TRACEABILITY IN FOOD AND AGRICULTURAL PRODUCTS

International
Trade
Centre

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1.   Introduction

Food safety has become a growing concern for citizens of many countries. Outbreaks of disease in animals that could be transmitted to humans such as the avian flu, or the presence of chemicals above acceptable limits in feed and food, can threaten both the quality and safety of products. The need to be able to withdraw or recall products identified as unsafe has become essential to protect people from food borne diseases. Traceability is a risk-management tool which enables food business operators or authorities to respond to that need. It is a cornerstone of any country's food safety policy.

The aim of this bulletin is to provide an overview of what is meant by traceability for food and agricultural products, with the related legislation in place in some key markets with regard to traceability requirements.

2.   What is traceability?

Also known as the 'one-step-back-one-step-forward' principle, traceability is the ability to identify the origin of food and feed ingredients and food sources, particularly when products are found to be faulty. A traceability system allows an organization to document and / or to locate a product through the stages and operations involved in the manufacture, processing, distribution and handling of feed and food, from primary production to consumption. It can therefore facilitate the identification of the cause of nonconformity of a product, and improve the ability to withdraw or recall such product if necessary and prevent unsafe products from reaching the customers.

2.1   Definition by ISO

The International Organization for Standardization defines traceability as:

"ability to follow the movement of a feed or food through specified stage(s) of production, processing and distribution" [1]

ISO 22005:2007 comprehensively explains the principles and requirements for the design and implementation of a feed and food traceability system. This standard allows organizations operating at any step of the food chain to:

1. Trace the flow of materials (feed, food, their ingredients and packaging);
2. Identify necessary documentation and tracking for each stage of production;
3. Ensure adequate coordination between the different actors involved;
4. Improve communication among the involved parties, and most importantly;
5. Improve the appropriate use and reliability of information, effectiveness and productivity of the organization.

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[1] ISO 22005:2007, 3.6, Traceability in the feed and food chain – General principles and basic requirements for system design and implementation.

2.2 Definition by CAC

Traceability/product tracing is defined by the Codex Alimentarius Commission (CAC)[2] as:

"The ability to follow the movement of a food through specified stage(s) of production, processing and distribution".

CAC has also set out principles for traceability as a tool within a food inspection and certification system. (See Annex)

3. Importance of traceability in the food and agricultural sector

3.1 Context

Today, food safety is a worldwide concern due to a number of food safety scandals. Outbreaks related to Escherichia coli, African swine fever, highly contagious diseases such as avian flu in poultry, bovine spongiform encephalopathy (BSE) and foot and mouth disease in livestock, presence of dioxin, and micro-organisms like Salmonella, Norovirus, Campylobacter, Listeria, Clostridium have resulted in heightened public and private attention to food attributes. Moreover, as increasing number of people undertake international travel, these outbreaks have the potential to reach pandemic proportions .

3.2 Food safety and identification

Trade in agri-food and commodities are foreseen to see continued increase. Changes in the trading environment have led to growth in global production network. The structure of the supply chain has evolved towards increased fragmentation and complexity across multiple enterprises, and global reach of agri-food supply chains. The large number of players involved, unpredictability of supply and perishable nature of food has heightened the need for assurance of quality and safety in relation to food products and production processes and to ensure traceability and compatibility among food safety measures[3].

Implementation of effective traceability systems improves the ability to implement verifiable safety and quality compliance programs. The resulting visibility of relevant information enables agri-food businesses to better manage risks and allows for quick reaction to emergencies, recalls, and withdrawals. Effective traceability systems significantly reduce response times when an animal or a plant disease outbreak occurs, by providing more rapid access to relevant and reliable information that helps determine the source and location of implicated products. Thus, information (about animal and plant health, country of origin etc.) at any point in the chain from producer to consumer has become crucial.

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[2] CAC/GL 60-2006 Principles for Traceability / Product Tracing as a Tool Within a Food Inspection and Certification System www.codexalimentarius.net/input/download/standards/.../CXG_060e.pdf
[3] WTO, World Trade Report 2012, Trade and public policies: A closer look at non-tariff measures in the 21st century.

Moreover, traceability allows targeted withdrawals and the provision of accurate information to the public, thereby minimising disruption to trade. Traceability can reduce the scope of the recall by between 50% and even up to 95% in some cases.[4] This reduces the amount of product that would have been wasted in the absence of the requisite traceability systems.

3.3   Other benefits

- In conjunction with GAP, GMP, HACCP, traceability can reinforce emphasis on prevention instead of only reacting or responding to breaches in food safety.
- Traceability systems applied correctly, with supporting information and communications technologies (ICTs), enables businesses to monitor and defend against risk in real time.
- It also enables businesses to make more informed management decisions, leading to increased market penetration, and reduced operating costs.
- Visibility of information provided by traceability systems enables businesses to utilize their resources and processes more effectively and efficiently and increase their long-term profitability. Correctly implemented, traceability can reduce out-of-date product losses, lower inventory levels, quicken the identification of process and supplier difficulties, and raise the effectiveness of logistics and distribution operations.
- Improved customer confidence also helps with branding and improved brand equity. Moreover, in cases of specialty produce from renowned sources such as saffron, vanilla, cloves, cacao and other spices and condiments that fetch higher value due their unique characteristics, traceability can help prevent contamination or mixing with lower value produce, guaranteeing product authenticity.

4.   Characteristics of traceability systems[5]

A traceability system is the totality of data and operations that is capable of maintaining the desired information about a product and its components through all or part of its production and utilization chain (ISO 2007). A traceability system records and follows the trail as products and materials come from suppliers and are processed and distributed as end products (ISO 2005). Therefore, the basis of all traceability systems is the ability to identify things that move along the supply chain.

The basic characteristics of traceability systems are as follows:

- identification of units / batches of all ingredients and products;
- registration of information on when and where units / batches are moved or trasformed; and
- a system linking these data and transferring all relevant traceability information with the product to the next stage or processing step.

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[4] Sparling & Sterling, 2005.
[5] Nimmo-Bell and Canesis and commissioned by New Zealand Trade and Enterprise; and Chemical analysis of food: Techniques and applications – Yolanda Pico

These characteristics, i.e. identification, information and the links between supply chain participants are common, irrespective of process or product involved. However, the traceability systems may differ in the amount of information recorder, how far (back or forward) the system tracks the information and the degree of precision with which the system can pinpoint the movement of a particular product.

In practice, traceability systems are record keeping systems that show the path of a particular product from suppliers through intermediate steps to consumers (Figure 1).

As well as identifying the product, traceability systems may identify other information (e.g. country of origin, species and best by date) that is associated with the product. Traceability systems range from paper-based systems to use of bar coding and Radio Frequency Identification Devices (RFID). Technologies on automatic identification and data capture allow data to be captured at minimal operating cost.

Figure 1: Conceptual framework of food traceability system
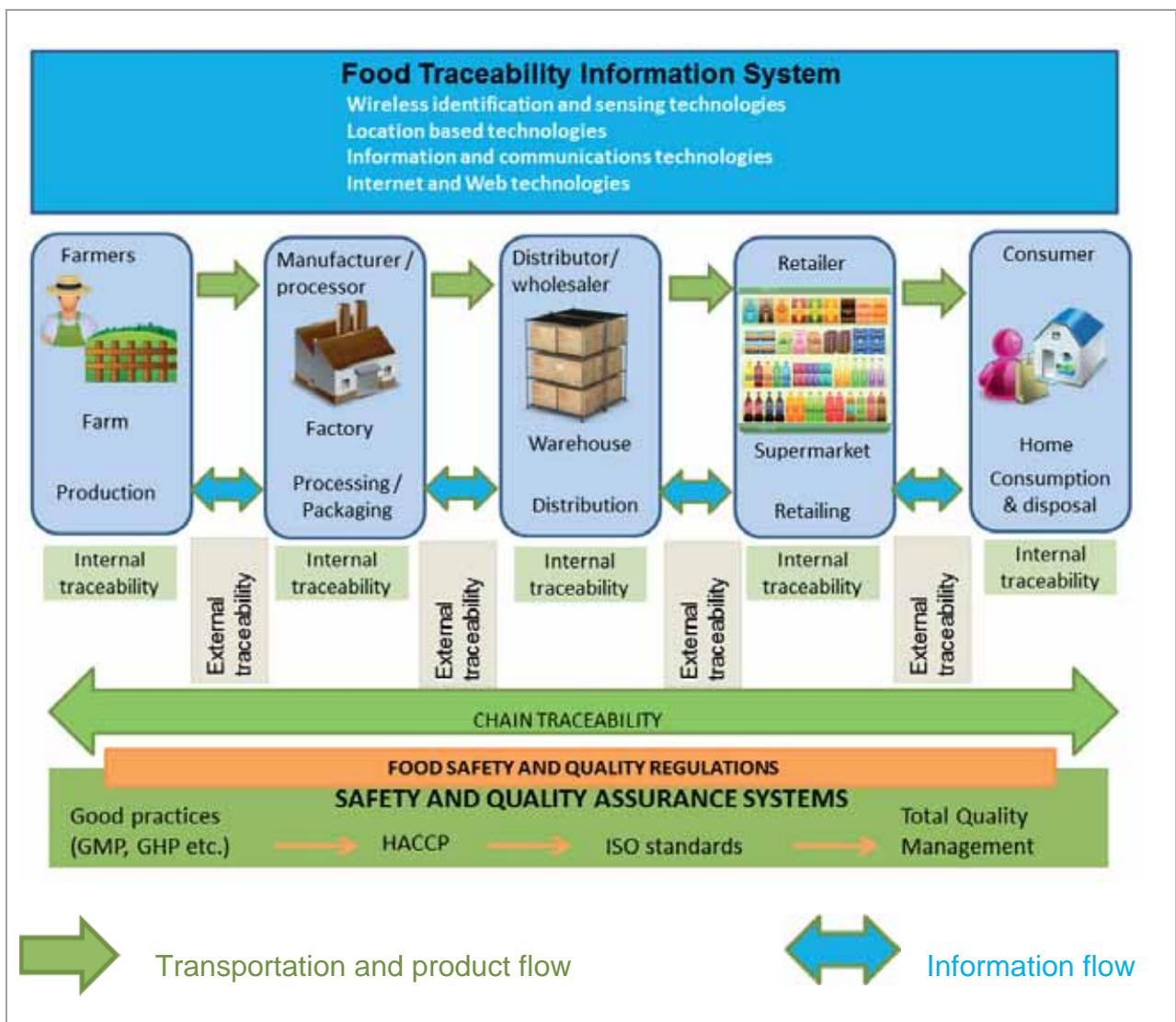
Source: Traceability in a food supply chain: Safety and quality perspectives Myo Min Aung, Yoon Seok Chang

As indicated above, a traceability system is also be characterized by its:
Breadth: Amount of information collected, depending upon the scope of traceability;
Depth: How far relevant information can be tracked forward and backward; and
Precision: Degree of assurance to pinpoint a particular food product and its movement.

5.   Types of traceability[6]

Implementing a traceability system within a supply chain requires all parties involved to link the physical flow of products with the flow of information about them. Adopting uniform industry requirements for traceability processes ensures agreement about identification of the traceable items between parties. This supports transparency and continuity of information across the supply chain.

5.1   External traceability

This requires all traceable items to be uniquely identified, and information to be shared between all affected distribution channel participants. The identification of products for the purpose of traceability may include assignment of a:

- Unique product identification number; and
- Batch/lot number.

To maintain external traceability, traceable item identification numbers must be communicated to distribution channel participants on product labels and related paper or electronic business documents. This links the physical products with the information requirements necessary for traceability. External traceability allows tracing back (supplier traceability) and tracking forward (client traceability).

5.2   Internal traceability

Internal traceability means processes must be maintained within an enterprise to link identities of raw materials to those of the finished goods. When one material is combined with others, and processed, reconfigured, or repacked, the new product must have its own Unique Product Identifier. The linkage must be maintained between this new product and its original material inputs (such as batters, breading, seasonings, marinades, salt, packaging materials, and many other inputs) to maintain traceability. A label showing the Lot Number of the traceable input item should remain on the packaging until that entire traceable item is depleted. This principle applies even when the traceable item is part of a larger packaging hierarchy (such as cases, pallets, or shipment containers).

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[6] A Guidance Document on the Best Practices in Food Traceability, Jianrong Zhang* and Tejas Bhatt Comprehensive Reviews in Food Science and Food Safety; Volume 13, Issue 5, pages 1074–1103, September 2014.

6.   Effectiveness of traceability systems

In all cases, traceability depends on the correct collection and recording of relevant data, coordinated within the context of a food safety management system. Analytical tests (e.g. DNA tracking or forms of mass spectrometry to verify origin) may be able to be performed to verify data. A traceability system is effective when food products can be completely traced across the food supply chain. The information should be readily accessible in order to know what, how much and from where product/s need to be recalled in case of food safety issues.

6.1   Factors affecting traceability

Major factors affecting the effectiveness of traceability are as follows:

- Supply chain structure and organization:
    - degree of collaboration between actors of the supply chain;
    - number of actors of the supply chain that achieve internal and external traceability
    - ability of actors of the supply chain to identify product origin;
    - ability of actors to manage traceability systems;
    - compatibility between actors.
- Destination of a product;
- Identification of traceable lot unit;
- Time needed to trace a product;
- Credibility of traceability method;
- Data identification methods and data standardization
- Extent to which a traceability system is incorporated in an already existent and functional information management system and/or a quality/safety assurance system;
- Legislation on traceability.

Farm to fork traceability requires that the processes of internal and external traceability be effectively conducted. Each traceability partner should be able to identify the direct source and direct recipient of traceable items as they pertain to their process. The implication is not that every supply-chain participant knows all the data related to traceability, but rather show proof that relevant members / partners in the supply chain have taken the requisite measures and that information can be accessed if needed. This requires application of the one-step-forward–one-step-back principle and, further, that distribution channel participants collect, record, store, and share minimum pieces of information for traceability, as described below:

- Any item that needs to be traced forward or backward should be identified with a globally unique identifier.
- All food chain participants should implement both internal and external traceability practices.
- Implementation of internal traceability should ensure that the necessary linkages between material inputs and finished product outputs are maintained.

6.2   Considerations for effective traceability

Important considerations for an effective food traceability system include:

- Trading partners (farm input suppliers, farms, harvest locations or vessels, suppliers, internal transactions within a company, customers, and third-party carriers).
- Product and processing locations (any physical location such as a hatchery, cultivation site or pond, farm, vessel, dock, buying station, warehouse, packing line, storage facility, receiving dock, or a store).
- The products that a company uses or creates.
- The logistic units that a company receives or ships.
- Inbound and outbound shipments.
- Date and time metrics as appropriate.

Identification is critical to a successful traceability program. Usually this is accomplished by labels and any number of technologies can be employed for labelling, including simple handwritten labels and more sophisticated radio frequency identification (RFID)-based technologies. However, barcoding remains the most common industry best practice for packaging hierarchies for shipping logistical units (such as cases, pallets, shipment containers, consumer items, and others).

6.3   Information requirement

Food receipt: In relation to food receipt, a food business must be able to provide information about what food, it has on the premises and where it came from. It must be able to provide the following information relating to food on the food premises:

- the name and business address in the country of the vendor, manufacturer or packer or, in the case of food imported into the country, the name and business address of the importer in the country; and
- the prescribed name or, if there is no prescribed name, an appropriate designation of the food.

This means that a food business must not receive a food unless it is able to identify the name of the food and the name of the supplier.

Food recall: A food business engaged in the wholesale supply, manufacture or importation of food must have a system, set out in a written document, to ensure it can recall unsafe food. The system should include records covering:

- Firm identification
- Production records
    – Product code
    – Code to ID plant where packaged
    – Production line
    – Date code
    – Time (Hour, Minutes, Seconds)
- volume or quantity of products manufactured or supplied

- batch or lot identification (or other markings)
- where products are distributed
- any other relevant production records.

7. How to implement traceability requirements

There are several means and methods to achieve traceability. There is a tendency to not always well define the required standard, leaving room for the organization(s) concerned to establish its/their own methods. Thus, other than checking whether the required quality system elements are in place, most organizations verify the effectiveness of traceability based on tracking and tracing exercises i.e. measuring the ability to provide information within defined time periods[7]. So called "input / output" analyses are utilized to verify numbers, volumes or weights of inputs, outputs and waste balances.

This kind of basic traceability requires that each product or component fulfils two requirements:

- An **identifier** (either at a batch or individual level) that is attached to the product at a given point in time; and
- A **record of its history** – a record which may include information about where, how and when it was produced, the enterprise(s) that produced it, and where it was sent. These records may need to be accessed at each link in the supply chain.

Thinking of a traceability system as an identifier and as a series of records makes the idea of traceability simpler to consider.

Implementing a traceability system will be facilitated when the enterprise itself is organized to an extent; process and methods of operation are known, repeated over time in a stable manner, and documented; a quality management system is already in place; and qualified staff are available.

7.1   A methodology[8] for implementation:

A basic four-step methodology that may be used is as follows:

1. Define the context and assess the needs: Implementation of traceability should be adapted to the company, the sector, the supplier profile, customer requirements (contractual requirements) and regulatory requirements. Based on these, evaluate the internal and external needs. Identify the data that needs to be traced and define the parameters of traceability.

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[7] For example, EU requirements (178/2002) for all food products are being implemented in the Netherlands, with a requirement for food operators to be able to provide traceability information forwards and backwards within four hours of request by the competent authority.
[8] EDES, Establishment of a traceability system, Coleacp.

2. Assess internal capacities: Review the data that is recorded and already in place for production management, customer relations, marketing, and accounting. Compare with the specifications of the external requirements.

3. Bring together the internal and the external: Define the goals, research solutions and resources. Prepare a traceability action plan and response strategy. Articulate the benefits to the company and the internal clients.

4. Set in place a project: Put together a team with an administrator, working methodology, schedule, budget and reporting. Using a "Plan-Do-Check-Act" cycle, test on a process on site or on "pilot" basis and improve/adjust the methodology. Train employees on the new requirement/task obligation. Extend to other parts. Assess the robustness of the system and periodically review the system with changes in context, clientele, suppliers, processes, products, and/or regulations.

7.2 Developing traceability procedures

Figure 2: Example of an activities flow chart

Step 1: Create an operations diagram

- Identify the main activities carried out by the company
- Organize the activities into a flow chart
- List inputs and outputs for each activity
- 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
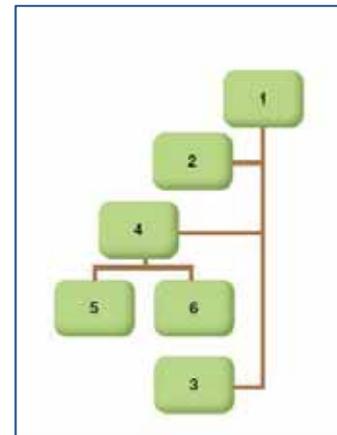
It is important to identify how continuity of information will be guaranteed throughout the process steps.

Step 2: Write-up the instructions to be followed as procedures

For each activity in the operations diagram:
- Identify the type of activity by name and number.
- Briefly describe the activity carried out.
- Identify / assign 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 data must be saved.

Figure 3: Example of a process flow chart

1 Reception and warehousing	2 Processing	3 Packaging	4 Interim storage	5 Shipping
Inputs Vegetables, meat, herbs, spices, water...	**Inputs** Equipment, energy **Outputs** Food products	**Inputs** Packages, labels **Outputs** Packed food products	**Inputs** Food products stacked on pallets, refrigeration **Outputs** Products assembled and labelled.	**Inputs** Packaged food products in pallets refrigerated **Outputs** Labelled pallets ready to ship

Source: Establishment of a traceability system, Handbook, COLEACP

Table 1: Example of traceability data capture

Data collected	What should be recorded
Input 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

Source: Establishment of a traceability system, Handbook, COLEACP

8.   Traceability tools and technology solutions

Automated data collection removes much of the time and expenses required for data processing and maintenance. Gathering information described in the previous section for large operations manually is time consuming, because workers must first record the information at the point of activity and then relay this information either manually or transcribe and enter the data into the computer system. This can lead to risks of recording the information incorrectly. For example, errors occur in 36% of consumer-packaged goods orders according to a study by the Grocery Manufacturers Association (GMA) in the United States[9]. Such errors lead to inventory inaccuracies, and stock ruptures.

Therefore, most traceability initiatives rely on technologies to provide efficient, accurate ways to track and trace products and their movement across the supply chain. This includes technology for product identification, information capture, analysis, storage and transmission of data as well as overall systems integration. Such systems include hardware such as measuring/sensing equipment, identification tags and labels, with software.
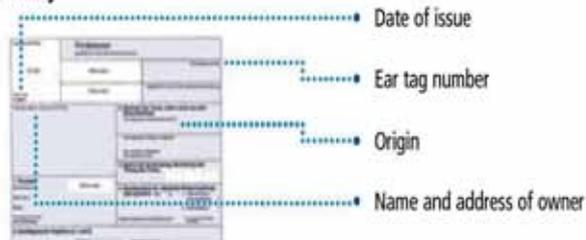
Data collection using tools such as bar code and RFID is exceptionally accurate (>99%). These tools scan, record product codes, lot numbers, invoice data, order numbers, and other information in less than a second.

8.1   Examples of traceability tools and labels

Sheep and goat tag, Lithuania

- Initials of the Animal Recording centre (Agriculture Information and Rural Business Development Centre)
- Country code
- 6-digit individual animal identification number

Cattle passport, Germany

- Date of issue
- Ear tag number
- Origin
- Name and address of owner

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[9] Bar Coding and RFID Enable Food Supply Chain Traceability and Safety, Zebra Technologies Whitepaper
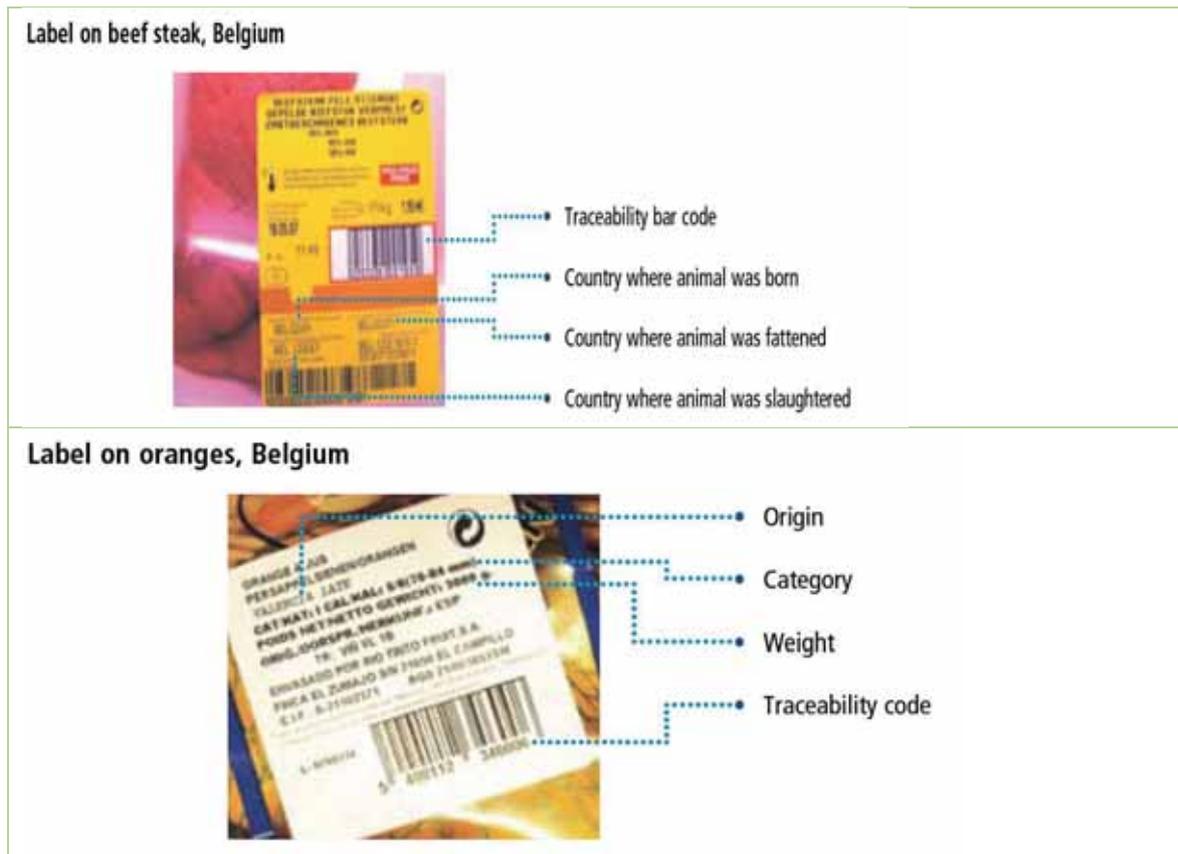
Source: European Commission Health and Consumer Protection Directorate General –
EU Factsheet on Food Traceability

8.2   Barcodes

A barcode is an optical machine-readable representation of data relating to the object to which it is attached. Barcodes systematically represent data by varying the widths and spacing of parallel lines (1D) or rectangles, dots, hexagons and other geometric patterns in two dimensions (2D). Barcodes originally were scanned by special optical scanners called barcode readers. Later, scanners and interpretive software became available on devices including desktop printers and smartphones.

Product traceability initiatives use a Global Trade Item Number (GTIN) to achieve traceability. A GTIN includes a GS1 company prefix and a unique item reference number compatible with Universal Product Code bar codes, and RFID (see following section) or human readable codes.

GS1 is a neutral, not-for-profit, international organization that develops and maintains standards for supply and demand chains across multiple sectors. GS1 works with communities of trading partners, industry organizations, governments and technology providers and responds to their business needs through the adoption and implementation of global standards. The GS1 Global Traceability Standard is available on the website www.gs1.org.

8.3 Radio Frequency Identification Device (RFID)

RFID is technology which inserts a chip capable of being identified through the frequency of radio waves emitted. Certain RFID devices even have a memory function (that stores data) which enables greater information transmission. RFID devices are either active (can send electronic waves) or passive (can only reflect electronic waves from a RFID reader).

In many cases, apart from using paper tags or brands on cattle, RFID tags can also be used for the purpose of their automatic identification. The paper tags, brands and RFID tags all function as an identifier in such systems. The function of a traceability system is to catch and identify such identifiers across the supply chain. Traceability system can identify which is/was/had been the location of specific item and what course such item follows/followed/had followed automatically. To realize such a function, tracking systems collect data strategically.

8.4 Wireless Sensor Network (WSN)

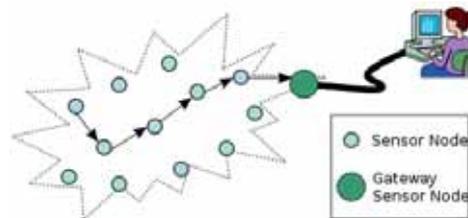**Figure 4a: Sensor nodes**

Figure 4b: Sensor nodes

A wireless sensor network (WSN) is a spatially distributed autonomous network of sensors to collect and monitor data from physical or environmental conditions such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity.

Additionally, more advanced technologies may also be used, such as Geographic Information System, Global Positioning System, Remote Sensing, etc.

9. Challenges in implementing traceability

9.1 Costs

Traceability-related costs include services, technology and software costs, changes in processes, training and on-going operating costs. These costs can be a significant burden to an enterprise, especially for SMEs in developing countries, with little perceived payback. However, viewed as an investment in process improvement, and

applied collectively across enterprises in a supply / value chain, traceability can provide substantial benefits, as indicated in the previous section.

9.2   Skills and implementation

SMEs aiming to export to lucrative markets of industrialized countries must have a reliable system for collecting and presenting the necessary information demonstrating compliance with buyers' requirements. However, food supply chains in developing countries rely on many smallholder farmers. Related support associations may not have the capacity to provide the necessary orientation and training the producers would need to create traceability documentation and set in place the requisite systems and processes.

9.3   Multiple requirements

Even in the simplest export chains, food products change hands multiple times. As a result, fully traceable documentation of food product movement quickly becomes very complicated. In addition, each buyer may also have their own requirements from suppliers, including slightly different documentation that results in duplicated or time-consuming efforts[10].

9.4   Traceability within the framework of food safety management systems

Traceability is but one component in a bigger scheme to achieve efficient supply management, product differentiation or quality management. Indeed, tracking food by lot does not achieve food safety unless there is also an effective safety control system, which includes good practices like good agricultural practices (GAP), good hygienic practices (GHP), good manufacturing practices (GMP), HACCP and so on.

In a fiercely competitive global economy, all key markets demand product traceability, driven by issues such as biosecurity, food safety, physical security and brand / market protection. Therefore, it is important to consider implementing traceability system, within a food safety system.

9.5   Challenges faced by developing countries[11]

Needless to say traceability requirements are burdensome for producers, particularly those in developing countries, where the production of small operators is often mixed before exportation. Record keeping obligations can also prove to be excessively difficult for them to comply with.

There are some immediate operational disadvantages to traceability systems. The problem of *"mixage"* is one of them. Raw agricultural commodities are often mixed shortly after harvest. This is done to build small quantities into exportable quantities.

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[10] ADBI working paper 139, Food Safety and ICT Traceability Systems: Lessons from Japan for Developing Countries http://www.adbi.org/files/2009.05.28.wp139.ict.food.traceability.system.pdf

[11] Main source of information: see footnote 12

"Mixage" takes place either in cooperatives or trade warehouses or in markets. Maintaining the quality of traceability through *"mixage"* systems can be onerous for those in developing countries. The requirement to know the processes to which a raw material has been subjected can limit the number of potential suppliers to those with the size and ability to have effective traceability systems in place. Small scale producers often cannot guarantee the provision of traceability or the record keeping on the maintenance of standards which goes with it.

In general, traceability systems favour large scale producers and vertically-integrated enterprises. The amount of information which must be stored and available for immediate review is considerable. If the traceability system is being introduced as a means of showing that certain standards are being met, then it is necessary to be in a position to show how those standards are being implemented.

Undoubtedly, these are additional costs to most market operators and possibly prohibitive ones for developing countries' exporters and producers. It is easier to manage traceability systems within single enterprises where the information is available in a single format to all participants in the production process from seed to farm and consumer.

9.6   Possible avenues to overcome the challenges

In the food industry, a diversity of (retail and private) quality standards generates uneven levels of safety, confusion over requirements and increased cost and complication for suppliers obliged to conform to multiple programmes. An international standard like ISO 22005 offers a solution for harmonisation of such standards and thus contributes to lowering technical trade barriers, allowing a greater participation of SMEs and small holder farmers in global value chains.

Adoption of international standards concerning traceability by developing countries may facilitate trade but will not in themselves mean that export of food products will rise. While international standards such as ISO 22005 go a long way in harmonizing the markets' requirements, exporters from developing countries still need to meet mandatory requirements of the country where they are exporting to. Increasingly, private voluntary requirements of buyers are gaining prominence, and these also need to be fulfilled to be able to export successfully.

Offering possibilities through innovative use of ICTs[12]:

A number of good practices and success stories in the use of ICTs enabling traceability systems for small farmers and producers[13] could equally be explored for replication. For example, in the case of mobile applications for mango traceability system in Mali, guarantee of seafood origin in Chile[14].

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[12] Benefits of ICT applications to farmers with emphasis on transaction costs: experiences from India, Subhash Bhatnagar, Indian Institute of Management, Ahmedabad.

[13] Case studies, Geotraceability https://www.geotraceability.com/Geotraceability/en/case-studies.php

[14] World Bank, InfoDev. https://www.ictinagriculture.org/sourcebook/module-12-improving-food-safety-and-traceability#system

Some advancement in ICT for possible application in traceability systems may include information systems management; scanning and other digital technology for product identification, image capture, storage and display; non-destructive testing and biosensors for quality and safety assessment; and geospatial tracking technology. While several products and software are commercially available to meet the needs of medium-scale farms and larger agribusinesses, appropriate traceability technology for small-scale farmers, particularly in the least developed countries are yet to materialize. Creative and innovative use of technologies, making rural access inexpensive and robust combining emerging and traditional technologies to overcome constraints, organizational design that brings together partners with specific value proposition, are among the success factors in applying ICTs and to provide scale through formation of communities for small operators.[15]

10.   Drivers of traceability

The adoption of traceability systems is driven by influences, incentives and pressures from different sources. These include government measures (in terms of legislation making traceability mandatory in certain markets), customer needs and consumer demands as also the private sector. Traceability system is also driven by generic drivers across the supply chain. Each will be dealt with separately, in the order indicated above.

10.1 Legislation or mandatory traceability

Traceability systems are already mandatory for all businesses in the food industry in certain developed countries. Most legislation stipulates that companies should demonstrate traceability but is not prescriptive in the way this outcome is achieved. They also usually require only one-up (upstream partner or supplier) and one-down (downstream partner or customer) traceability. They do not require chain traceability or internal (company-wide) traceability.

Food/product safety scares, such as avian flu, BSE, red dye Sudan 1[16], illegal additives and residues, have alarmed consumers, who expect governments to ensure that food is safe and to handle food safety incidents. Hence, consumer confidence and the imperative to ensure the safety of health is the main driver for governments to introduce mandatory traceability.

Consumer confidence can be analysed in terms of human behaviour. There is a stark contrast in the assessment of and reaction to risks by scientists (logical, methodical, probabilistic, averages) vis-à-vis the general public (emotional distortion, variety of influences to human behaviour). People behave according to perceptions, not facts.

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[15] Benefits of ICT applications to farmers with emphasis on transaction costs: experiences from India, Subhash Bhatnagar, Indian Institute of Management, Ahmedabad.

[16] Sudan dyes : A family of industrial dyes normally used for colouring plastics and other synthetic materials, banned in food due to genotoxicity.
http://ec.europa.eu/food/food/chemicalsafety/fraudulent/qanda_en.pdf

Traceability is a key pillar in providing a perception of safety. Further, in terms of firm behaviour, the cost of penalties (e.g. infringement notices, prohibition, seizure, plant closure), loss of reputation or prestige, and the probability of detecting unsafe food (e.g. food-borne illness surveillance) improves the cost-benefit equation for traceability systems.

10.2 Customers

Aside from legal compliance, implementation of traceability systems are increasingly part of commercial negotiations and product specifications (CIES, 2005). The CIES[17] Global Food Safety Initiative and its five benchmarked food safety standards require traceability systems. The quality management standards of ISO 22000 also require traceability.

Major retailers and brand owners have already incorporated sustainability criteria into their procurement. Sustainability criteria include product safety, environment/animal welfare and community good. Retailers and manufacturers incorporate sustainability as a business-to-business procurement tool so that consumers can relax and continue to trust the brand[18]. Traceability can be used to provide assurance for the sustainability criteria.

10.3 Consumers

Research highlights the credibility of the source of information as being important[19] and that the majority of consumers are willing to pay more if there is a guarantee on the origin and production practices.[20]

The results of the experiments in the Souza-Monteiro and Caswell study of the United States and Canada show that traceability on its own is not as valued as attributes like food safety assurance and animal welfare. Rather, it has value to consumers when it is associated with a desirable quality assurance system or credence attributes and that information is provided prior to consumption.

Similarly, an EU survey showed that the majority of consumers are willing to pay more for higher quality meat and vegetables and would trust them more if there is a guarantee on the origin and production practices[21]. According to various surveys, a large majority of consumers in the EU and US are willing to pay a premium for products which feature Country of Origin Labelling (COOL) and geographical labelling and certifications[22].

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[17] www.ciesnet.com

[18] Hume, 2004

[19] Souza-Monteiro and Caswell, 2005

[20] Gjerde et al., 2004

[21] Gjerde et al., 2004

[22] Thompson et al., 2005

11. Traceability in selected key markets

11.1 The European Union

Traceability in the EU is mainly driven by risk assessment, risk management and risk information. The EU food laws aim to manage and reduce risk through the application of HACCP (Hazard Analysis Critical Control Point)-based programs and traceability working together to identify and control risks.

The main regulations relating to traceability in EU are listed below.

The electronic Official Journal of the EU, "EUR-Lex Access to European Union law" (accessible from http://eur-lex.europa.eu/homepage.html) provides texts and summaries of EU law and other public EU documents. More information, complete texts and references to other related regulations may be found on this site.

A. General Food Law - The European Community Regulation E/178/2002[23]

The General Food Law Regulation is aimed to ensure a high level of protection of human life and consumers' interests in relation to food.

It lays down general principles, requirements and procedures of the food law, and establishes European Food Safety Authority (http://www.efsa.europa.eu/) as the body responsible for risk assessment and is independent from risk management. It moreover creates the main procedures and tools for the management of emergencies and crises as well as the Rapid Alert System for Food and Feed (RASFF) allowing for product risks to be known everywhere in the EU.

- **Article 3 of the EC/178/2002** defines traceability as:

"The 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."

- **EC/178/2002** in its introduction refers to traceability as follows:

"(28) Experience has shown that the functioning of the internal market in food or feed can be jeopardised where it is impossible to trace food and feed. It is therefore necessary to establish a comprehensive system of traceability within food and feed businesses so that targeted and accurate withdrawals can be undertaken or information given to consumers or control officials, thereby avoiding the potential for unnecessary wider disruption in the event of food safety problems.

(29) It is necessary to ensure that a food or feed business including an importer can identify at least the business from which the food, feed, animal or substance that may

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[23] Full text EC/178/2002: http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32002R0178&from=EN

be incorporated into a food or feed has been supplied, to ensure that on investigation, traceability can be assured at all stages."

- **Article 18 of the EC/178/2002 on Traceability stipulates**

"Traceability

1. *The traceability of food, feed, food-producing animals, and any other substance intended to be, or expected to be, incorporated into a food or feed shall be established at all stages of production, processing and distribution.*

2. *Food and feed business operators shall be able to identify any person from whom they have been supplied with a food, a feed, a food-producing animal, or any substance intended to be, or expected to be, incorporated into a food or feed.*

3. *To this end, such operators shall have in place systems and procedures which allow for this information to be made available to the competent authorities on demand.*

4. *Food and feed business operators shall have in place systems and procedures to identify the other businesses to which their products have been supplied. This information shall be made available to the competent authorities on demand.*

5. *Food or feed which is placed on the market or is likely to be placed on the market in the Community shall be adequately labelled or identified to facilitate its traceability, through relevant documentation or information in accordance with the relevant requirements of more specific provisions.*

6. *Provisions for the purpose of applying the requirements of this Article in respect of specific sectors may be adopted in accordance with the procedure laid down in Article 58(2)."*

- **Information to be documented**
  Food business operators are required to document[24]:
  - Name, addresses of supplier and identification of
  - products supplied,
  - Name, address of direct recipient and identification of
  - products delivered,
  - Date and, where necessary, time of transaction/delivery,
  - Volume, where appropriate, or quantity

The general rule for keeping records is 5 year period, however, (i) for products which have a *"use by"* date less than 3 months records could be kept for the period of 6 months after date of manufacturing or delivery, (ii) for products with a "best before" date records could be kept for the period of the shelf-life plus 6 months.

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[24] EU Traceability Requirements, Marco Thorup Frederiksen, EuroFish

B. Fishery and aquaculture products

Regulation EC 2065/2001[25] laying down detailed rules for the application of Council Regulation (EC) No 104/2000 as regards informing consumers about fishery and aquaculture products

- **Introduction to EC 2065/2001** refers to traceability as follows:

"Provision should be made for the Member States to establish arrangements for checking the traceability of products covered by this Regulation."

- **Article 8 EC 2065/2001** on Traceability and control stipulates

"Traceability and control
Article 8
The information required concerning the commercial designation, the production method and the catch area shall be available at each stage of marketing of the species concerned. This information together with the scientific name of the species concerned shall be provided by means of the labelling or packaging of the product, or by means of a commercial document accompanying the goods, including the invoice."

Regulation EC 1224/2009[26] establishing a Community control system for ensuring compliance with the rules of the common fisheries policy[27]

- **Article 58** on traceability explains

"Article 58
Traceability
1. Without prejudice to Regulation (EC) No 178/2002, all lots of fisheries and aquaculture products shall be traceable at all stages of production, processing and distribution, from catching or harvesting to retail stage.

2. Fisheries and aquaculture products placed on the market or likely to be placed on the market in the Community shall be adequately labelled to ensure the traceability of each lot.

3. Lots of fisheries and aquaculture products may be merged or split after first sale only if it is possible to trace them back to catching or harvesting stage.

4. Member States shall ensure that operators have in place systems and procedures to identify any operator from whom they have been supplied with lots of fisheries and aquaculture products and to whom these products have been supplied. This information shall be made available to the competent authorities on demand.

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[25] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:278:0006:0008:EN:PDF

[26] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:343:0001:0050:EN:PDF

[27] To be read in conjunction with COM(2013)9 - Amendment of Council Regulation (EC) No 1224/2009 establishing a Community control system for ensuring compliance with the rules of the Common Fisheries Policy http://www.eumonitor.eu/9353000/1/j4nvhdfcs8bljza_j9vvik7m1c3gyxp/vj6htavk06xz

5. *The minimum labelling and information requirements for all lots of fisheries and aquaculture products shall include:*

   a. *the identification number of each lot;*
   b. *the external identification number and name of the fishing vessel or the name of the aquaculture production unit;*
   c. *the FAO alpha-3 code of each species;*
   d. *the date of catches or the date of production;*
   e. *the quantities of each species in kilograms expressed in net weight or, where appropriate, the number of individuals;*
   f. *the name and address of the suppliers;*
   g. *the information to consumers provided for in Article 8 of Regulation (EC) No. 2065/2001: the commercial designation, the scientific name, the relevant geographical area and the production method;*
   h. *whether the fisheries products have been previously frozen or not.*

6. *Member States shall ensure that the information listed in points (g) and (h) of paragraph 5 is available to the consumer at retail sale stage.*

7. *The information listed in points (a) to (f) of paragraph 5shall not apply to fisheries and aquaculture products imported into the Community with catch certificates submitted in accordance with Regulation (EC) No 1005/2008.*

8. *Member States may exempt from the requirements set out in this Article small quantities of products sold directly from fishing vessels to consumers, provided that these do not exceed the value of EUR 50 per day. Any amendment to this threshold shall be adopted in accordance with the procedure referred to in Article 119.*

9. *Detailed rules for the application of this Article shall be adopted in accordance with the procedure referred to in Article 119."*

Regulation EC 404/2011[28] laying down detailed rules for the implementation of Council Regulation (EC) No 1224/2009 (see above)

EC 404/2011 deals with traceability under TITLE IV, Control of marketing, Chapter I, Traceability. Article 66 defines "Fisheries and aquaculture products" Article 67 deals with Information on lots and Article 68, with Information to the consumer. (Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32011R0404&from=EN)

C. Organic Production: Regulation (EC) 834/2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91

- **Article 27 on Control Systems** states:

"TITLE V
CONTROLS

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[28] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:112:0001:0153:EN:PDF

Article 27
Control system
1. Member States shall ensure that the control system as set up allows for the traceability of each product at all stages of production, preparation and distribution in accordance with Article 18 of Regulation (EC) No 178/2002, in particular, in order to give consumers guarantees that organic products have been produced in compliance with the requirements set out in this Regulation."

- **Article 29 on Documentary evidence stipulates:**

"Article 29
Documentary evidence

1. The control authorities and the control bodies referred to in Article 27(4) shall provide documentary evidence to any such operator who is subject to their controls and who in the sphere of his activities, meets the requirements laid down in this Regulation. The documentary evidence shall at least permit the identification of the operator and the type or range of products as well as the period of validity.

2. The operator shall verify the documentary evidence of his suppliers.

3. The form of the documentary evidence referred to in paragraph 1 shall be drawn up in accordance with the procedure referred to in Article 37(2), taking into account the advantages of electronic certification."

- **Article 32 on import of compliant products** stipulates:

" TITLE VI
TRADE WITH THIRD COUNTRIES
Article 32
Import of compliant products
1. A product imported from a third country may be placed on the Community market as organic provided that:
….
(b) all operators, including the exporters, have been subject to control by a control authority or control body recognised in accordance with paragraph 2
(c) the operators concerned shall be able to provide at any time, to the importers or the national authorities, documentary evidence as referred to in Article 29, permitting the identification of the operator who carried out the last operation and the verification of compliance by that operator with points (a) and (b), issued by the control authority or control body referred to in point (b)."

D. GM food: Regulation EC 1830/2003 concerning traceability and labelling of genetically modified organisms and the traceability of food and feed products from genetically modified organisms and amending Directive 2001/18/EC

Labelling and traceability: All the products covered by this Regulation are subject to compulsory labelling, which shall enable consumers to be better informed and will offer them the freedom to choose to buy products consisting of, containing or made from GMOs.

The specific requirements of this Regulation related to labelling shall not apply in isolation as these rules are in addition to the following rules which also concern labelling:

- the general labelling rules applicable to foodstuffs generally intended for human consumption (Directive 2000/13/EC);
- the general labelling rules provided for the marketing of feed (Regulation (EC) No 767/2009);
- the specific labelling rules applicable to GMO food and feed (Regulation (EC) No 1829/2003).

Traceability enables GMOs and their products to be traced throughout the production chain. This system is based on the transmission and holding of information by each operator.

GMOs or products containing GMOS: Operators must transmit the following information in writing:

- an indication that the products consist of or contain GMOs;
- the unique identifiers assigned to the GMOs.

If the product is a mixture of GMOs, the industrial operator may submit a declaration of use of these products, together with a list of the unique identifiers assigned to all the GMOs used to constitute the mixture.

As stipulated by the General Food Law (EC Regulation 178/2002), this information must also be held for five years.

E. Food contact materials: Regulation EC 1935/2004 - Framework Regulation on materials and articles intended to come into contact with food

This Regulation lays down a general framework for materials and articles that are intended to come into contact with food. All materials and articles used to package food must comply with the requirements of the Regulation. In order to take into account scientific progress, the new framework authorises the introduction of "active" and "intelligent" packaging which extends the shelf-life of food or provides information on its freshness (for example, intelligent packaging may change colour if food has gone off).

This Regulation also establishes the requirements to be met regarding the traceability of food contact materials from production to sale.

The labelling or documentation accompanying materials and articles placed on the market in the Community should guarantee the traceability of the said materials and articles. This facilitates control, the recall of defective products, consumer information and the attribution of responsibility.

Introduction text to Regulation EC 1935/2004 states:

"(18) The traceability of materials and articles intended to come into contact with food should be ensured at all stages in order to facilitate control, the recall of defective products, consumer information and the attribution of responsibility. Business operators should at least be able to identify the businesses from which, and to which, the materials and articles are supplied."

Article 5 allows
Specific measures for groups of materials and articles
…
"(k) specific provisions for ensuring the traceability of materials and articles including provisions regarding the duration for retention of records or provisions to allow, if necessary, for derogations from the requirements of Article 17.
(l) additional provisions of labelling for active and intelligent materials and articles;"

"Article 15
Labelling
1.   Without prejudice to the specific measures referred to in Article 5, materials and articles, which are not yet in contact with food when placed on the market, shall be accompanied by:
… adequate labelling or identification to ensure traceability of the material or article, as described in Article 17."

"Article 17
Traceability

1.   The traceability of materials and articles shall be ensured at all stages in order to facilitate control, the recall of defective products, consumer information and the attribution of responsibility.

2.   With due regard to technological feasibility, business operators shall have in place systems and procedures to allow identification of the businesses from which and to which materials or articles and, where appropriate, substances or products covered by this Regulation and its implementing measures used in their manufacture are supplied. That information shall be made available to the competent authorities on demand.

3.   The materials and articles which are placed on the market in the Community shall be identifiable by an appropriate system which allows their traceability by means of labelling or relevant documentation or information."

F. Good manufacturing practice for materials and articles intended to come into contact with food Regulation EC 2023/2006[29]

The manufacture of materials intended to come into contact with food must comply with the regulations on good manufacturing practice so that these materials do not represent a danger for the consumer, neither change the composition of food nor the organoleptic characteristics[30] thereof.

This Regulation establishes "good manufacturing practice" for materials and articles intended to come into contact with food. 'Good manufacturing practice (GMP)' means those aspects of quality assurance which ensure that materials and articles are consistently produced and controlled to ensure conformity with the rules applicable to them and with the quality standards appropriate to their intended use by not endangering human health or causing an unacceptable change in the composition of the food or causing a deterioration in the organoleptic characteristics thereof.

Manufacturers must establish a quality assurance system and a quality control system (see below) following the detailed manufacturing regulations, for example the processes involving printing inks.

Materials in contact with food include objects such as containers and packaging, but also all materials in contact with foodstuffs, such as paper and cardboard or those which could possibly transfer their constituents to food, for example inks and adhesives.

Annex 1 to Regulation (EC) No 1935/2004 includes a list of the materials covered by this Regulation: active and intelligent objects, adhesives, ceramics, cork, rubbers, glass, ion-exchange resins, metals and alloys, paper and cardboard, plastics, printing inks, regenerated cellulose, silicones, textiles, varnishes and coatings, waxes and wood.

This Regulation includes an obligation for manufacturers to implement a quality assurance system (taking account of the personnel required to put the system in place and the size of the business), as well as a quality control system. The latter provides for measures to be taken should a business fail to comply with good manufacturing practice.

In addition, manufacturers shall create and maintain documentation regarding the specifications, manufacturing formulae and product processing which are important for the compliance and safety of the finished article, as well as those related to the various manufacturing operations. They are required to make the documentation available to the competent authorities at their request.

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[29] http://eur-lex.europa.eu/legal-content/EN/LSU/?uri=CELEX:32006R2023
[30] Oxford English Dictionary: Organoleptic characters are those impressions produced on the organs of taste, smell, and touch.

Table 2: EU - The traceability system: clear roles and responsibilities

The food and feed production chain often involves many steps, from the import or primary production of a product to its sale to the final consumer. At every stage, food and feed businesses, Member State competent authorities and the EU have clearly defined roles and responsibilities and need to respond appropriately when a risk is identified.

	Overall responsibilities	Actions taken when a risk is identified
Food and feed businesses	Identify and document information on products "one step forward and one step back" in the food chain.	- Immediately withdraw the affected products from the market and, if necessary, recall them from consumers. - Destroy any batch, lot or consignment of feed that does not satisfy food safety requirements. - Inform the competent authorities of the risk and of the action it has taken.
Member State authorities	- Monitor production, processing and distribution of food and feed products to ensure that operators have traceability systems in place. - Fix and enforce appropriate penalties for operators that do not meet EU requirements on traceability.	- Ensure that operators are meeting their obligations. - Take appropriate measures to secure food safety. - Trace the risk backwards and forwards along the food chain. - Notify the Rapid Alert System for Food and Feed (see box below).
The EU	- Establishes sector-specific legislation on traceability as appropriate. - The Food and Veterinary Office of the European Commission carries out regular inspections to ensure that food and feed operators are meeting food safety standards – including the implementation of traceability systems.	- The European Commission alerts members of the Rapid Alert System for Food and Feed of the risk. - Requests information from operators to enable traceability and coordinates action by national authorities. - May impose import/export restrictions.

Source: European Commission Health and Consumer Protection Directorate General
EU Factsheet on Food Traceability
(http://ec.europa.eu/food/food/foodlaw/traceability/factsheet_trace_2007_en.pdf)

The Rapid Alert System for Food and Feed (RASFF)

The RASFF network, in place since 1979, was enhanced by the General Food Law in 2002. Members of the network are the 27 Member States, the European Commission, the European Food Safety Authority, Iceland, Liechtenstein and Norway. This warning system supports the traceability system by enabling the rapid exchange of information whenever a risk to food or feed safety is identified. If a member of the network becomes aware of a potential risk to human health, it notifies the European Commission, which immediately transmits this information to the other members – and beyond so that corrective action can be rapidly taken.

Source: European Commission Health and Consumer Protection Directorate General
EU Factsheet on Food Traceability
(http://ec.europa.eu/food/food/foodlaw/traceability/factsheet_trace_2007_en.pdf)

11.2 United States of America

Due to the global nature of food supply chains, safety and security breaches in the supply chains constitute potential threats. Motivated by the safety and the security of the country, as well as pressure from the private sector in global supply chains, the US government has emphasized the need for supply chain track and trace solutions.

Importers to the U.S. are required to maintain records that identify the immediate sources of their foods. Processors are required to create these records at the time of processing. They must maintain these records for at least two years and make them available to the US Food and Drug Administration (USFDA) within four hours, if requested. The Bioterrorism Act of 2002 requires domestic and foreign facilities that manufacture, process, pack or import food for human consumption in the United States to register with the USFDA. For more information, visit Bioterrorism and Drug Preparedness.

Provisions to keep fresh vegetables and other foods regulated by the FDA as safe as possible for consumers are detailed in the FDA Food Safety Modernization Act (FSMA) 2011. Measures to improve traceability within the U.S. food supply are among the key provisions of this legislation.

Food Safety Modernization Act:
The FSMA enables FDA to better protect public health by strengthening the food safety system by increased focus on preventing food safety problems rather than relying primarily on reacting to problems after they occur.
As a key element of this preventive approach, FDA was mandated to establish science-based, minimum standards for the safe growing, harvesting, packing, and holding of produce on farms to minimize contamination that could cause serious adverse health consequences or death.

Among FDA's key new authorities and mandates[31] are:

- **Prevention:** FDA's mandate to require comprehensive, science-based preventive controls across the food supply includes mandatory preventive controls for food facilities, mandatory produce safety standards and authority to prevent intentional contamination.
- **Inspection and Compliance:**. FDA is to provide oversight, ensure compliance with requirements and respond effectively when problems emerge, through mandated inspection frequency based on risk, access to records, including industry food safety plans, and testing by accredited laboratories.
- **Response:** FDA is to respond effectively when problems emerge despite preventive controls through mandatory recall, expanded administrative detention, suspension of registration and enhanced food tracing abilities.

Enhanced product tracing abilities: FDA is to establish a system that will enhance its ability to track and trace both domestic and imported foods. In addition, FDA is directed to establish pilot projects to explore and evaluate methods to rapidly and effectively identify recipients of food to prevent or control a foodborne illness outbreak.

Additional Recordkeeping for High Risk Foods: FDA is directed to issue proposed rulemaking to establish recordkeeping requirements for facilities that manufacture, process, pack, or hold foods that the Secretary designates as high-risk foods.

Imports: FDA has authority to better ensure that imported products meet U.S. standards and are safe for U.S. consumers through importer accountability, Third Party Certification, certification for high risk foods, and voluntary qualified importer program, and authority to deny entry.

Section 204 of the FSMA: Enhancing tracking and tracing of food and record keeping relates to traceability.

11.3 Canada

The Canadian Food Inspection Agency (CFIA) is the government agency responsible for food safety in Canada, and that is considering a more widespread implementation of traceability requirements among Canadian food businesses[32].
This initiative forms part of the Safe Food for Canadians (SFCA) Act 2012, aiming to better protect Canadian families from risks to food safety.

The SFCA legislation will draw together all food inspection regulations in Canada currently administered under four different Acts into one overarching law. This will

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[31] Background on the FDA Food Safety Modernization Act (FSMA)

http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm239907.htm

[32] Source : http://www.inspection.gc.ca/about-the-cfia/acts-and-regulations/regulatory-initiatives/sfca/food-safety-systems/your-business/traceability/eng/1427310329573/1427310330167
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enable the CFIA to apply consistent regulatory requirements and inspection approaches across all regulated food commodities.

The legislation also allows the CFIA to:
- **create a stronger system to trace products** throughout the production chain to ensure that unsafe foods are identified more rapidly and removed from the supply chain as quickly as possible, and enhance industry requirements for record keeping and documentation.

Under the Action Plan, the CFIA intends to:
- **improve the safety of imported food** by requiring food importers to put in place clear controls to ensure the food they sell is compliant with Canadian regulations, and
- **develop new rules to reduce the risks** posed by pathogens such as E. coli. For example, new requirements will strengthen the control of E. coli in plants producing raw beef.

In the interim, before the Safe Food for Canadians Act comes into force, the CFIA will be implementing some changes using existing authorities and administrative guidelines.

While many businesses in Canada have traceability systems in place, others do not. This can impact the effectiveness and timeliness of food safety investigations and recalls. Businesses that can trace the source of each food product supplied to them (one step back) and its next destination (one step forward) can access timely and precise information as needed. This can significantly reduce the time it takes businesses to remove unsafe food products from the market.

The CFIA is proposing that most food businesses involved in the following activities would need to adopt a system for traceability:

- Importing food;
- Preparing food for export or inter-provincial trade;
- Trading food across a provincial border or exporting food to another country;
- Growing and harvesting fresh fruits and vegetables for export or inter-provincial trade;
- Slaughtering food animals where the meat product leaves the province;
- Storing and handling meat products in their imported condition for CFIA inspection; or
- Food retailing (in this case, you would only need to trace food one step back but not forward to the consumer).

Having a traceability system involves preparing and keeping records that include the following information:

- Common name of the food and lot code;
- Name and principal place of business of the person who manufactured, prepared, stored, packaged or labelled the food (or the name and principal place of business of the person for who this was done);

- Name and principal place of business of the person you received the food from and on what date;
- Name of the person to whom you are providing the food to and on what date; and
- Places the food was moved to before you provided it to another person.

Records would have to be accessible in Canada and maintained for two years. Where electronic records are used, they would need to be provided, upon request, in a format that can be easily opened and manipulated by standard commercial software.

11.4 Japan[33]

Japanese regulations: Japanese law requires a full traceability system only for domestic beef. For other foods, Article 3 of Japan's Food Sanitation Law requests that each operator keep records to identify all their suppliers and customers—a "one-step-back" and "one-step-forward" record. This request is similar to Article 18 of the European Union's EC Regulation 178/2002. However, in Japan this type of record keeping is only recommended and is not compulsory. On the other hand, Japanese regulations do require labelling of the place of origin for fresh food and minimally processed food, not only at retail level but also at wholesale level. However, while origin labelling itself is required, a record-keeping system to verify origin area by providing documentation such as delivery slips and/or invoices is only recommended, not legally required, per Article 3 of the Food Sanitation Law.

Japanese Agricultural Standards (JAS): The JAS system was established in 1950 and is overseen by the Ministry of Agriculture, Forestry and Fisheries (MAFF). One of the main components of the JAS system is its compliance certification systems. Products passing inspection in accordance with the JAS requirements are allowed to display the JAS logo. These standards are voluntary.

Originally, the JAS standards were intended to assure general product quality and standardized labeling. However, in the 1990s, MAFF expanded the JAS system to cover specific methods of production. These expanded standards, called Specific JAS, cover: (i) processed meat products (aged ham, sausage, and bacon); (ii) free-range chicken (Jidoriniku); (iii) organic foods; and (iv) other products disclosing production history and methods.

The producers and packers who wish to be certified under the Specific JAS are required to maintain records to verify production methods and segregation management. While this is not a full traceability system, it makes for a certain degree of traceability. These standards were created to differentiate high-quality products from common products and are not expected to expand to encompass the entire food market.

The government has taken steps to support the development of traceability systems in Japan and in 2003, the Food Safety and Consumer Affairs Bureau was established

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[33] ADBI Working Paper Series 139, May 2009, Food Safety and ICT Traceability Systems: Lessons from Japan for Developing Countries
http://www.adbi.org/files/2009.05.28.wp139.ict.food.traceability.system.pdf

within the Japanese Ministry of Agriculture, Forestry and Fisheries (MAFF). Although traceability systems are not legally required except for domestic beef, MAFF policy is to encourage food business operators to voluntarily establish traceability systems (MAFF 2004, 2007).

To support this policy, MAFF has provided funding for projects such as developing traceability systems utilizing advanced ICT and formulating a handbook to guide the establishment of traceability systems. This Handbook for the Introduction of Food Traceability Systems was created for food business operators and aims to facilitate cooperation between the various operators throughout the food chain (Revision Committee on the Handbook for Introduction of Food Traceability Systems 2007). The handbook covers definitions, basic objectives of traceability, the role each operator should play to establish traceability, and how to proceed with the introduction of a traceability system. It outlines examples of general traceability systems as well as guidelines for specific food items. An English translation has been produced for overseas suppliers[34].

11.5 Australia[35]

Risk management and market access as a generic driver features strongly in Australia. The food supply chain is one of the most diverse in existence and is particularly relevant to the Australian economy, with links to primary production, primary processing and value adding operations associated with export/import trades. Safe food is squarely on the agenda in Australia. Not only is authentication of export products a major focus, but also authentication of documentation and approved business activity is regarded as essential by government at both a State and Federal level. Hence, there is a drive for electronic certification within electronic commerce. Productivity gains and product differentiation are the drivers in the retail sector. These include authentication, Country of Origin Labelling (COOL), cost reduction, shrinkage issues, and inventory control of goods.

For food processing businesses, traceability should extend to being able to identify the source of all food inputs such as:

- raw materials
- additives
- other ingredients
- packaging

The system a food business has in place includes any procedures for identifying producers, suppliers, customers and products and the records kept including:

- name and address (and other contact details) of suppliers and a description of products or inputs supplied
- name and addresses (and other contact details) of customers and a description of the product supplied to them

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[34] http://www.maff.go.jp/j/syouan/seisaku/trace/pdf/handbook_en.pdf
[35] http://www.foodstandards.gov.au/industry/safetystandards/traceability/Pages/default.aspx

- date of transaction or delivery
- batch or lot identification (or other markings)
- volume or quantity of product supplied or received
- any other relevant production records.

In Australia, the Australia New Zealand Food Standards Code[36], Standard 3.2.2 - Food Safety Practices and General Requirements. (Available from https://www.foodstandards.gov.au/publications/documents/3_2_2.pdf) covers the "one step back and one step forward" elements of traceability under Clause 5 (2) Food receipt and Clause 12 Food recall.

In relation to food receipt, a food business must be able to provide information about what food it has on the premises and where it came from. This means that a food business must not receive a food unless it is able to identify the name of the food and the name of the supplier.

In relation to food recall, a food business engaged in the wholesale supply, manufacture or importation of food must have in place a system to ensure the recall of unsafe food; set out this system in a written document and make this document available to an authorised officer upon request; and comply with this system when recalling unsafe food.

Primary production and processing standards in Chapter 4 of the Food Standards Code also include specific traceability requirements for:

- seafood businesses (Standard 4.2.1)
- dairy primary production, transport and processing businesses (Standard 4.2.4)
- poultry processors (Standard 4.2.2)
- egg producers and egg processors (Standard 4.2.5)
- seed sprout processors (Standard 4.2.6)

12. Traceability and Private Standards

Retailers and supermarkets increasingly require compliance with private standards supported by private food certification to ensure that the products they import are safe and in conformity with consumer expectations in relation to environmental, health, and workers' health and safety aspects. Although not legally binding, voluntary private standards are, de facto, increasingly becoming "mandatory" because of the market power of certain large retailers and importers that operate globally. Thus, the choice of whether or not to comply with a voluntary standard becomes a choice between compliance and less competitive goods, and consequently diminishing (or zero) market share.

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[36] http://www.foodstandards.gov.au/industry/safetystandards/traceability/pages/default.aspx

Global Food Safety Initiative (GFSI):
For agricultural production, the Global Food Safety Initiative (GFSI) has established a set of agricultural criteria against which a private voluntary standard can be benchmarked. A food safety management scheme is 'recognized' by GFSI when it meets internationally recognized minimum food safety requirements, developed by multi stakeholders, which are set out in the GFSI Guidance Document. GFSI is not a scheme in itself, and neither does it carry out any accreditation or certification activities.

Certification to a GFSI recognized scheme is achieved through a successful third party audit against any of the schemes listed as being recognized by GFSI.

Among the schemes recognized by GFSI[37] are:

- PrimusGFS standard,
- Global Aquaculture Alliance Seafood
- GLOBALG.A.P. Integrated Farm Assurance Scheme and Produce Safety Standards
- Food Safety System Certification (FSSC22000)
- Global Red Meat Standard (GRMS)
- CanadaGAP
- Safe Quality Food (SQF)
- The British Retail Consortium (BRC) Global Standard for food safety
- International Food Standard (IFS)

Requirements from some of the above schemes are enumerated below.

12.1 The SQF[38]

The SQF (Safe Quality Food) Institute is a division of the Food Marketing Institute (FMI), established to administer the SQF Program, a global food safety and quality certification and management system. The Program provides independent certification that a supplier's food safety and quality management system complies with international and domestic food safety regulations. This enables suppliers to assure their customers that food has been produced, processed, prepared and handled according to the highest possible standards, at all levels of the supply chain.

Concerning traceability requirements, the SQF 2000 Code thus stipulates:

4.6.2 Product Trace: Finished product shall be traceable to the customer. The product trace system shall be documented in a procedure with responsibilities defined. It shall provide for the identification of raw materials and other inputs that may have an impact on finished product quality and safety. Raw materials and other inputs shall be traceable through the process to the finished product. Records of product dispatch and destination shall be maintained.

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[37] Global Food Safety Initiative (GFSI) Recognized Schemes http://www.mygfsi.com/schemes-certification/recognised-schemes.html
[38] http://www.sqfi.com/

12.2 The BRC Global Standard[39]

In 1998 the British Retail Consortium (BRC), responding to industry needs, developed and introduced the BRC Food Technical Standard to be used to evaluate manufacturers of retailers own brand food products. It is designed to be used as a pillar to help retailers and brand owners with their 'due diligence' defence, should they be subject to a prosecution by the enforcement authorities.

The BRC Global Food Standard on traceability:

Section 2.13 The Company shall have a system with the ability to trace materials from raw material source to finished product.

Section 2.13.1 Where rework or any reworking operation is performed, traceability shall be maintained.

Section 2.13.2 The system shall be regularly tested to ensure traceability can be determined from raw material source to finished product.

12.3 International Food Standard (IFS)[40]

German and French food trade associations, with the assistance of other international retailers, have developed the IFS or the International Food Standard as a response to food safety concerns. The aim of the standard is to focus the various requirements of retailers on one standard. Benefits of the standard include enhanced transparency along the food chain and a reduced number of customer audits resulting in cost savings. Certification to IFS by an independent third-party helps suppliers demonstrate to retailers that their product safety, quality and legal obligations are fulfilled.

The International Food Standard is also a so-called KO (knock-out) criterion: non-compliance automatically leads to an inability to be certified and stipulates:

Section 4.19 Traceability:

"The Organisation shall adequately identify all raw materials and be able to trace work in progress and finished product at all stages during manufacture, storage, dispatch and, where appropriate, distribution to the customer."

Foundation level:

4.19.1 "The organisation shall demonstrate the ability to trace each product backward to processing plant and raw material organizations, and forwards to delivery point."

4.19.2 "Where rework or any reworking operation is performed, traceability shall be maintained."

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[39] http://www.brc.org.uk/standards/
[40] http://www.bsi-emea.com/Food+Safety/Standards/IFS.xalter

Higher level:

4.19.3 "The organisation shall maintain records of the product during the relevant stages of production."

4.19.4 "From all relevant raw materials samples shall be available and kept stored until the end of the expiry date of the end product."

4.19.5 "Samples from the produced charges shall be stored appropriate and kept until the expiry date of the end product."

12.4 EFSIS[41]

The EFSIS is the agri-food division of SAIGLOBAL[42]. EFSIS provides retailers, manufacturers, farmers and caterers throughout the world with expert inspection and certification of their operations to ensure standards are maintained.

The EFSIS traceability requirements are:

23.1 The Company shall have a system with the ability to trace materials (including packaging) from raw material source to finished product and from finished product back to raw material source.

23.1.1 Where rework or any reworking operation is performed, traceability shall be maintained.

23.1.2 The system shall be regularly tested to ensure traceability can be determined from raw material source to finished product and from finished product back to raw material source.

23.1.3 The level of traceability shall be such as to enable the recall procedure to operate effectively and complaints to be traced to a defined production run.

13. Conclusion

Today, in several developed countries, traceability requirements have become mandatory. The issue of food safety has been the main cause for adopting such regulations. Indeed, both the government and buyers have reason to take such measures because of crises such as outbreaks of avian flu or BSE. Furthermore, a traceability system also guarantees product authenticity and gives reliable information to customers.

However, developing countries may face significant obstacles in achieving sufficient traceability standards. They lack information and proper infrastructure to implement an effective traceability system which they perceive as costly.

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[41] http://www.efsis.com/htm/en/whatisefsis.php
[42] http://www.saiglobal.com

Small enterprises tend to focus only on local markets with less stringent traceability requirements. However, this is not sustainable as sooner or later the requirements on the domestic market would also change and align themselves with international standards. ISO 22005 is an international standard which gives the principles and specifies the basic requirements for the design and implementation of a traceability system and it may be used for complying with international market requirements.

Regulations on traceability are here to stay and the sooner enterprises in developing countries start implementing a system for traceability the better it will be for them in the long term.

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ANNEX

CODEX ALIMENTARIUS COMMISSION

PRINCIPLES FOR TRACEABILITY/PRODUCT TRACING AS A TOOL WITHIN A FOOD INSPECTION AND CERTIFICATION SYSTEM CAC/GL 60-2006

SECTION 1 – SCOPE

1. This document elaborates a set of principles to assist competent authorities in utilising traceability/product tracing as a tool within their food inspection and certification system. This document should be read in conjunction with all relevant Codex texts as well as those adopted by IPPC and OIE where appropriate.

2. Recognizing the dual mandate of the Codex Alimentarius, traceability/product tracing is a tool that may be applied, when and as appropriate, within a food inspection and certification system in order to contribute to the protection of consumers against food-borne hazards and deceptive marketing practices and the facilitation of trade on the basis of accurate product description.[1]

SECTION 2 – DEFINITIONS

Inspection[2]: is the examination of food or systems for control of food, raw materials, processing and distribution, including in-process and finished product testing, in order to verify that they conform to requirements.

Certification[2]: is the procedure by which official certification bodies and officially recognized bodies provide written or equivalent assurance that foods or food control systems conform to 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.

Equivalence[3]: is the capability of different inspection and certification systems to meet the same objectives.

Traceability/product tracing[4]: the ability to follow the movement of a food through specified stage(s) of production, processing and distribution.

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[1] Codex Principles for Food Import and Export Inspection and Certification (CAC/GL 20 – 1995).
[2] Codex Principles for Food Import and Export Inspection and Certification (CAC/GL 20 – 1995).
[3] Codex Guidelines for the Design, Operation, Assessment and Accreditation of Food Import and Export Inspection and Certification Systems. (CAC/GL 26 – 1997).
[4] Codex Procedural Manual

SECTION 3 – PRINCIPLES

3. These principles cover the context, rationale, design and application of traceability/product tracing as a tool for use by a competent authority within a food inspection and certification system.

Context

4. Traceability/product tracing, as defined above, is one of a number of tools that may be utilised by a competent authority within its food inspection and certification system.

5. An importing country should consider that a food inspection and certification system without a traceability/product tracing tool may meet the same objective and produce the same outcomes (e.g. regarding food safety, provide the same level of protection) as a food inspection and certification system with traceability/product tracing[5].

6. It should not be mandatory for an exporting country to replicate (i.e. establish the same) the traceability/product tracing tool as used by the importing country, when applicable.

Rationale

7. The application of a traceability/product tracing tool by a competent authority should improve the effectiveness and/or efficiency of the actions that may be necessary regarding its measures or requirements within its food inspection and certification system.

8. Traceability/product tracing is a tool that when applied in a food safety context does not in itself improve food safety outcomes unless it is combined with appropriate measures and requirements. It can contribute to the effectiveness and/or efficiency of associated food safety measures[6].

9. Traceability/product tracing is a tool that when applied in a food inspection and certification system can contribute to the protection of consumers against deceptive marketing practices and facilitation of trade on the basis of accurate product description[7].

10. In every case a traceability/product tracing tool should be justified within the context of the food inspection and certification system and the purpose, objectives and specifications of the traceability/product tracing tool clearly described. The

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[5] Codex Guidelines for the Development of Equivalence Agreements Regarding Food Import and Export Inspection and Certification Systems (CAC/GL 34-1999); Codex Guidelines on the Judgement of Equivalence of Sanitary Measures Associated with Food Inspection and Certification Systems (CAC/GL 53-2003).

[6] For example, by providing information on suppliers or customers involved in potential food safety issues so enabling targeted product recall/withdrawal.

[7] For example, by reinforcing confidence in the authenticity of the product and the accuracy of information provided on the products (e.g. country of origin, organic farming, religious concerns such as kosher or halal).

scope and extent of application of the tool should also be consistent with the described need.

Design

11. The traceability/product tracing tool may apply to all or specified stages of the food chain (from production[8] to distribution), as appropriate to the objectives of the food inspection and certification system.

12. The traceability/product tracing tool should be able to identify at any specified stage of the food chain (from production to distribution) from where the food came (one step back) and to where the food went (one step forward), as appropriate to the objectives of the food inspection and certification system.

13. The objectives, scope and related procedures of a food inspection and certification system that includes a traceability/product tracing tool should be transparent and made available to competent authorities of the exporting country upon request.

Application

14. The application of traceability/product tracing should take into account the capabilities of developing countries.

15. If in the context of a traceability/product tracing tool an importing country has objectives or outcomes of their food inspection and certification system which cannot be met by an exporting country, the importing country should consider the provision of assistance to the exporting country, and especially in the case of a developing country. Assistance may include longer time frames for implementation, flexibility of design and technical assistance, so that the objectives or outcomes of the food inspection and certification system of the importing country can be met.

16. A food inspection and certification system within which a traceability/product tracing tool is applied should not be more trade restrictive than necessary.

17. The application of the traceability/product tracing tool should be practical, technically feasible and economically viable within a food inspection and certification system.

18. In deciding whether and how to apply the traceability/product tracing tool, in the context of a food inspection and certification system the competent authority should take account of the assessed food safety risks and/or the characteristics of the potential deceptive marketing practices being addressed.

19. Traceability/product tracing tool within the context of a food inspection and certification system should be implemented when and as appropriate on a case by case basis.

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[8] Production could be interpreted in such a broad manner as to cover food producing animals, feed, fertilizers, pesticides, veterinary drugs and any input of plant or animal origin, etc. if relevant for specific applications of traceability/product tracing to food.