative* (GFSI)" is **a non-profit foundation** created in 2000 and managed by the "*Consumer Goods Forum"*.

The primary goal of the foundation is to **compare and approve** (through a process known as *benchmarking*) **a series of food health standards** against a reference document (*GFSI Guidance Document*).

In 2007, eight major retailer brands reached an agreement on this reference document. The goal of the process is to reduce the growing number of audits suppliers are facing by implementing the philosophy "once certified, accepted everywhere". GLOBALG.A.P. and BRC are among the standards that have been benchmarked against GFSI reference documents.

A section of the GFSI reference document is dedicated to traceability. The standard requires that companies develop and use procedures and a system that:

- Enables **identification** of each product, ingredient or service coming out of the company
- Includes the **complete logs** of packaged product batches, with their packaging, throughout the packaging process

- Includes the **purchaser references and destination market** of every product sold.

❑ ***Fairtrade Labelling Organisation* (FLO) requirements**

The international Fairtrade Labelling Organisation (FLO) has **two separate legal entities**:

- **FLO e.v.**: **a non-profit organisation** with several stakeholders (bringing together 19 labelling initiatives, three producer networks and two marketing organisations). The organisation coordinates the **Fairtrade** label at the international level. Its primary missions are to establish international fair trade standards and to organise support for producers worldwide
- **FLO-CERT**: **a private for-profit entity** that **carries out audits** and authorises companies to use the "Fairtrade" brand which is now one of the most widely recognised social and development labels in the world.

The goal of fair trade is to **create opportunities** for poor producers and workers who are marginalised by the traditional trade system. Trade operators can become Fair Trade if they commit to supporting its goals. The standards, called "Generic Trade Standards", are the minimal requirements to be applied to industrialists to prove their commitment to Fair Trade. The requirements of these standards include a section dedicated to traceability.

Fair trade traceability requirements are implemented to **protect operators and consumers**. They insure that the **authenticity** of Fair Trade products can be verified and that operators only sell Fair Trade products that are in fact fair trade. They **guarantee the origin** of products back to producers thanks to documented verification and the assurance that the products are physically separate and distinguishable from non-fair trade products. The standard emphasises that the method used to prove physical traceability is **at the discretion of the operator**. In this commercial standard, traceability requirements are applicable from the producer onward.

- ***Physical product traceability***

All operators must be able to prove the physical traceability of their products.[18] For product traceability, operators must demonstrate that the origin of certified products bought, sold or processed is guaranteed from their purchase from the supplier through their sale to their customer (downstream - upstream). It is up to the buyer to make sure

[18] A transition period is required when operators cannot prove complete conformity with the standard's physical traceability criteria. This period cannot be greater than two years from the effective date of Fair Trade's "Generic Trade Standards". Additional studies will determine if the physical traceability principle is feasible, and to what extent, for operators certified according to standards for sugarcane, cocoa, fruit juices and tea. Until a decision is taken based on the results of these studies, operators certified for Free Trade sugarcane, cocoa, fruit juices and tea are exempt from physical traceability criteria.

that the origin of the products purchased as certified can be demonstrated from the producer on.

Products must be physically identifiable. The identification method is at the discretion of the operator but must be verifiable via the presence of the FLO identifier ("FLO ID") or of the words "FLO Fairtrade" on the packaging.

▸ ***Traceability through documentation***

The standard also requires that buyer and seller clearly use an identification method on corresponding documents (such as Contracts, Maritime Bills of Lading, Delivery Notes, Invoices). All operators must ensure that they and the certifying body can identify:

- The product supplier
- The physical appearance of the product before transaction (purchase or sale)
- Modifications made and corresponding yields
- Waste
- Volumes bought and sold (upstream - downstream)
- The dates of the various transactions
- Payment of the Fair Trade price and pre-financing (when applicable)

Certified products bought and sold in bulk must be **stored in a special area and remain in a separate space or be stored at a separate time** from non-certified products. When this isn't possible, the operator must take all necessary measures to ensure that the risk of substitution of certified products by non-certified products is minimised. Traceability documentation criteria must always be complied with.

Regulations, Norms, Certifications and Standards: a helpful reminder

Legal **regulations**:

- Are part of either a national or European legislative framework
- Are a legal obligation that companies must comply with (or face sanctions)
- Impact sector perimeters or specific products

Example: Regulation (CE) 178/2002 on the traceability of food products.

Norms are tied to a reference:

- Recommended practice (Best Practice): the best way to proceed on a given issue
- Generally the result of studies and discussions carried out by companies within standardisation bodies

Example: ISO 17025 - "General requirements for the competence of testing and calibration laboratories" (ISO/CEI 17025 September 2005)

Certifications are tied to transversal systems:

- Based on sets of standards guaranteeing a certain quality level in company operations
- Validation of conformity (by audit) with standard practices
- Certification is part of quality (assurance) management

Example: ISO 900, ISO 14001, etc.

Standards are tools:

- Shared by those involved in a given sector or activity
- To have common operating methods to facilitate and increase the reliability of interactions between them

Example: EAN 128 barcodes

1.6. The components of a product traceability system

1.6.1. What is a "traceability system"?

A traceability system is a **system integrated in a production structure** (company, packing station, workshop, site, group, etc.) that makes it possible to trace an entity chosen in advance to pilot risks and quality from the originator and, sometimes, to the customer. A traceability system increases the reliability and proper use of information and improves company efficiency and profitability.

The following **four key points** must be implemented by the company:

- Product identification: tracking by lot
- Management of links between the operations carried out for each lot
- Data recording: pre-selection of information to be recorded
- Communication: association of an information flow with a product flow

Key principles of traceability

A traceability system consists of a **set of correlated or interactive items** designed to provide ***tracing*** (qualitative tracking) and ***tracking*** (quantitative tracking).

As a system intended to provide traceability of processes within and between organisations and, more precisely, within a *supply chain*, a traceability system is intended to:

- **Provide real-time tracking** of activities and of the flows connecting the activities
- **Highlight** as quickly as possible any **problems** that might arise during a process in order to be able to take action as quickly as possible (and resolve issues)
- **Illustrate the activities** (and the flows linking the activities) that make up a process through systematic modelling, in order to describe the operation of the organisation in concrete terms and to highlight the value chain. This is the basis for the development of a competitive advantage.

1.6.2. The functionalities of "traceability system"

To achieve its goals, a traceability system must include:

- A **series of actions to be carried out during production**, particularly at certain key process steps (e.g.: data collection during operations, checking and recording of this data, information archiving)
- A **documentation system** to:
  - Record the data required to build a product's history
  - Tie the information together with robust links (relational database, data capture forms)
  - Enable use of the information (give them meaning)
  - Circulate the information among partners (upstream and downstream)
- A **coherent identification system and batch labelling** of incoming and outgoing products.

Consequently, a traceability system must have various functionalities:

1. **Data acquisition**

   Data capture must take place at the place and exact time they are generated and the information must be recorded by the person best prepared to explain their existence and meaning: the person carrying out the action.

   Data acquisition implies the ability to concurrently identify: physical flows, players, locations, the documents required for item movement, the equipment used for processing, handling and transporting the flows, the activities that make up the process and the sequence of activities.

   It is, therefore, based on the implementation of a coherent identification system throughout the entire process that ensures that the data tracked will have the same meaning for all involved.

2. **Storage of collected data**

   Data storage is absolutely necessary to provide an overall picture of the processes traced. This stored data is important for analysis of the processes which have been completed.

3. **Data processing**

The system must be able to process the data to have a real picture of the activities carried out in the company and of the links between activities (that is, a picture of the processes). This is to enable examination of the organisation's activity overall rather than in parts or in isolation. The result is the creation of the performance indicators required to pilot processes and compile statistics.

4. **Information dissemination**

The dissemination of tracked information enables the exchange of information to follow up on flows and activities and the transmission of special instructions in the event of problems. The challenge for dissemination is to ensure continuity at the information flow level in parallel with physical flows and production activities (better coordination among operators).

1.6.3. A few thoughts on data collection

Data collection cannot be done haphazardly. It must be:

- **Organised and coherent** to obtain complete and detailed data
- **Systematic** to ensure that nothing is missed and to be able to gather all of the information needed
- **Structured** to facilitate the reconstruction of chains of states and situations

Traceability is an enabling tool for action on, and decision-making about, given objectives. Tracing is, therefore, more than data collection. It means:

- Using data in a way that gives them meaning by inter-connecting them
- Validating their reliability
- Having usable and relevant results on hand at the right time.

Three important points should be mentioned:

1. The entity is followed: information is structured and organised around the entity and its potential circuits.
2. Exhaustive information is meaningless: accumulating data in bulk isn't tracing! Only reliable and meaningful data is relevant to the goals of traceability.
3. The information is intended to be used. It isn't quantity that counts, **but quality and reliability**. Having a great deal of unusable data will not very helpful when they are needed (generally after the fact). For example: is it important to know the location of a product when its composition or lot number is needed? This is a good reason for thinking about items and needs before starting to collect data. The three evaluation criteria are:
   - Data reliability: 100% of data is correct
   - Data relevance: ability to answer the questions asked
   - System effectiveness: the information meets (internal and external) needs.

1.6.4. Inadequate or failed traceability: consequences

"**Inadequate traceability**" results in **insufficient information** or unsuitable information (quality or quantity). Traceability is not interrupted but is carried out less effectively. When traceability is inadequate, the required analyses cannot be carried out...and expected decisions cannot be made (e.g.: when managing a food crisis). This can lead, for example, to a more extensive recall than would have been needed if all required data had been available.

When linking the identities of entities is or becomes impossible, there is "**traceability failure**": it is no longer possible to move from one step to another in the history of the entity within the process.

The causes of traceability failure can be:

- A defect in traceability system design: certain links between recorded identifications are omitted because they related to special cases or exceptions
- Poor use in practice: an unidentified component is introduced into manufacturing, a tool is replaced without being recorded, a batch is used in production without being identified, a product is labelled instead of another one, etc. ;
- System error: an error or technical problem affects records and breaks the link between them.

Regardless of the quality of the recorded data, they become useless. The upshot is that the traceability chain is interrupted: upstream and downstream traceability is no longer possible.

An internal traceability failure in a company means that the traceability system becomes unusable overall. Certain steps may work but the overall view expected from traceability (for safety or execution) is no longer available.

When the failure is within the chain, traceability stops at the doors of the company where the failure took place. It becomes impossible to move upstream or downstream to find the real causes or effects of the problem to be analysed. The cost of the problem (expenses incurred, legal liability, etc.) will be for this company.

Appendices

A.1. Some definitions

Blocking: Any temporary measure that stops the movement of products and withholds them from consumers for a given period of time. Subsequent analysis leads either to the renewed sale of the products (unblocking) or to the initiation of a withdrawal procedure.

Certification: Procedure by which official certification bodies and officially certified bodies provide written or equivalent assurance that foods or food control systems conform to specified requirements. Certification of food may be, as appropriate, based on a range of inspection activities which may include continuous on-line inspection, auditing of quality assurance systems and examination of finished products (according to the *Codex Alimentarius*).

Barcode: Identification and management system that uses a set number of digits to carry product information including country code, company identifier, item identifier, etc.

EAN (*European Article Number*): European standard for the identification of trade products using barcodes.

Record: Document that provides tangible proof of activities carried out or of results obtained (ISO 8402:1994).

Entity: A set of real or abstract objects that exist independently and share a set of common properties.

Equivalence: Ability of different inspection and certification systems to meet the same objectives (according to *Codex Alimentarius*).

Chain: All players who, through their successive activities for a given product or category of products, contribute to producing, processing, warehousing, transporting and selling the product.

Identification: Unique relationship between a reference or identifier and a lot, product unit, player, activity or place. Written and recorded identification enables the transmission and storage of information about an entity, from production through finished product.

Inspection: Is the examination of food or monitoring systems for food, raw materials, processing and distribution, including in-process and finished product testing, to verify that they conform to requirements (according to *Codex Alimentarius*).

Lot: The concept of a lot is set based on the context pre-defined by the operators of the chain. A lot is a group of units of a food with identical characteristics produced and/or packaged in virtually identical conditions. At inspection time, lot units have identical characteristics in terms of type, variety, calibre, packaging, brand and origin.

Recall: Any measure intended to ensure the return of a harmful product which distributors or retailers have already delivered to consumers or made available to them.

Withdrawal: Any measure intended to prevent the distribution and exposure of a harmful product and its sale to consumers.

RFID (*Radio Frequency IDentification*)**:** Identification system consisting of radio frequency labels (electronic chips), antennae to receive signals and decoders integrated in the computer system to read data.

Traceability system: Set of correlated or interactive elements intended for the "*tracing"* (qualitative tracking) and "*tracking*" (quantitative tracking) of one or more categories of given items.

Traceability: Ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution (according to Regulation (CE)178/2002).

Product traceability/tracing: Ability to follow a food through specified stages of production, processing and distribution (according to the *Codex Alimentarius*).

Ascending traceability (ascending): Ability to find the history and origin of a lot at every step of the product life cycle from a lot or unit of product. Within the chain, the associated data must provide the ability to follow movement from product back to raw materials.

Descending traceability: Ability to find the destination of a lot or unit of product at every step of the product life cycle. Within a chain, the associated data must enable tracking from upstream through to the finished product.

A.2. Sample descending traceability diagram

Type 1 requirement: Customer
Type 2 requirement: Regulations
Type 3 requirement: Specific to the company

Steps	Type of requirement:	Information and data	Recording media
Pre-requisites	1, 2 and 3	- Plot identification and references	- List of referenced plots - List of producers - Producer commitment contract - Plot codes
Type selection	1, 3	- Agronomic, taste and storage tests	- List of types selected - Test results

Planting	1, 2 and 3	- Seed or seedling batch n° - Supplier name - Name of the preceding crop - Name/quantity/date of pesticide products used by the seedling supplier - Planting date - Agronomic value of the soil	- Crop sheet - Plant passport - Delivery slip - Seedling/seed labels - Soil analysis
Organic and mineral fertilisation	1, 3	- Product type/quantity spread/date/proof - Sprayer checks - Residue analysis	- Crop log - Product invoices - Soil analysis results
Crop protection	1, 2 and 3	- Product type/quantity or dosage/date/proof - Organic fertilisation	- Crop sheet - Sprayer maintenance and calibrating sheet - Analysis results - Product invoices

Irrigation	1, 3	- Water source/quantity pumped/date/proof - Mineral and bacteriological water analysis results	- Crop sheet - Water analysis result
Harvest	1, 2 and 3	- Ripeness level/quantity harvested/date	- Compliance sheet - Harvest crate sheet - Crop sheet
Receipt by station	1, 2 and 3	- Quality control of lots received (ripeness, calibre, weight, appearance, residue)	- Reception control sheet - Residue analysis results
Refrigerated storage	1, 3	- Duration, conditions (T°, hygrometry, controlled atmosphere), product location in coolers - Fruit development	- Control sheet for coolers and currently stored fruit - Storage plan - Box pallet/crate labels

Sorting-calibrating-packaging	1, 2 and 3	- Sorting inspection results (type, calibre, weight, appearance, category)	- Inspection sheets
Shipping	1, 3	- Lot destination - Quantity/date/quality level/lot number - Transporter/date/ temperature during transport - Customer complaints: reason/quantity/ product	- Shipping slip - Sales invoice - Transport slip - Temperature record - Complaint form

A.3. Sample ascending traceability diagram

Identification documents	Steps	Information available
▪ Label/product	Sorting, calibrating, packaging	- Lot reference - Producer reference - Type, calibre, weight, category
▪ Box pallet/crate labels ▪ Refrigeration inspection sheet ▪ Storage plan	Refrigerated storage	- Plot reference - Producer reference - Harvest date - Type - Conformity inspection results - Storage inspection results - Storage condition inspection (temperature, hygrometry and controlled atmosphere
▪ Harvest crate label ▪ Compliance sheet	Reception	- Plot reference - Producer reference - Harvest date - Type - Conformity inspection results
▪ Identification of harvest crates ▪ Crop sheet	Harvest	- Plot reference - Producer reference - Harvest date - Type - Quantity - Ripeness

▪ Crop sheet ▪ Product invoice	Crop supervision	- Plot reference - Producer reference - Pesticide products used - Fertilisers used - Source and quantities of water pumped
▪ Crop sheet ▪ Seedling and seed labels	Planting	- Seed and seedling n° - Supplier name - Preceding crop - Planting and disinfection date - Agronomic value - Plot reference - Producer reference - Record of weeding operations - Herbicide products used before planting
▪ List of types selected	Type selection	- Sensory and agronomic test results - Test and experimentation results
▪ List of referenced plots ▪ List of producers ▪ Producer commitment contract	Pre-requisites	- Plot reference - Producer reference
▪ Shipping slip ▪ Sales invoice ▪ Transport slip ▪ Temperature record ▪ Customer complaint sheet	Shipping	- Lot destination - Quantity/date/quality level/lot number - Transporter/date/ temperature during transport - Customer complaints: reason/quantity/product

A.4. GS1 labelling recommendations

The overall goal of GS1 is to enable every operator in a chain to label the products they make and sell using information that the preceding operator has supplied them with. In order to be able to transmit the information required to the next steps, GS1 gives recommendations on the **minimum data** to be forwarded to the next operator. These data can be put on the rack sheet, on adhesive labels, etc.

Data to be written on the card or label:

- Producer/grower number (authorisation number)
- Product name, variety or commercial type

- Class/category (not valid for potatoes)
- Size/calibre
- Country of origin
- Net weight (if compulsory or agreed to)
- Lot number (see below)
- Harvest date (optional)
- Plot number (optional)
- Date

The grower can put a lot number on their products. If they do, the combination of lot number and grower identification will ensure traceability. If they don't put the lot number on, the auctioneer/packer/importer must put one on at a later time. The harvest date can be useful in helping producers obtain more information on a product's best by date or in the event of a recall. The plot number provides additional information on the origin of the product.

Personal notes

Personal notes

2

Chapter 2

Implementing a traceability management system

2.1. Implementing a traceability management system

Basic principle: the implementation of traceability **must be adapted to** the objectives of the sector, to the company, to its environment and to its regulatory, contractual (client requests) and internal constraints.

2.1.1. Implementing a "traceability system"

A traceability system is a **technical tool** intended to help companies comply with **set objectives** and it is used, when necessary, to determine the history and/or location of a product and all of its components.

The **ISO 22005:2007 standard**[1] sets the principles and specifies the basic requirements applicable to the design and implementation of a traceability system in the food chain. It can be applied by any "organisation" operating at any level of the food chain. It must be designed to **flexible** enough to enable operators to meet the objectives they have identified as being **relevant for them**.

Traceability is usually initiated by an outside request that combines **regulatory obligations** with **client demands**. The latter may also be subject to a regulatory traceability obligation at their level or may be interested in having complete traceability without having to bear the cost alone.

Since traceability requests **usually come from the outside with specific goals**, the challenge resides in implementing an **effective** traceability system in the company that will be **suited** to the size of the company, to its resources and to the qualified people available.

The implementation of a traceability system must be viewed as a "**project**" by the company. It requires a structured approach, that is, a methodology. Throughout the project, it will be important **never to lose track** of the fact that traceability is simply a tool for product **safety** and **quality** and not a goal in itself.

Implementation of a traceability system will be facilitated by:

- A degree of organisation in the company and of the project

[1] ISO 22005:2007, *Traceability in the feed and food chain — General principles and basic requirements for system design and implementation* was developed by ISO/TC 34, Food Products. It is available from ISO.

- Known and stable processes and operational methods (a minimum number of operations that repeat over time must be identified)
- Well-documented processes and modes of operation
- The presence within the company of quality management systems (traceability provides visibility and understanding, not a way to solve problems or reduce risk). The temptation to link *traceability and quality* is great: this is, however, truer for "*tracing"* than for "*tracking*".[2]
- The availability of qualified staff informed about the project. The entire company is affected by its implementation. Although the actual use of traceability only involves a few players or services, it must take into account all operations and all employees. Everyone must answer the question: *"What can I do to enhance visibility of products and flows?"*

Cutting the project up into "pieces" can lead to the implementation of several complementary, competing or incompatible traceability systems.

2.1.2. The basics of the methodology

A **four-step** methodology is usually used:

1. Environment definition and needs assessment (external and internal)

The company must identify the data to be traced, particularly those that:

- Meet regulatory requirements
- Meet market needs (clients)
- Meet the company's own requirements (organisation, reactiveness).

Who requests traceability, how and why?
Is it really a basic need or just a fad?
What do business professionals think about the trend and what are competitors doing?

Even if the trigger is a request from a business partner, time must be taken to analyse the subject to understand its positive and negative effects on the company (business opportunities provided by better traceability) and the resources available (state of the art).

This analysis will be used to create a "**business vision**" of traceability for the company: *What are the purposes, formats, benefits for the company's operations and for the target markets*? Only a well-designed "business vision" will provide a return on investment.

2. Assess internal capacities

All companies have a minimum amount of data recorded and stored for customer and production management, market studies, cost price calculations, marketing,

[2] *Tracing* and *tracking* are equally important and required within the framework of food safety.

accounting, tax returns, etc. They all provide implicit traceability systems. During the internal assessment, these existing internal capacities will have to be carefully identified and compared with external requirements.

What is already in place and what has already been recorded?
What in-house experience does the company have with traceability?
What are the weak and strong points of existing traceability compared to the specifications of the external request ?

Lastly, a traceability project should not be viewed solely as an "exercise" to be carried out internally since it also involves suppliers (direct) and service providers. The latter will have to be involved during traceability analysis and implementation.

3. Bringing internal and external together

The decision to implement traceability must bring together the "internal" and "external" aspects of the company. A traceability action plan and response strategy must be established given external requirements in order to sell the future system to clients, suppliers and, especially, to internal employees. Everyone in the company has to understand and accept the value of the project.

What can be gained from traceability within the organisation?
For example, what management benefits will it provide?
Will well-organised traceability help me complete my tasks more effectively?

These are important questions and the answers must clearly show the benefits for everyone at their own level.

4. Putting together a real project

Development of the traceability system must be **set up as a company project** with: a steering committee, a team, a working methodology, a schedule, a budget and validation of, and reporting on, each step.

It is important to follow the steps below when setting up the project to successfully implement a useful and effective traceability system:

- Define and plan the project. Keep employees informed
- Set up a suitable steering committee
- Define the parameters of traceability (context, existing elements, objectives) and the tools to be used
- Test on a process on site or on a "pilot" case and improve the system if need be
- Train employees on new requirements and obligations
- Extend the system to the entire organisation while communicating internally and externally about the traceability system

- Assess the robustness of the system: internal audits (based on previously defined indicators), test product withdraw/recall systems (simulate a crisis) and verify operator qualifications
- Periodically review the system (analyse changes in client, regulatory, process and product requirements).

Implementing a traceability system requires an action plan coordinated by a steering committee.

Once the system is set up, an **"administrator" must be designated**. They will be responsible for managing traceability in the company and will work with a set of indicators to evaluate the results, benefits, malfunctions and effectiveness of the system.

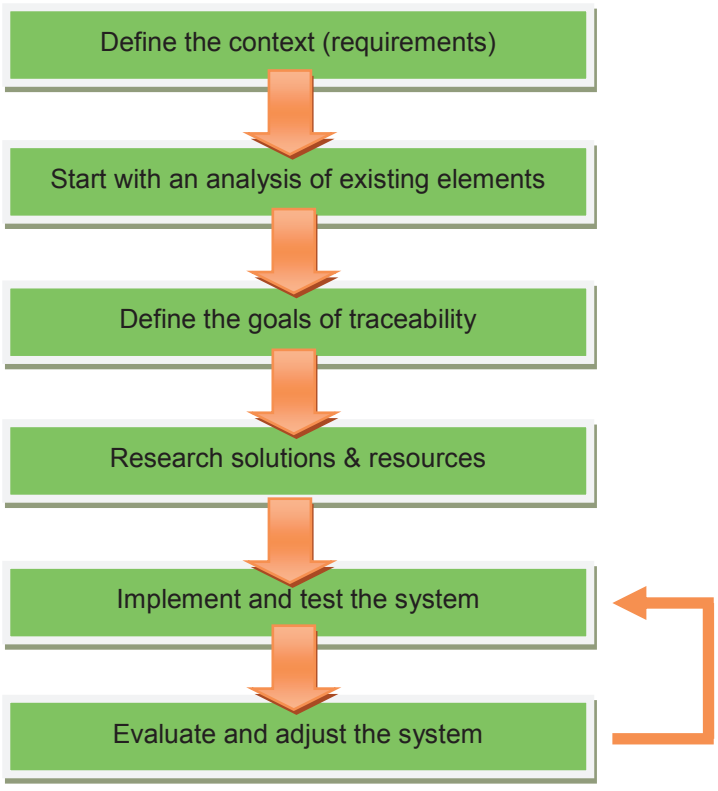
2.2. Creating an action plan

2.2.1. How to create an action plan

Implementing an organised traceability system in a company requires the creation of a coherent "Action Plan". It should include:

- A description of the project and an analysis of existing elements
- The definition of goals and a schedule of the steps to be completed (timing chart of tasks to be completed)
- The implementation of tools and a test phase of the system ("pilot project")
- An employee training programme and an information programme (that includes customers)
- A follow-up programme/evaluation of the system that makes any required adjustments.

Traceability: Start with existing elements and develop an action plan



This implementation scheme is the most logical approach to setting up an **effective and relevant traceability system** (meeting identified external and internal needs).

2.2.2. Important steps for consideration

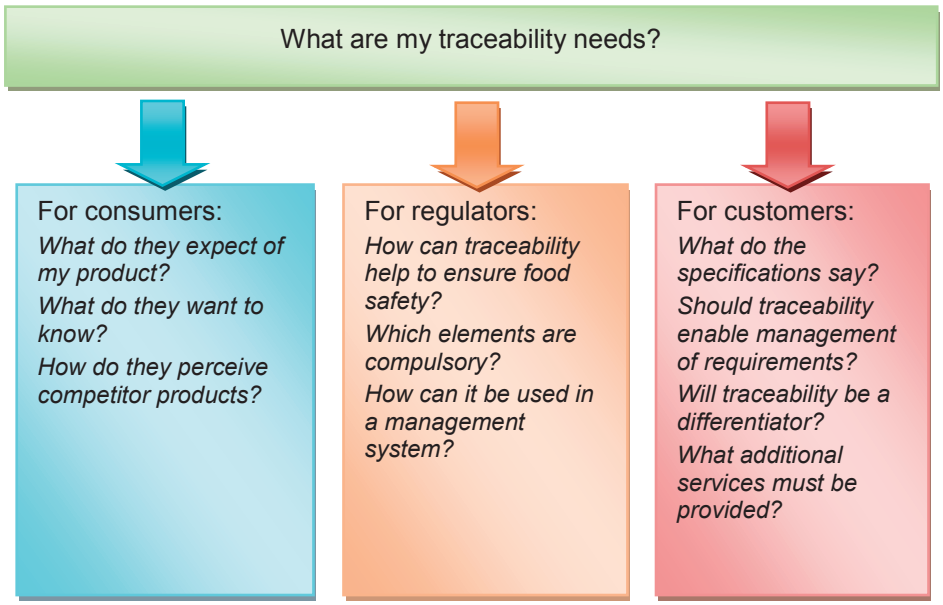
A series of steps is required to effectively implement a traceability system:

Step no. 1 - Define the project

Implementation will be difficult if objectives and expectations are not defined, or change constantly. The following must be defined to enable study of what is expected from the traceability system:

- **The "entities" to be tracked:** To trace effectively, **products** must first be clearly **defined** (type, composition, properties, commercial specifications, regulatory specifications, etc.). It is much easier to trace a defined product than a product that is either not defined or ill-defined. Likewise, tracing a product with few components is easier than tracing a product with many components. This is the case for many of the chemical products used (e.g. mixes of pesticide products, compound fertilisers, etc.).[3]
- **The issues that must be addressed or dealt with:** and the information to be provided. If the purpose of traceability is **product health safety**, **risks must be correctly evaluated ahead of time**: they must be known and measured and solutions must be found to reduce them. Implementation of traceability will be difficult if there are many risk factors and/or they are difficult to control.

Traceability: Define the context



[3] Note that it is also easier to implement traceability on lots and product units than on "continuous" products, especially if continuity leads to chaining of batches that will be mixed in the end-product (pallets consisting of products from several sources, products stored in silos, fruit jams, etc.)

- **The boundaries of traceability** (where it starts, what it covers and where it ends). That is: questions about what really needs to be done in practical terms must be answered:
  - Track and/or trace?
  - Which entity and why?
  - What level of detail is required?
  - To take what decisions?
  - To answer which questions (e.g.: audit, inspection) or handle which situations (e.g. crises)?
- **Required information** Generally speaking, it's better to have too much information that not enough. But it's also better to have some reliable information rather than too much unusable information. The ideal is to have a lot of useful information... It's always too late to find the missing information after the fact. Creating a list of required information is a **key step** that will condition the rest of the implementation. Note that it's impossible to *trace* using a system set up solely for *tracking*.

Step no. 2 – Project coordination

A steering committee must set up to coordinate actions. It must be a reflection of the entire company and not of a particular sector (e.g.: field production and packaging station). It must bring together all of the potential **users** of the traceability system (e.g.: commercial services) and all **producers** of traceability elements (e.g.: all operators in the field). It shouldn't only involve people who handle systems (whether computerised or not). It should be headed by a "Project Leader" who knows the subject and the company well!

All actions must be planned and coordinated by the **steering committee** The traceability system will have to become part of a managerial, business, regulatory, technical, IT, cultural and human environment. An overall understanding of all contextual elements, including the workings of the **food safety management system (FSMS),** is required to build an effective system based on objectives useful for the company and accepted by those involved on a daily basis.

Step no. 3 – Define the elements of the traceability system

The following is required, at a minimum, to build a traceability system suited to the objectives defined in the company project:

- Describe the product life cycle (process details)
- Describe information flows and the documentary base of the traceability system
- Define the human, technical, IT and financial resources needed

❒ Describe the product life cycle and the ascending and descending traceability schemes

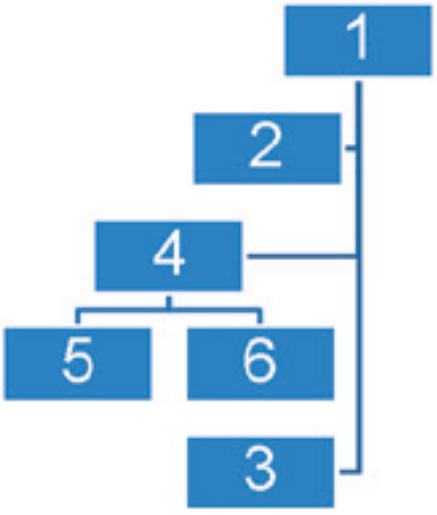
Traceability presupposes the existence of a circuit followed by the entity: this is the product's "life cycle". The goal is to recover all of the information and data required for traceability management throughout the entire life cycle. Traceability therefore requires full knowledge of the **logical sequence** of operations.

The more complex the circuit, the more variations or degrees of variation it will have, the more unstable and changing it will be and the more difficult establishing traceability will be because the links to be built will themselves be multiple, changing and complex. A continuous flow is also difficult to track: only its beginning and end are known! Steps, sequences and markers must be defined to structure traceability.

Therefore, the following must be done:

- Create a **life cycle for products**, link by link, and describe the existing links between each step and everyone involved in the chain.
- Define the **markers** of the life cycle within which traceability will be implemented: from where until where; what level of precision is required; what are the key steps, etc.?
- Develop **ascending and descending traceability schemes.**

Analyse the product life cycle: create a diagram of operations[4] based on a logical sequence.



Analysis of physical flows and processes

Analyse the **flow of items** to identify their key points:

- Operations carried out
- All changes of state or packaging
- Transport, movements, warehousing or removal from inventory
- Assemblies (components brought in at a certain point of the process) and mixes

It is important to identify how continuity of information will be guaranteed throughout the process steps.

[4] Identify essential operations moving from raw materials to finished products.

The data recorded, the basis of the company's traceability system, **will not be the result of chance.** A good understanding of flows and processes (of the operations carried out) will enable identification of which data should be captured and where and how it should be recorded.

Establish **"traceability procedures"** for the company's employees. This will ensure that the data considered to be indispensable will be recorded at the right place, at the right time and in the right format and that they will be kept and communicated under the required conditions.

❒ Establish information flows and the documentary base for the traceability system

Traceability is a matter of information. Its implementation is tied to the company's information flows and to the systems implemented. It feeds off of them and feeds them. Knowing these flows and systems will ensure that they are used as effectively as possible.

System documentation and the resources to be used are part of the documentary basis of the food safety management system:

- Starting with the life cycle, **inventory all data** and information to be recorded, step-by-step
- Create a list of the different **records used** as traceability media (**analysis of existing elements**!) and their normal retention periods (the life expectancy of products and regulations must be taken into account to determine the retention period)
- Write out the **procedures** to define the steps to be taken for each link. The procedures implemented must provide control over the traceability continuum at the critical points identified
- If computer program development is required, write out the **functional specifications** and infer the **appropriate tools and management resources** required. Tools already in place aren't usually suitable for traceability. Adjustments will be necessary and their complexity will reflect that of the information system.

❒ Define the human, technical, IT and financial resources required

For each step and for each recording media, it will be necessary to define the **responsibilities of each person** doing the recording, the frequency of data collection and the processing required for the data.

The tools and data management resources must ensure:

- Identification of the object traced. **"Lots" must be defined** to accomplish this and it must be determined whether or not their definition complies with customer, regulatory and company requirements
- Information collection, transport and reproduction
- Guaranteed **data integrity**
- That **information and product become inseparable** (**labelling** that guarantees a **consistent link between information and the product traced**).

In order to select data tools and transmission methods, it is necessary to **first** evaluate the data collection and transmission systems that already exist in the company: can they simply be adapted?

The implementation of a traceability system is not limited to selecting markers, identifiers and authenticators. Although these choices are important for the project, it is imperative to have a global, organisational and technical approach.

Step no. 4 - Agricultural production pilot project

With respect to agricultural production, it is recommended that a pilot project be carried out with a limited number of representative producers.

A simulation of the traceability approach based on the pre-established objectives should be carried out to validate the proposed implementation. An evaluation of this operation will enable adjustments to be made before roll-out.

Step no. 5 - Training

The company must implement a training program.

It must be suitable and designed to inform all operators in the chain about the approach and to train them to use the tools.

Step no. 6 - Internal and external communication

This is proposed by the steering committee to company management and is intended to explain and promote the approach implemented internally and to the company's customers.

Feedback must be provided (impact measurement) to improve system effectiveness.

Step no. 7 - System assessment

Assessing the system will enable verification of its relevance compared to the goals set beforehand. The traceability system must be assessed periodically during internal audits of the food safety management system.

The data input to this review can be:

- Results (tests, audits, etc.)
- Modifications to the process
- Changes in regulations
- Corrective actions
- New expectations in the chain

2.3. Developing traceability procedures ?

2.3.1. Sample approach

To develop traceability procedures: understand the context, carry out needs analysis as explained above and create a list of instructions to be followed based on the operations diagram.

We will use the concrete example below to facilitate understanding of the procedures used to illustrate the approach.

Description of the company environment:

The family company GIANT GREEN grows vegetables and fruits that it sells to supermarkets throughout the country. Part of its production is also sold to small local processors for canning. After attending a trade fair, Mensah Kyra, the owner of GIANT GREEN, understood the benefits of exporting certain products to Europe. However, he also understood that his future customers would ask for a great deal of information on his production and packaging practices. He therefore decided to implement a traceability system in his company right away. He felt that implementing traceability would also help with inventory control, to improve his practices and to increase his profit margins.

Crops are planted to meet expected market needs, but during the season, GIANT GREEN also buys products from small producers nearby. GIANT GREEN buys its seed and seedlings from a few local suppliers. Mensah or his assistant spray pesticides and fertiliser themselves. They hire labour for some fieldwork and for packaging. GIANT GREEN also sometimes takes care of packaging for several other producers.

Harvested products are brought directly from the fields to the station and placed in one of the chillers. In general, pickers put the products in plastic containers and transport them to the station in GIANT GREEN trailers. The produce brought in from the fields or taken from the chiller is emptied into a wash basin at the start of the packing line. Each product is then sorted according to its appearance, calibre and colour then packaged in printed boxes. Packaged products are placed on a pallet and, if not shipped immediately, returned to the chiller until shipping time.

While preparing to implement his traceability system, Mensah Kyra realised that he had to be able to track all of inputs, in the field, and from harvest through shipping, including products packed for other growers. This means that he has to collect data on the fields, varieties, quantities, harvest dates, packaging and shipping. What's more, he has to keep logs of all fertiliser and pesticide spraying. He needs to know what information has to recorded when inputs are received, what information has to be archived and what information has to be shared with his customers when products are shipped. Since GIANT GREEN produces several types of vegetables and fruits that require fairly different processing and handling, Mensah Kyra realised that he would have to create different recording systems for each operation when harvesting, storage and data sharing processes are very different.

2.3.2. Step 1 - Creating an operations diagram

The first step consists in creating a **diagram** to show the logical sequence of the company's operations.

It will provide a clear guide to sources of information useful to traceability for all operations carried out during the production and packaging process.

- **Identify the main activities** carried out by the company.

There are several activities taking place in the company in the horticultural example (reception of inputs, planting and spreading, harvesting and storage, sorting and packaging, warehousing and shipping)

- **Create a list** of all of the company's different activities and put them in a *flow chart*. For example, for this case study:

- **Number every activity** to help you identify them and to be able to refer to them in traceability protocols.

  Every activity can also produce and use several types of inputs and outputs. There can, therefore, be several ways to collect different types of data. It may be necessary to identify and separate these different types of activities in order to create clear protocols.

  For example, the reception of inputs includes all of the products, consumable items and materials required to carry out the company's activities.

  Although these inputs are all received within the framework of the same activity, different employees may manage each input and the data may be collected and stored differently.

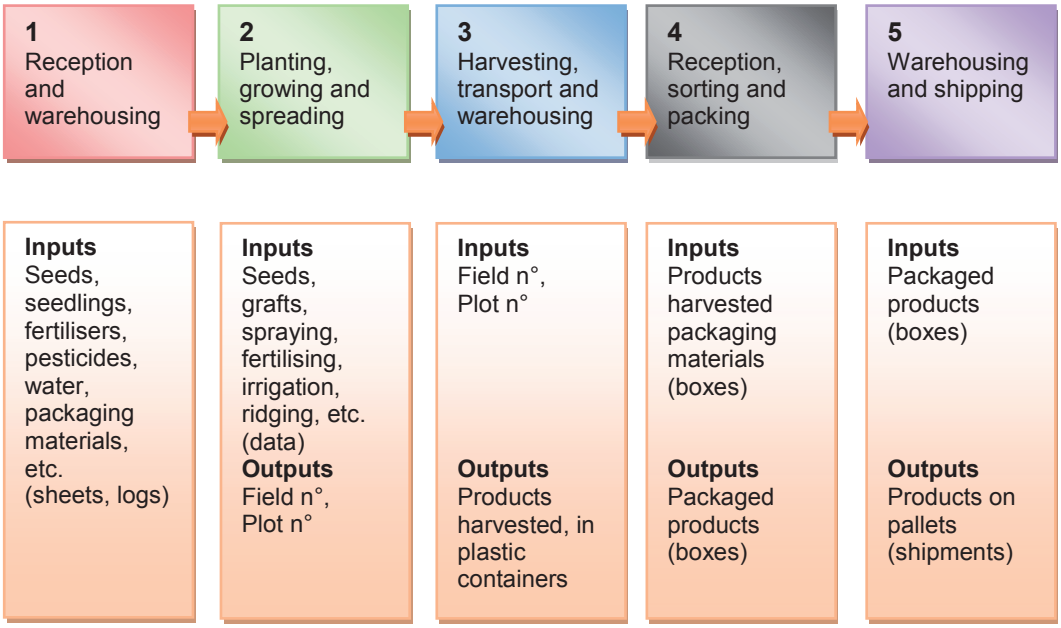
  The decision about whether or not to create different procedures for each type of activity must be decided by management.

- **List all inputs and outputs used for each activity**

  Inputs are all products, consumable items and equipment needed to carry out activities within the framework of each operation.

  Outputs are the works in progress, finished products and sub-products of each operation.

  Generally speaking, the outputs of one activity are the inputs of another one.



2.3.3. Step 2 – Write-up the instructions to be followed as procedures

At each step of the process, a **series of "procedures"** (instructions to be followed) will explain to company employees how to capture and document traceability information.

These procedures can change and will need to be updated as the company changes...like all other company procedures.

For each activity in the operations diagram:

- Identify the type of activity by name (and number)
- Briefly describe the activity carried out
- **Identify the person responsible for the activity, the data to be captured and the traceability data documentation to be kept**
- **Explain how to capture traceability data**
- **Indicate where the data must be saved**.

This approach will help you ensure that you are collecting, saving and sharing all of the traceability data needed in your company. It's often helpful to include samples of forms to be filled out and documents to be collected (invoices, product use logs, production sheets, receiving and shipping logs, etc.)

Use these procedures to train employees and to explain to them their role and responsibilities in the traceability system.

2.3.4. Sample data recording procedures

❒ **Example 1: "Planting, Growing and Spreading" procedure**

Activity: Activity number 2 - Planting, growing and applying pesticide products

Description: Planting seed/seedlings and spreading agronomic inputs (fertilisers, pesticides, manure, compost)

Person responsible: Production Manager

1. Take seed or seedlings out of storage for planting. Write down seed batch numbers, planting dates and the product and variety planted in each field and block on up-to-date field sheets.
2. When pesticide products and fertilisers are taken out of storage, cross them off **the inventory lists** in the storage area.
3. When inputs are spread, write the following information for each type of input on the appropriate forms:

Input used	Data to be recorded	Form to be completed
Fertiliser	Operator name (signature) Application date Field/block number Quantity/ha Composition of the mix Batch number	Agronomic inputs log
Pesticide products	Operator name (signature) Application date Field/block number Brand name Active compound(s) Quantity/ha Time to harvest (TTH) Batch number	Agronomic inputs log
Manure, compost	Operator name (signature) Application date Field/block number Quantity/ha Product spread and type (e.g.: chicken manure)	Agronomic inputs log

❒ Example 2: "Harvesting, Transport and Warehousing" procedure

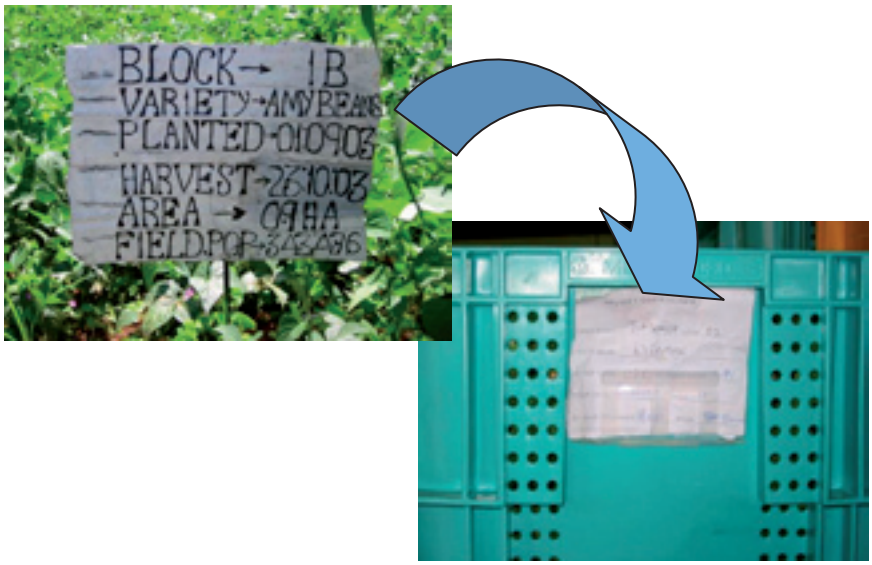
Activity: Activity number 3 - Harvesting, transporting and warehousing products

Description: Harvest products, transport them to the station and warehouse them.

Persons in charge: Production Manager, Transporter and Station Manager.

1. Before harvesting, pick up clean containers in the clean container warehousing area (see the **Buildings Diagram**), load them onto a trailer and take them to the right fields (Transporter).
2. While harvesting, manually fill out the **product harvest form** (form "X"), with the product harvested, the variety, the harvest date, the amount harvested, the field or block, the name of the person responsible and the amount harvested (Production Manager).
3. Form "X" is kept in the office of the Production Manager. When form "X" has been filled out, sign and date the bottom of the form and file it (also kept in the office of the Production Manager).
4. Transport the harvested product to the harvested products cooler (Transporter).
5. At the station, write down the field number and the harvest date on stickers and place on each container. This will be the batch number of the harvested produce. The field number and harvest date should be written as: *xx-mm-dd* (field number-month-day) (Station Manager).

Keep the field data through to the station!



❒ Example 3: "Warehousing and Shipping" procedure

Activity: Activity number 5 – Product warehousing and shipping

Description: Load the product onto the lorry and ship

Persons in charge: Station Manager

1. Fill out the **pick-up list** for each order.
2. Find the produce corresponding to the order in the chiller. Make sure the packaging identifier and label are on each crate. Take the packaged produce out of the cooler and to the loading dock.
3. A lorry is assigned when the produce is ready for shipping. Inspect the lorry to ensure that it is clean.
4. Load the product onto the lorry.
5. Check the contents of the lorry by comparing it with the order sheet.
6. Write out the shipment information: product/variety, packaging, quantity, destination, lorry number, shipping date and packaging identifier on form "Y". Fill out a Transport sheet. Give the Transport sheet to the lorry driver.

Data collected	What should be recorded?
Output lot number	Packaging identification
Product identification	Product code
Product description	Product description
Shipping date	Order preparation and ship date
Identification of origin	Company name and address
Shipment identification	Customer order number
Shipper identification	Company name and address
Identification of destination	Customer name and address (destination)
Receiver identification	Customer number
Quantity	Number of pallets shipped
Units (box)	Number

Personal notes

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Chapter 3

Traceability tools

3.1. Data media

For operators, selecting traceability media means the **freedom to choose** the system best-suited to the specificities of the chain, to product production and distribution methods and to the company's volume of activity (there is an obligation to obtain results, but also a degree of freedom in terms of the methods used).

There are **two types of traceability media:** paper and electronic media. The latter can also be coupled with automatic identification equipment such as barcodes and smart labels.

3.1.1. Paper documents

Traceability systems based on paper documents and manual transmission of information can be used in companies/organisations in which the number of "documents" and "recording sheets" is limited.

This solution, which offers the advantages of **low-cost**, **ease of implementation** and ease of use by employees, can be **sufficiently effective** to allow a company to tell its customers that it has a traceability system for its operations and products.

However, to be truly effective, data collection must be uniform and objective. The preparation of recording forms is of utmost importance as is the training of the operators who will be required to collect data.

Paper documents can:

- Be tied to the product (label, packaging)
- Physically follow the product (traveller, delivery slip, invoice).

The documents must both be written and validated by the various people responsible (Station Manager, Quality Manager, Production Manager, Warehouse Manager, Purchasing Manager, etc.).

They normally exist as **forms** to be filled out by an operator (see the recording **Annexe for samples**). They are generally **record cards**, **logs**, record sheets and data collection cards. Their size must be optimised to collect as much useful data as possible.

There are several steps to creating a data collection form:

1. Selecting the data to be collected (type of data: measurements, observations, etc.). The importance of a good definition of "**useful recording**" **(usable)** should not be underestimated.[1]

[1] For example, take the case of a usage log for pesticide products in the field. At the time of dosing to prepare the spray mixture, the operator has to enter the amount measured out (in ml) or weighed (in g) and the amount of mixture (in litres) to be prepared on the quantity form rather than the "dose/ha" indicated on the label. In the event of a problem with residue, the theoretical

2. Designing the record form (data collection sheet). This form is usually a table. It is designed to enable systematic recording of data using numbers (e.g.: temperature in °C), ratings (e.g.: good), dates (of the operation) or symbols (code).
3. Determination of the data collection period, frequency and place.
4. Identification of the person recording the data (e.g.: operator) or of the manager responsible for supervising data collection (e.g.: Production Manager, who signs the form).

In large companies, paper media is often difficult to manage given the large number of sheets that must be kept for a long period of time (at least, for the life cycle of the product). A **combined system is used in many companies**: paper forms are used first then the information is entered into the computer (with a risk of error during this operation).

3.1.2. Electronic media

The advantage of using a computer system for managing traceability is that it solves paper problems. A computer system provides:

- Easier management of records while reducing concerns about storage time
- Immediate storage of data within the company
- Linking of workstations with the same data (e.g.: lot numbers) accessible to all operators involved thanks to data centralisation
- Reduced reaction time for the creation of data reports on a given lot (e.g.: to respond to an importer or a public authority in the event of a problem).

The effectiveness of this system increases when it is coupled with an identification system like “**barcoding**" or "**RFID**". Use of these identification systems replaces manual data entry on the computer and **eliminates typing errors.**

However, it should be pointed out that this isn't a miracle solution and that a computerised system **is only effective if paper traceability is already well organised and operational**!
What's more, computerising traceability requires qualified staff and will be more expensive (purchase of computer equipment and user licenses, employee training).

❑ **Barcodes**

Using barcodes enables producers to identify every unit in a production batch. It also enables retailers to manage their inventory better.

There are several types of barcodes. The main ones are: Code 39, Interleaved 2 of 5, MONARCH (CODABAR), Code 11, Code 93, Code 128, Code 49, Code PDF417, Code 1 and EAN. This information coding system uses as **succession of bars and spaces** of different widths. Their juxtaposition represents numeric or alphanumeric data.

dose per hectare provided will not be helpful in identifying a calculation error made when the product was measured out.

Labelling with this code can be done several different ways using ink jet, laser or thermal printing. The code is read with an optical device such as a pencil, laser gun scanner, etc.

There are **two types** of barcodes:

- Internal barcodes: code created by a company for internal use only
- External barcodes: usually of the GENCOD type. This consists of a number code and a symbology using bars: **called *Gencod* EAN** (*European Article Numbering (article code)*), an international code standard that includes several standards of which **EAN 13** is the most widely used. The code consists of 13 digits representing a national identifier, a manufacturer and product code and a control key. This system makes it possible to identify each unit in a lot from manufacturing through distribution.

❑ Radio frequency or smart labels

RFID (*Radio Frequency IDentification*) is based on the principle that any object can be equipped with lightweight chips (tags, transponders[2] or microchips) that provide information readable from a short distance using small portable readers. The information is contained in the marker and can be used to track inventory or trace products. This is a contactless labelling and reading technology. The system is still not very widely used in the fruits and vegetables sector.

Smart label applications are **not widely used** in the agri-foods industry. This is primarily due to the cost for products with low added value like most agri-foods products, including fresh fruits and vegetables.
A RFID system consists of **three parts**:

1) A tag which manages:
   - Physical aspects of exchanges (frequency, transfer speed, modulation, etc).
   - Logical management of exchanges (protocol)
   - Data storage.

   Tags can be packaged in a number of formats (cards, tags, tokens, capsules, labels, etc.). There are two types of tags, also called "smart labels":
   - Read-only (passive): they contain recorded data entered by the manufacturer which cannot be changed or added to. These labels (most common) are woken up by electromagnetic induction (the radio wave sent by the reader) and return an agreed-to signal at short distance. Data life is estimated at 10 years and 100,000 write cycles
   - Active tags: (more costly) are equipped with their own energy source (battery or solar panel) and a microchip. They can emit a signal alone and/or have a more complex dialogue with the reader. They have autonomy of several months to several years. Write-once/read-many labels contain information recorded by the first user which can be read but not changed or added to. On the other hand, write-many/read-many labels can be written several times, erased, changed, added to and read many times.

   In all cases, RFID tags are characterised by:
   - Their small size (to 1 mm)

[2] A system able to respond to a radio signal is called a transponder.

- Their low cost (a few euro cents for the least expensive ones)
- The presence of a relatively large antenna
- The potential for update during use

2) An interrogator (or reader) which ensures communication with the tag:
   - Data encoding and decoding, verification, storage and transmission
   - Management of communication with the tag (activation, session initiation, read, write, authorisation, etc.)
   - Data transmission management (frequency, transfer speed, modulation, emission power, etc.).

   The interrogator can be either fixed or mobile. Antennas can be internal or external, depending on the application.

   Information exchange in a RFID system takes place as follows:
   - The interrogator transmits a radio signal at a given frequency to tags in its read zone
   - The signal provides the tags with the energy needed to respond
   - The "activated" tags send a signal to the reader to establish a dialogue using a predefined communication protocol.

3) The information system (IS):
   Manages the functions and processes that either act on the data exchanged with the tag, or uses them.

❑ Databases

A database provides a way to **manage information**. It is a tool for managing data about a specific subject or for a particular purpose (for example product traceability).

A database management system is an optimised and secure physical and logical file storage tool which provides access to saved information: these data are accessible from remote work stations.

The data stored in the database can be queried: detailed information about an entity with a code can be found in the database to which the code refers. Databases must include:

- Data search interfaces
- Alert interfaces.

The effectiveness of these systems depends on their overall design and the rigour with which they are used.

❑ Traceability software

There are many software packages available and it isn't always easy to appreciate their relevance and effectiveness[3]. The cost of user licences can also be relatively high, as can keeping software up-to-date.

[3] This is the case of HORTITRACE software which was developed by COLEACP/PIP.

A computerised traceability system is simply a data recording system. It enables effective structuring and filing of data and the quick production of reports that would be more difficult to create using a manual system (paper). As with a manual system, great care must be paid to the procedures implemented to ensure effective and safe use of the software.

Procedures can vary from one company to another but it should also be remembered that if a manual traceability system is already in place, and the system is operational and used effectively, the computerised system will work the same way and should be modelled on the manual system. If a manual system isn't used, or is poorly used, **the computer system will not solve any problems**. In the best case, installing a software application will underscore the need to be able to produce traceability sheets and will give rise to advice on the implementation of procedures.

3.2. Product labelling

3.2.1. Product labelling and traceability

Labelling is a pre-requisite for traceability. However, "labelling" doesn't mean "tracing". Putting a mark on a product **facilitates its identification and contributes to the reliability** and systematisation of traceability, be it *tracing* or *tracking*.

On the other hand, while traceability implies several companies along the industrial and logistics chain, the mark will only be useful if it can be used by the other companies involved: this is why it is necessary to use "marks" or "codes" that are legible and usable by all operators in a chain (see below).

Labelling must:

- Be done with a system other companies can use
- Refer to code that is comprehensible by these companies (standards). Reading and not understanding a label is of little use
- Be suited to the purpose and visible: an inaccessible or hidden label is useless.

Labelling products implies pre-definition of the relevant labelling level. Labelling at the unit level can be useless (and, therefore, be a useless cost) if **labelling lots** or **logistics units** is sufficient.

The answer will depend on the use made of the product downstream and on the identification needs that arise during its life cycle.

3.2.2. Data carried by products

The information carried by an entity is **isolated** traceability data which are, therefore, incomplete and of little interest in themselves.

Traceability data can be categorised as:

- **Information** (best by date, etc.)
- **Legal information** on packaging
- **Labelling formats** (e.g.: EAN 128, a widely used product identifier[4])

The following is used when **tracing at the unit level**:

- A product identifier
- A unit serial number

The following is present when tracing at the group level (**product lot**):

- A product identifier
- A lot number (logistics lot or production lot) that can be expressed several different ways:

[4] EAN combines a standardised code and symbology (see Appendix).

- Incremental sequential number (including the SSCC or *Serial Shipping Container Code*[5] for the logistics unit)
- Time chart information (date and time).

Identification information must always be **in plain text** and **visible**.

3.2.3. Labelling requirements for product safety

Every lot of food products sold must be unequivocally identifiable. In the event of an emergency, or if a withdrawal or recall must be organised, the identification must enable suppliers, customers and the competent authorities to **find the lot(s) in question** and their origin without error.

In compliance with the ***Codex Alimentarius standard***[6], each package must, at a minimum, have the following information printed on the same side, in legible, indelible characters visible from the outside:

Identification

- *Exporter, packager and/or shipper (and national registration number)*
- *Lot number*

Type of product

- *Product name, if contents are not visible from the outside*
- *Name of the variety or commercial type (if required)*

Product origin

- *Country of origin and, optionally, the region of production or national, regional or local appellation*

Commercial characteristics

- *Category*
- *Calibre (reference letter or weight scale)*
- *Number of units (optional)*
- *Net weight (optional)*

Official inspection stamp (optional)

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5 A number unequivocally identifying the goods on which it is placed, from exporter to end-customer. Thanks to the SSCC, the product's movement can be followed through the supply chain and links created to corresponding information (e.g.: data previously recorded in producer logs).

6 CAC/GL 60-2006 - *Principles for traceability/product tracing as a tool within a food inspection and certification system*.

This information can also be included in the product shipping documents.

In addition, certain lots of plants or plant products intended for the European market and potentially carrying pests must include a **Phytosanitary Certificate** (see Directive 2000/29/CE).

3.2.4. Benefits of coding for traceability

❑ **Why is traceability based on coding systems?**

In order to obtain useful traceability information, data on product locations, movements, operations carried out, contextual data, etc. must be recorded. However, to trace, the exact product being traced must be known. **Items must be named and specifically identifiable** to collect, organise and use information about them[7].

An **unequivocal relationship** between the item traced (identified) and the information (recorded about it) underlies all traceability.

Identification consists in retrieving information about the entity, at specific times in its movement though the production, packaging and sales processes. It **combines five elements**: an object (the entity), a location, a point in time, a context and an operation.

It provides information for a precise time and location but doesn't provide the history of operations carried out before that moment or indicate what will happen afterwards. An identification is only meaningful when it is connected to others, not in isolation: it isn't the collection of information that matters but **its organisation** for the purpose of meeting pre-defined objectives.

As soon as processes become complex, or there are many entities, it is preferable to use a **coding system** to identify them. A system should provide the following benefits:

1. Reduced subjectivity: fewer errors or interpretations
2. Linking of entities (relational or sequential hierarchy trees)
3. Increased automation
4. Disconnection of entities from operations and the changes that affect it.

Coding doesn't mean description: it means naming the entity to be able to identify it precisely. The format of the "name" can have meaning but the meaning is not descriptive. The code has no meaning in itself: it is an identification number that can be built using a given set of coding rules (coding structure). Coding enables the naming of objects with greater or less precision. The actual information about the coded product is found in the database, to which the code refers.

Coding, like labelling, is a **pre-requisite** for traceability, but isn't sufficient to meet regulatory and business requirements.

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[7] Having identification information may also be insufficient: **authentication** information may be required for the product.

How is a coding system designed?

Coding means providing entities to be traced with a unique "identification number" that must enable **identification** of entities throughout their life cycle.

For example: code 2411 983 7:

2411: product type (e.g.: fresh mango)
983: registration number for this type of product (e.g.: the mango lot number)
7: control key

Coding can go down to the unit level within a production series. The only limitation is complexity: using a 40-digit code will increase the precision of traceability but decrease productivity (especially if the codes are recorded manually).

The use of control keys in coding systems helps to reduce the risk of error. A control key (one or more digits) is created by applying an algorithm to the code. Entering the key validates whether the code is good or not. In the event of an error, the key calculation will return a different key than the one entered. The system will detect errors.

Once identification is complete, databases are tasked with storing all of the information about a product (exact origin, content, composition, circuit, manufacturing dates, delivery dates, expiration dates, etc.). The information is forwarded via electronic exchange (EDI) during product transport time.

❑ Why use standards?

Traceability can be carried out internally in a reliable, relevant and effective way. However, companies rarely use traceability in isolation because of their relationships with their suppliers and customers.

If every company in a chain applied its own identification rules, **every point of contact between two companies would become a source of difficulty** (e.g.: **traceability breakdown**) because of differences in coding. Ensuring continuity of traceability in the chain would require significant effort because of the necessity of connecting the codes used by each link:

- By re-coding products at their entry into the next company which requires adding a new label (with a new code)
- Or by ensuring that there is a match between the coding systems used thanks to concordance tables.

These relationships call for the use of the **shared rules** provided by "standards". The role of standards is to provide common rules to those involved in an industrial chain or sector to facilitate information exchange and interactions.

Traceability, by its nature, encourages the use of standards because it overflows from companies both upstream and downstream. Inventing rules is a waste of time: at some point or another, it will be necessary to provide consistency with a standard. A typical example is the **EAN code** which is used to identify everyday consumer products. This code is placed by the manufacturer and is readable by all of the shops in which the product is sold.

The use of standards has **four benefits**:

1. Standards are the common language of an industry: **using them strengthens sector integration** and, over time, provides the means to enter into a relationship with other sector partners.
2. Standards are created through consultation and are related to good practices. Using them results in greater expertise.
3. Standards are designed to cover all possibilities. Using standards increases reliability.
4. Most solutions and tools available conform with standards. Using them leads to time and resource savings.

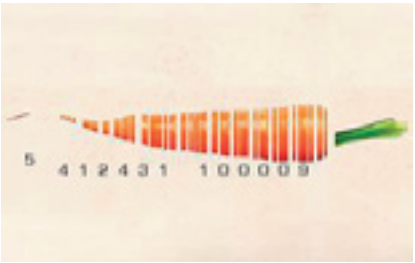
Standards exist in all sectors and can be of several types.

For example:

- GS1/EAN UCC **for fast moving consumer goods**[8]
- GLN (Global Location Number): identifies **destinations**
- SSCC (*Serial Shipping Container Code*): **identifies packages**
- GTIN (*Global Trade Item Number*): **identifies products** (units sold to consumers)
- CIP 13: identifies medicines
- Galia: identifies cars
- Etc.

All of these codes are structured in a similar way:

- A prefix variable by situation
- A company identifier usually assigned by a national standards body
- A specific identifier (location, product, package, etc.) assigned by the company
- A control key to ensure code integrity and correct reading.



In fact, international convergence is theoretically easy to establish via the addition of prefixes, suffixes, etc. In practice, of course, this is far more complex since nomenclatures and directories must be harmonised and, in addition, industrial software and readers must be modified.

[8] Prior to this standard, European manufacturers and retailers used EAN (European Article Numbering) standards and North Americans used UCC (Uniform Code Council) standards. The GCI (Global Commerce Initiative) is a working body created in 1999 by industrialists, retailers (Auchan, Carrefour, Tesco, etc.) and manufacturers (Nestlé, Coca-Cola, Procter & Gamble, Johnson & Johnson, etc.) to facilitate integration of the supply chain and to simplify business processes. It works toward the convergence of current coding standards. For example, GCI projects include support to GLN (Global Location Numbers) and GTIN (Global Trade Item Numbers). It launched the GSMP (Global Standard Maintenance Process) in January 2002. EAN (European Article Numbering) and UCC (Uniform Code Council) also joined forces and new standards are being designed for the global **EAN-UCC standard**.

Appendix – International codes

A.1. GLN *(Global Location Number)*, international location-function code

This is a unique international 13-digit code used to designate a location. It can be:

- **A company:** company, subsidiary, etc.
- **A functional entity:** accounting department, warehouse, etc.
- **A physical entity:** room, hospital room, warehouse aisle, etc.

"301" or "302"	National supplier or retailer code	Internal code	Control key
3 digits	5 to 8 digits	1 to 4 digits	1 digit

A.2. GTIN *(Global Trade Item Number)*

This is a unique international 13-digit code used to designate product units that can be purchased by consumers. It is an extension of the EAN-13 code.

Generally speaking, a unique international number is assigned to each commercial unit (for example, a plastic-wrapped tray with a bunch of tomatoes intended for a point of sale) or a standard group of commercial units (for example, a pallet with several crates of tomatoes, transferred from the warehouse to a retail shop). This is the **GTIN** number (*Global Trade Item Number*). The GTIN contains no information on the product. It is simply a unique key providing access to information stored in databases. Four GTIN numbering systems are available for the identification of commercial units: GTIN-14, GTIN-13, GTIN-12 and GTIN-8. Selection of a numbering system depends on the type of product and the application.

Sample use of GTIN-13:

***5412345**: GS1 company prefix (in this example, assigned by GS1 Belgium & Luxembourg)*

***00001**: item number assigned by the company*

***3**: control key*

There are now **GTIN+** codes (that is, the GTIN code + the lot number or the expiration date (BBD, *Best Before Date*) or the production date (PD, *Production Date*)) and a **SGTIN** code (GTIN with the serial number of the item).

A.3. SSCC *(Serial Shipping Container Code)*

The SSCC is an 18-digit GS1 number that unequivocally identifies the logistics unit on which it is placed. It is used in logistics **to number packages** (e.g.: pallets). For example, three identical items sent in three different packages will have the same EAN-13 item number but different SSCC codes. Every SSCC number is different around the world.

Open	Country	Manufacturer code	Sequential number	Control key
1 digit	1 digit	5 to 8 digits	7 to 10 digits	1 digit

In combination with the *EDI* despatch advice, the SSCC ensures quick and correct reception of merchandise. In addition, all of the data tied to the logistics unit, that is, the approval number, the GTIN(s), the packaging date, etc. can be exchanged via EDI using the SSCC as a reference. The SSCC is a pure traceability tool.

The SSCC is marked on the logistics unit using UCC/EAN-128 symbols.

***00**: Application Identifier (AI) introducing the SSCC*
***1**: serial number extension (between 0 and 9)*
***54123456**: company prefix (if using an 8-digit prefix)*
***00001234**: serial number*
***5**: Control digit*

A.4. Barcodes

Barcodes carry information. Their purpose is to code relevant data about a product or service at every step of the supply chain.

Logical identification (location, products, packages) is most often printed and read using a barcode. The use of barcodes is always subject to physical characteristics (size and shape of the media, background colour, etc.)

Several standards co-exist depending on these characteristics and the number of digits used:

- **EAN-8** and **EAN-13**: 8 or 13 digits (written in plain text under the bars) - used essentially for consumer products
- **ITF 14:** 14 digits: this data is larger and more clearly legible. It is primarily used in logistics on packaging (boxes, pallets, etc.)
- **UCC/EAN 128**: a new standard enabling representation of a variable length chain of alpha-numeric characters.

When additional information about a product is needed in the fruits and vegetables chain, for example, the lot number, the weight or the packaging date, **UCC/EAN-128** symbology

can be used to encode the data in addition to the product identification (GTIN). This may be the date the product was palletised, the operator's national authorisation number and the net weight.

GS1 A*pplication Identifiers* (AI) must be included in UCC/EAN-128 barcodes. They define the data structure of the data in the elements they introduce.

Application Identifier (AI) (01) is the GTIN
Application Identifier (AI) (13) is the packaging date, in this case, 7 October 2002
Application Identifier (AI) (7030) is the producer's national authorisation number

A.5. The QR code *(Quick Response Code)*

The **QR code** is a two-dimensional barcode (**matrix code**) consisting of black modules arranged on a square white background.

The name QR is the acronym for "*Quick Response*", because its data content can be decoded quickly. Intended for use with a QR code reader, a mobile telephone, or a smart phone, it has the advantage of being able to store more information than a regular bar code.

QRs can store up to 7,089 numeric characters or 4,296 alphanumeric characters which is far above the capacity of barcodes.

They are found on many different media: they simply have to be scanned using the photo mode of a mobile telephone and sent in order to receive information (composition, origin, lot number, manufacturing date, etc.). Despite its cost, applications are being rolled for certain food products (e.g.: olive oils in Italy).

A.6. RFID and the EPC *(Electronic Product Code)*

Initiated by several players, including EAN and UCC, the EPC (*Electronic Product Code*) is a RFID microchip-based identification system consisting primarily of:

- A product identifier (based on the same structure as the GTIN code)
- An individual item identifier via the addition of a sequential number.

Barcode and RFID technologies are often spoken of as if the first will eventually replace the latter. It now seems that the technologies will be used in a complementary way by combining the advantages of both. One-dimensional barcodes are cheap and electronic

labels can store information. RFID is a solution whenever dynamic information is required and the price of labels is considered at the operational level (multiple use). One example of this kind of use is industrial laundry. Every hanger has an electronic label for tracking through the process and each piece of clothing is identified with a barcode for tracking from drop-off to pick-up.

Personal notes

2

Appendices

Appendices:
Sample recording sheets

A.1. Crop operations record samples

- Nursery tracking log (Sheet no. 1)
- Orchard/field tracking sheet (Sheet no. 2)
- Irrigation log (Sheet no. 3)
- Fertilisation log (Sheet no. 4)
- Chemical products inventory sheet (Sheet no. 5)
- Pesticide treatment log (Sheet no. 6)
- Harvest log (Sheet no. 7)

A.2. Packaging operations record samples

- Reception of primary products at station log (Sheet no. 8)
- Fruit wash tracking sheets (Sheets no. 9 & no. 10)
- Post-harvest treatment log (Sheet no. 11)
- Product drying log (Sheet no. 12)
- Palletisation log (Sheet no. 13)
- Finished products warehousing sheet (Sheet no. 14)
- Temperature monitoring sheet (Sheet no. 15)
- Finished products shipping log (Sheet no. 16)
- Premises cleaning log (Sheet no. 17)

A.3. Record of incoming and outgoing products

- Incoming raw materials log (Sheet no. 18)
- Outgoing finished products log (Sheet no. 19)

A.4. Inputs, effluents and waste management log

A.5. Sample lot marking

Company name	NURSERY LOG	Sheet no. 1

Variety: .....

Seed source ☐ Produced internally ☐ Purchased

Crop treatments ☐ Yes ☐ No

Treatment date	Reason for treatment	Product brand name	Formulation	Dose prescribed	Quantity measured (g or ml)	Application method	Equipment used	Operator

Type of nursery: ☐ GMO ☐ Non-GMO

Type of substrate: Origin: Substrate disinfection ☐ yes ☐ no

Type of fertiliser: ☐ Mineral fertiliser ☐ Organic fertiliser

Mineral fertiliser: Composition: Manufacturer:

Organic fertiliser: Type: Origin:

Irrigation:

Source of irrigation water: ☐ Drilling ☐ Lake ☐ River ☐ Other:

Irrigation method: ☐ Drip ☐ Sprinkler ☐ Furrow ☐ Other:

Company name	ORCHARD/FIELD TRACKING SHEET	Sheet no. 2

Producer identification: .....

Address: .....

Orchard/field identification: .....

Type of seedlings: ☐ GMO ☐ Non-GMO

Plot	Planting or sowing date	Grafting date	Type	Origin of seedlings/seed		Origin of grafts		Number of plants	Area	Operator
				Internally produced	Purchased	Internally produced	Purchased			

Fertilisation: ☐ Yes ☐ No

Type of fertiliser: ☐ Mineral ☐ Organic

Irrigation:

Source of irrigation water: ☐ Drilling ☐ Lake ☐ River ☐ Other:

Irrigation method: ☐ Drip ☐ Sprinkler ☐ Furrow ☐ Other:

Company name	IRRIGATION LOG	Sheet no. 3

Source of irrigation water: ☐ Drilling ☐ Lake ☐ River ☐ Other:

Irrigation method: ☐ Drip ☐ Sprinkler ☐ Furrow ☐ Other:

Water analysis results: ☐ Available ☐ Not available

Irrigation date	Plot	Area	Number of plants	Amount of water used	Operator

Company name	FERTILISATION LOG	Sheet no. 4

Orchard/field identification: .....

Plot no.: .....

Plot area: .....

Variety: .....

Fertilisation date	Composition (N P K) (or type, if organic fertiliser)	Brand name & batch no. (or origin, if organic fertiliser)	Total amount used (kg)	Application Method and/or equipment	Identification Operator(s)	Production Manager Signature

Company name	CHEMICAL PRODUCTS INVENTORY MANAGEMENT SHEET	Sheet no. 5

Brand name: .....

Active compounds: .....

Amount returned to stock	Origin Supplier Batch /no.	Date entered in inventory	Date taken from inventory	Destination (use)	Remaining stock	Name of the inventory manager	Manager initials

Company name	PESTICIDE TREATMENT LOG	Sheet no. 6

Orchard/field identification: ……

Plot no.: ……

Plot area: ……

Variety: ……

Treatment date	Targets	Brand name	Formulation	Dose/ha	Quantity measured	Volume of diluted spray product prepared	TTH[1]	Appliance no.	Applicator(s)	Production Manager Signature

[1] Time to harvest (TTH)

Company name	HARVEST LOG	Sheet no. 7

Crop/Season: ……/…….. **Harvest date**: ……../……../……

Producer identification: ……

Orchard/field identification: ……

Plot no.: ……

Plot area: ……

Variety: ……

Number of cases to be shipped	Gross weight

Transporter	Packaging station manager
Name: ……	Name: ……
Vehicle no.: ……..… Departure time: …….. Signature:	Vehicle no.: ……..… Departure time: …….. Signature:

Company name	PACKHOUSE SAMPLE RECEIPT RECORD FOR PRIMARY PRODUCTS	Sheet no. 8

Crop/Season: ……../……..….. **Reception order no.**: ……..

Date	Collector identification	Supplier identification	Variety	Quantity	Manager initials

Company name	FRUIT WASH TRACKING SHEET	Sheet no. 9

Crop/Season: ……../…….. **Cooler no.**: ……..

Source of wash water: ☐ Borehole ☐ Public supply ☐ Other

Wash water analysis: ☐ Yes ☐ No

Date	Renewal time	Identification of the batch processed	Notes	Amount of water used	Manager name	Signature

Company name	FRUIT WASH TRACKING SHEET	Sheet no. 10

Crop/Season: ……../……..

Week	Of ……..……to ……..						
Operations	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of water basins							
Start time:							
1st renewal (Time)							
2nd renewal (Time)							
3rd renewal (Time)							
4rd renewal (Time)							
……							
Notes and remarks							
Operator name							
Signature							

Company name	POST-HARVEST TREATMENT LOG	Sheet no. 11

Crop/Season: ……../……..

Date	Identification of batches treated	Reason for treatment	Brand name	Dose/concentration recommended	Amount measured/ concentration used	Application method	Station Manager initials

Company name	FRUIT DRYING LOG	Sheet no. 12

Mango season: ……../……

Date	Dryer identification	Rack identification	Product identification	Heating temperature	Start heating	End heating	Quantity dried	Manager initials

Company name	PALLETISATION LOG	Sheet no. 13

Crop/Season: ……../……..

Date	Pallet identification	Number of boxes	Lot identification	Size	Station Manager initials

Company name	FINISHED PRODUCTS WAREHOUSING CARD	Sheet no. 14

Crop/Season: ……../…….. **Product identification**: ……..

Date	Lot identification	Quantity incoming	Quantity outgoing	Destination	Remaining stock	Manager name	Initials

Company name	TEMPERATURE MONITORING SHEET	Sheet no. 15

Crop/Season: ……../…….. **Chiller no.**: ……..

Date of entry in chiller	Time of temperature recording	Temperature recorded	Temperature required	Lot identification	Notes	Packaging Manager initials

Company name	FINISHED PRODUCTS SHIPPING LOG	Sheet no. 16

Crop/Season: ……/…….. **Product identification**: ……..

Delivery date	Pallet identification	Total number of pallets	Total weight shipped	Identification of receiving organisation	Packaging Manager initials

Company name	PREMISES CLEANING LOG	 Sheet no. 17

Crop/Season: ……..…../……..…..

Day of the week	……/…../……					
Area cleaned	Method	Product used	Time	Notes and remarks	Operator name	Signature
Toilets and showers						
Fresh mango reception room						
Wash area						
Preparation and racking area						
Packaging area						
Finished products storage area						
Changing area						
Office						

Company name	INCOMING RAW MATERIALS LOG	Sheet no. 18

Crop/Season: ……../……..

Reception date	Supplier identification	Product description	Quantity received	Product condition	Notes	Manager initials

Company name	OUTGOING FINISHED PRODUCTS LOG	Sheet no. 19

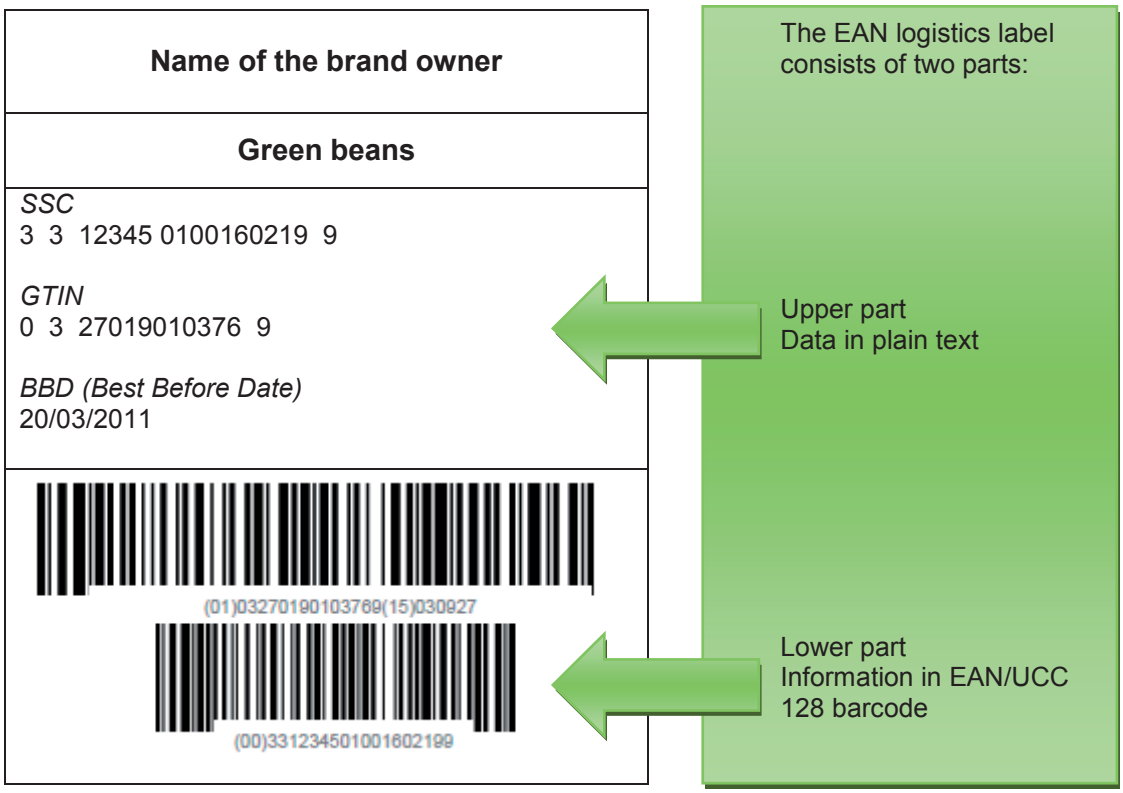
Crop/Season:……..…../……

Delivery date	Identification of receiving identification	Product description	Quantity delivered	Manager initials

A.6. Sample product marking (labelling)

Marking of products in packhouse
Photo Maud Delacollette

Sample logistics label placed on a product from Kenya
Photo Maud Delacollette


Name of the brand owner
Green beans
SSC
3 3 12345 0100160219 9
GTIN
0 3 27019010376 9
BBD (Best Before Date)
20/03/2011
(01)03270190103769(15)030927
(00)331234501001602199
The EAN logistics label consists of two parts:
Upper part
Data in plain text
Lower part
Information in EAN/UCC 128 barcode

Personal notes

2

Most used abbreviations and acronyms

Most used abbreviations and acronyms

ACP	African, Caribbean and Pacific Group of States
ADI	Acceptable Daily Intake (in mg/kg bw/day)
AOEL	Acceptable Operator Exposure Level
ARfD	Acute Reference Dose (“an estimate of the amount a substance in food or drinking water, normally expressed on a body weight basis, that can be ingested in a period of 24 h or less without appreciable health risks to the consumer "- JMPR, 2002).
CAS	Chemical Abstracts Services
CCP	Critical Control Point (HACCP Method)
CLP	Regulation (EC) 1272/2008 on Classification, Labelling and Packaging of substances and mixtures (or regulation CLP)
CMR	Carcinogenic, mutagenic and reprotoxic chemicals, abbreviated as CMR chemicals, make up the first and most toxic category of the toxicity classes into which hazardous chemicals can be subdivided, according to EU legislation.
DT_{50}	Half-Life (e.g. time for the concentration of an active ingredient in the soil to be reduced by 50%) or $T_{1/2}$
EC	Emulsifiable concentrate, solvent based liquid formulation of pesticide
ECPPP	Empty Containers of Plant Protection Products
EMS	Environnemental Management System
EPA	Environmental Protection Agency (USA)

EPPO	European Plant Protection Organisation
ETI	Ethical Trading Initiative
EU	European Union
FAO	Food and Agriculture Organisation
FLO	Fairtrade Labelling Organizations International
FSMS	Food Safety Management System
GAP	Good Agricultural Practice
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
GLP	Good Laboratory Practice
GMO	Genetically Modified Organism
HACCP	Hazard Analytical Critical Control Point
IARC	International Agency for Research on Cancer
ICB	Independent Certification Bodies
ICM	Integrated Crop Management
ILO	International Labour Organisation
INERIS	Institut National de l'Environnement industriel et des risques (France)

INRS	Institut National de Recherche et de Sécurité (France)
IOBC	International Organization for Biological Control
IPM	Integrated Pest Management
ISO	International Standard Organisation
IUPAC	International Union of Pure and Applied Chemistry
Kd	Soil/Water Adsorption Coefficient
LCA	Life Cycle Assessment (also known as Life Cycle Analysis)
LD_{50}	Letal Dose 50 (in mg/kg bw)
LOAEL	Lowest observed adverse effect level
LOQ	Limit of Quantification (also DL : determination limit)
MRL	Maximum Residue Level (or Maximum Residue Limits)
MSDS	Medical Safety Data Sheet
NGO	Non Governmental Organisation
NOAEL	No Observable Effect Level or NOEL (No Effect Level)
OECD	Organisation for Economic Co-operation and Development
OHSAS	Occupational Health and Safety Assessment Series

OSHA-EU	European Agency for Safety and Health at Work
PCB	Polychlorobiphenyls
PCR	Polymerase Chain Reaction (enables researchers to produce millions of copies of a specific DNA sequence in approximately two hours)
PHI	Pre-Harvest Interval
PNEC	Previsible Non Effect Concentration
PPE	Personal Protective Equipment
PRA	Professional Risk Assessment (or Analysis)
REACH	Regulation (CE) 1907/2006) (Registration, Evaluation, Authorisation and Restriction of Chemical substances)
SA 8000	Social Accountability 8000 (standard on the human rights of workers)
SDS	Safety Data Sheet
TLV	Threshold Limit Value (of a chemical substance)
TNC	Tesco Nature Choice : TESCO's private standard
UL	Ultra Low volume formulation, oil based liquid pesticide formulations
UNCED	United Nations Conference on Economy and Development
UNECE	United Nations Economic Commission for Europe
UNO	United Nations Organisation

WG	Water dispersible granules, granular pesticide formulations
WP	Wettable powder, dry powdered pesticide formulations
WTO	World Trade Organisation

2

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Bibliographical references

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- General regulations - Integrated Farm Assurance – Part III, Certification of producer groups (Option 2) (Version 3.1_Nov09)
- Control Points and Compliance Criteria - Integrated Farm Assurance – All farm base (Version 3.0-2-Sep07)
- Control Points and Compliance Criteria – Crops base (Version 3.0-3_Feb09)

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  - General regulations – Integrated Farm Assurance – Part II, Rules for option 2 and option 1 multi-sites with QMS (Interim Final Version 4.0_Jan 2011)
  - Control Points and Compliance Criteria Integrated Farm Assurance – All farm base (Interim Final Version 4.0_Jan 2011)
  - Control Points and Compliance Criteria Integrated Farm Assurance – Crops base (Interim Final Version 4.0_Jan 2011)

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Useful Websites

Useful Websites

AZAQUAR (Food Sciences and Techniques): http://www.azaquar.com/

BRC : http://www.brc.org.uk/

CNIL (*Commission nationale de l'informatique et des libertés*): http://www.cnil.fr/

COLEACP-PIP: http://pip.coleacp.eu/

EUROPEAN COMMISSION:
http://ec.europa.eu/food/food/foodlaw/traceability/index_en.htm

CTA: http://www.cta.int/

FAIR TRADE: http://www.fairtrade.net/

FOOD TRACE: http://eufoodtrace.org/

FRESHFEL EUROPE: http://www.freshfel.org/asp/index.asp

GFSI: http://www.mygfsi.com/

GLOGALG.A.P: http://www.globalgap.org/cms/front_content.php?idcat=9

GS1-France: http://www.gs1.fr/

IET (*Institut Européen de la Traçabilité agroalimentaire*): http://www.ie-trace.com/

POLE TRACABILITE: http://www.poletracabilite.com/

TRACEHABIL: http://www.tracehabil.com/

COLEACP PIP
Training manuals

1. PRINCIPLES OF HYGIENE AND OF FOOD SAFETY MANAGEMENT
2. **TRACEABILITY**
3. RISK ANALYSIS AND CONTROL IN PRODUCTION
4. OPERATOR SAFETY AND GOOD CROP PROTECTION PRACTICES
5. REGULATIONS, NORMS AND PRIVATE STANDARDS
6. TECHNIQUES IN COMMUNICATION
7. FOUNDATIONS OF CROP PROTECTION
8. TECHNIQUES OF TRAINING
9. SUSTAINABLE AND RESPONSIBLE PRODUCTION
10. BIOLOGICAL CONTROL AND INTEGRATED CROP PROTECTION
11. ETHICAL PRODUCTION
12. ORGANIC FRUIT AND VEGETABLE PRODUCTION IN ACP COUNTRIES

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