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INFORMATION MANAGEMENT IN AGRIFOOD CHAINS:

Towards an Integrated Paperless Framework for Agrifood Trade Facilitation

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Information Management in Agrifood Chains: Towards and Integrated Paperless Framework for Agrifood Trade Facilitation

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Preface

International trade in agricultural and food products is more complex than trade in manufacturing – trade regulations are stricter, paperwork is more cumbersome and logistics are more complex. These elements are mainly required for ensuring food safety for consumers. Detailed information on traded goods alongside the movement of goods in a supply chain is critically important for food safety. Various actors need to exchange information in the complex process of importing and exporting agrifood products. While there has been significant progress in the development of regulatory trade single windows to facilitate trade in goods in general, together with efforts to issue electronic sanitary and phytosanitary (SPS) certificates as well as to establish food traceability systems in some countries, these paperless systems may not fully meet the needs of the agriculture and food sector, where the requirement for accurate and timely information on products and their movements from farm to fork is becoming increasingly important to trade facilitation.

This publication outlines a framework for integrated agrifood information management, taking into account the functional needs of various stakeholders along the supply chain. The benefits as well as challenges involved in developing a comprehensive system are discussed. Some examples of existing paperless systems – which are considered good practices for agrifood trade – are also included together with the list of relevant international standards to be taken into account when implementing the systems. Practical recommendations for, and milestones in the enhancement of agrifood information systems for trade facilitation are provided, including a recommendation to develop a Single Window for Agrifood Trade (SWAT).

This publication is aimed mainly at government officials involved in overseeing and making policies related to agrifood trade. It is also relevant to the private sector (both existing and potential traders), associations and any agrifood supply-chain stakeholders interested in making agrifood trade both safer and more efficient. Simple text has been used to explain the technical content as far as possible. This policy guide builds on the series of technical and legal guides produced by UNNExT to facilitate paperless trade implementation. All previous guides are available at http://unnext.unescap.org.

List of abbreviations and acronyms

Agrifood	agricultural produce and derived food products
AIDC	automated identification and data capture
ASC	Aquaculture Stewardship Council
B2B	business-to-business
B2C	business-to-consumer
B2G	business-to-government
BRC	British Retail Council
CSV	Comma Separated Values
ebXML	Electronic Business XML
eCustoms	electronic customs systems
EPC	Electronic Product Code
EPCIS	Electronic Product Code Information Services
ePermit	electronic permit systems
EUROSTAT	Statistical Office of the European Union
FAO	ood and Agriculture Organization of the United Nations
FBO	food business operators
FLO	Fairtrade International
G2B	government-to-business
G2G	government-to-government
GLN	Global Location Number
GS1	Global Standard One
GTIN	Global Trade Item Number
HS	Harmonized Commodity Description and Coding System
IAC	Issuing Agency Code (for ISO15459)
IFS	International Food Standard
IOS	inter-agency information systems
ISO	International Standards Organization
IT	information (and communications) technology
IUU	illegal, unregulated and unreported
Layer 2	Refers to the private sector in the layered approach to agrifood chain information management
Layer 3	Refers to certification bodies in the layered approach to agrifood chain information management
LU	logistic unit
OASIS	Organization for the Advancement of Structured Information Standards
OIE	World Organisation for Animal Health
POS	point of sale
RASFF	Rapid Alert System for Feed and Food
RFID	radio frequency identifier
RGCodes	A globally unique numbering scheme
RSPO	Roundtable for Sustainable Palm Oil
SGTIN	Serial GTIN
SSCC	Serial Shipping Container Code
SW	single window
TRACES	Trade Control and Expert System
TU	trade unit
UBL	Universal Business Language (an OASIS standard)

UML	Universal Modelling Language
UNTDET	United Nations Trade Data Element Directory
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
UNNeXT	United Nations Network of Experts for Paperless Trade in Asia-Pacific
URL	Unified Resource Locator
WHO	World Health Organization
WTO	World Trade Organization
XML	Extended Markup Language

Executive summary

The present publication seeks to introduce information management in the agrifood chains as an integral part of trade facilitation in the sector. Agrifood chain information management can be understood as the collection and distribution of information about food and the food-trade along the whole food supply chain, from farm to fork. The concept embraces both traceability and trade facilitation systems, such as national single windows, customs systems and other controls. This guiding document puts forth a progressive way of looking at the way information is transferred in the agrifood sector.

The special nature of food and agricultural products has many implications for trade facilitation in the sector. The production and consumption of food has implications for human health; economic prosperity and environmental sustainability. Food as a source of human nutrition must be safe. Food is also a cultural good with several preferences and rules that govern the production and use of food. Food production is essential for the livelihoods of smallholder farmers and a creator of wealth for the private sector. The perishable and time-sensitive nature of agrifood products also requires efficient and speedy movement within countries and across borders. Hence, information about food needs to be transparent, traceable and managed through an integrated information system. If implemented corrected information management in agrifood chains can contribute to 'smarter food'. The 'smarter food vision' seeks to use information technology to make the food trade more *inclusive* to all producers; to make the consumption of food *safe;* and to ensure that information about food is *accessible* by the consumers. This is idea is rooted in the collection and distribution of electronic information along the agrifood chain.

This publication argues that an exchange of electronic information throughout the whole food supply chain is required to successfully and efficiently facilitate the trade in the agrifood sector. Furthermore, the publication has identified four 'macro-trends' which influence the discourse on information gathering for agrifood products. These macro-trends include guaranteeing food security and safety; increasing sustainability of food production; ensuring food quality and efficient trade of agrifoods. Agrifood chain information management systems will have to take these four macrotrends into account.

It is also recognized that the complex relationships between agrifood chain stakeholders, namely public sector, private sector, consumers can make the implementation of information systems for food a difficult task. There are many standards, controls and guidelines, which seek to promote food safety, sustainable production and efficient trade. However, comprehensive standardization within the agrifood chain management system information sector is still required.

It is essential to consider the governance structure of the agrifood chain information management system. In order to make the implementation of agrifood chain information management systems manageable, this publication recommends using a layered approach. Layer 1, or the regulatory layer, would be constituted by control systems of the public authority in order to collect data required by laws and regulations. This publication recommends implementing layer 1 as part of a national single window, which we specifically call the Single Window for Agrifood Trade (SWAT). Layer 2, or the private sector layer, will be implemented by

traceability systems within the private sector and governed by private contracts between business partners. However, it is recommended that the public agencies take a leading role in facilitating the adoption of suitable systems and operators. Layer 3, the verification layer, addresses the need to verify the content of the data stored in layers 1 and 2. This process increases the credibility of the data as well as the robustness of the information management system. Verification agencies can be governmental actors or third-party actors, such as certification agencies.

Single Window for Agrifood Trade (SWAT) is an inter-organization information system, which aims to bring about security and efficiency in agrifood cross-border trade through collaboration, electronic information exchange and efficient regulation. SWAT should be considered as part of a comprehensive approach to national trade facilitation policy and action. SWAT can take the form of an integrated subcomponent of existing national single windows or as an independent system which interfaces with a national single window. SWAT is recommended as the model for layer 1 and facilitates the establishment of layers 2 and 3 of an agrifood chain information management system. The publication proposes a number of milestones and recommendations towards to the implementation of SWAT. These include:

- Establishment of risk-based inspection systems for issuance of licenses and certificates
- Establishment of a roundtable for agrifood chain information management
- Identification of missing paperless systems for agrifood trade and their implementation
- Establishment of normative databases for locations, products and land use
- Establishment of a standard framework for identification and information exchange
- Establishment of authorised economic operators
- Establishment of risk-based inspection systems for issuance of licenses and certificates
- Establishment of a food safety emergency system
- Addressing legal implications of information management systems for agrifood chains
- Funding development of core components

In addition, the four actions, which can help to launch the SWAT and establish its relevance to the private and public sector actors by providing some quick wins and benefits, have been outlined. These actions would include:

- Action 1: Implement electronic agrifood licence/permit/certificate and audit system
- Action 2: Establish international cooperation on SWAT and inter-agency information systems
- Action 3: Implementation of an automated risk-based inspection system using cross-border electronic information exchange of agrifood permits and certificates
- Action 4: Implementation of an automated food safety emergency management system using national as well as cross-border electronic information exchanges.

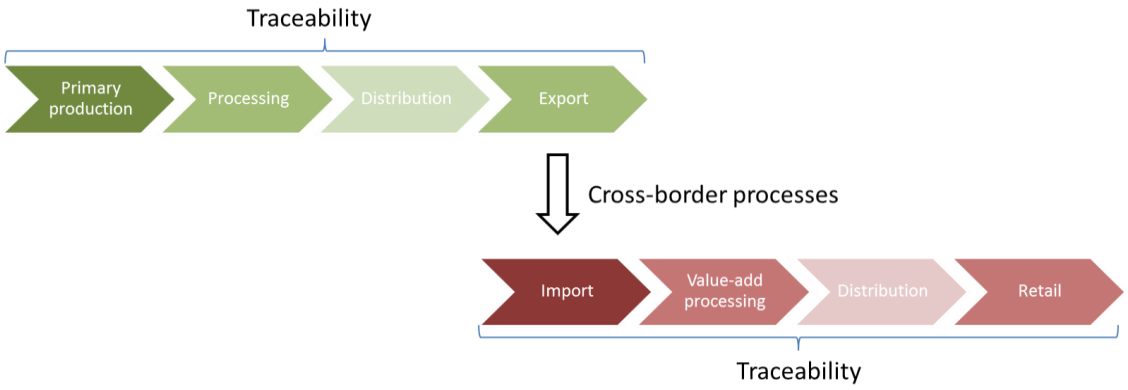
These actions can assist in identifying measures and activities that can be more easily implemented, in order to provide early success stories. A sectorial approach looking first at high value, fraud ridden or market-excluded products is advised. However, it is also essential

that countries look at the measures that a necessary beyond these initial actions. The publication also provides a checklist for countries wanting to implement agrifood chain information management. It is also emphasized that the implementation of an effective agrifood chain information system will be context-specific. Nevertheless, it will also require commitment by the stakeholders to collaborate and move towards greater transparency within the agrifood chain. This guiding document contains case studies demonstrating the measures taken in various countries to implement and operate agrifood chain information management systems.

Chapter I: Introducing information management in agrifood chains

Single window facilities are a central tool in the facilitation of international trade, as evidenced by the inclusion of a provision for their implementation in the final text of the World Trade Organization (WTO) Trade Facilitation Agreement (TFA). The United Nations Network of Experts for Paperless Trade in Asia and the Pacific (UNNExT) (unnext.unescap.org) provides a comprehensive Single Window Implementation Toolkit for trade facilitation, based on the UN/CEFACT step-by-step process.[1] The present publication complements these more horizontal, i.e., sector-independent, guides by applying some of the principles to the agrifood sector, taking into account the specific requirements and characteristics of that sector.

Figure 1: A typical food supply chain and its relationship to information management processes



The agrifood sector is not only a very important business sector; it also deals with a commodity that is intimately related to human health, well-being, religion, preferences, legality and sustainability. Hence, there are many factors and concepts that refer to the way the food item was created, processed, handled and traded. In addition to food consumers becoming increasingly concerned about food security and food safety, millions of small producers in developing countries also depend on the development of this sector. This suggests that the entire collection of structured information along the supply chain, including primary production, processing, distribution, trade related cross-border processes, import processes, retailing and up to the customer, should be considered in enhancing agrifood trade facilitation for inclusive and sustainable development.

Accordingly, this publication proposes an ambitious and forward-looking 'Smarter Food' vision to be implemented through modern integrated information management in agrifood chains. As figure 1 shows agrifood information management encompasses both food traceability and the cross-border import export processes, which are usually addressed in electronic trade facilitation measures, such as national single windows. The reason for attempting to deal with both at the same time is the special nature of food. Import processes may very well depend on details of the production process, and the legality of a food item may be challenged if certain

[1] The toolkit includes an overview document on single window project planning and management [(ESCAP-UNECE, 2012a), as well as guidelines on specific aspects of the implementation process, e.g., on legal aspects (ESCAP-UNECE, 2012b), business process analysis (ESCAP-UNECE, 2012c), trade form design (ESCAP-UNECE, 2012d), and data harmonization and modelling (UNNExT-ESCAP-UNECE, 2012).

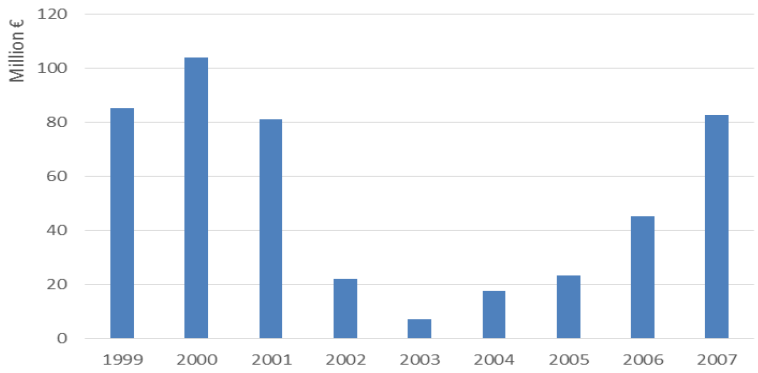
processes are not followed (see box 1). Consumption of a particular food may depend on social or environmental circumstances of production. The food chain therefore has to be considered as a whole and cannot simply be broken into pre-trade, trade and post-trade processes. As it is argued later in this publication, the role of Government is to assist the private sector in coming up with an efficient information management platform. This publication seeks to provide input into the implementation process for information management systems.

The remainder of this chapter introduces agrifood chain information management systems and details the vision of smarter food that drives the implementation of these systems. Chapter II highlights macro-trends in agrifood chain information management and outlines a structure for an integrated agrifood information management system. Practical recommendations for implementation are given in chapter III. Additional technical information on standards and information system architectures as well as an implementation checklist are provided in the appendices.

Box 1: Traceability and trade: The case of Thailand's frozen shrimp exports

In 2002, European Union border control detected illegal antibiotics in frozen shrimp from Thailand. Thailand claimed that the substances had been used only on one or two farms in the country, but was unable to produce hard data that the shipments effectively had come from those farms. The European Union – using the risk avoidance principle – subsequently decided to close the European Union borders to all frozen shrimp imports from Thailand. As figure 2 shows, the effect on the sector was disastrous. Although the border was reopened less than one year after the incident, the sector took five years to recover, costing Thailand more than US$ 400 million in lost exports.

Figure 2: Exports (in Mio €) of crustaceans from Thailand to EU27[2]



Source: EUROSTAT, 2008.

[2] EU27 refers to the European Union 27: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom

A. The agrifood business and its information needs

Global agricultural trade has experienced significant growth in recent decades. According to the WTO the value of exports of agricultural products has nearly tripled between 2000 and 2012 (WTO, 2014). In 2013, the largest importer agricultural products was the European Union, followed by China, the United States of America and Japan[3]. The pattern of agrifood trade is truly global in nature. Food consumed in one country can originate from almost anywhere on the planet. Globally, there is increasing demand for high-value products; coupled with high prices in the international food markets there are increasing opportunities for developing countries to participate in and benefit from international trade in agrifood products (WTO, 2014).

Food is also a cultural commodity. Worldwide, there is a range of beliefs of what can or cannot be eaten and how. Muslims do not eat pork and Hindus avoid beef. As a food scandal in 2013 showed, eating horse meat is quite unacceptable in the United Kingdom. Europeans, in general, shun eating insects. In northern Viet Nam dog meat is considered to be a delicacy, while in Malaysia it is illegal. Wine and spirit-based sauces are one of the pillars of French cuisine, in Indonesia this is considered unacceptable. Kebap Iskender in Istanbul happily mixes dairy products with meat while Jewish tradition requires that the two are kept separate.

From the perspective of human consumption, food is also a very sensitive commodity since it has a direct impact on human health. Non-processed food generally spoils quickly. It is sensitive to the use of correct transportation and storage conditions. Deep-frozen fish generally has a shelf life counted in years – but only if the cold chain is not broken. Grain, when stored correctly, can last thousands of years, as findings from Egyptian tombs have shown. However, mycotoxins grow quickly when the storage conditions are not correct – creating major concerns for human health.

Food is a very sensitive commodity. It is perishable and sensitive to temperature. Fast trade transaction is thus warranted along with fast information exchange. Due to various religious restrictions and cultural practices, customers demand information about their food including production, ingredients, sustainability etc. Regulators also require significant amounts of information for facilitation and control. Therefore, quick and efficient exchange of information for agrifood trade is extremely important.

Trading such a high-risk and sensitive commodity globally requires very efficient control. Some of these controls can be performed directly on the food itself. For example, tests can identify microbiological threats. DNA can be used to determine unwanted sources of meat in a food product. The European Union-funded TRACE[4] project even showed that, in some cases, the origin can be determined directly from the product itself.

However, another set of controls requires information from the production process itself. Only in singular instances can one determine if an animal was slaughtered according to Halal principles, for example. Whether an organic food was grown in a field without use of artificial fertilizers might be impossible to determine.

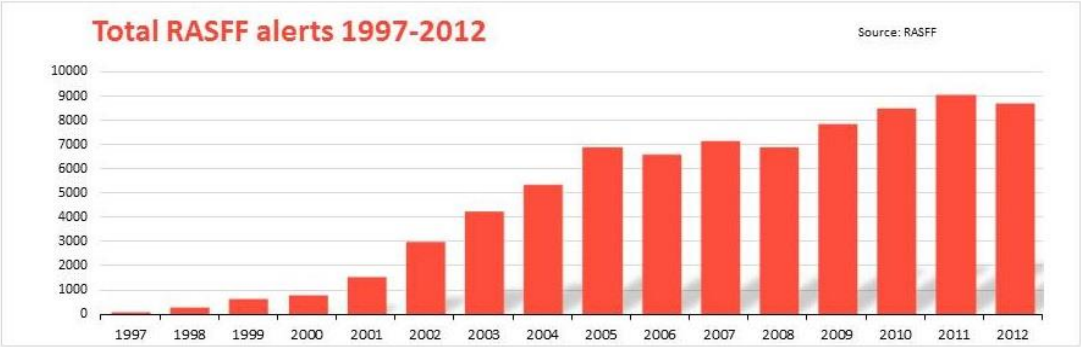
[3] Data from the WTO International trade and market access database. Accessed on 15 January 2014.
[4] www.trace.eu.org.

Sustainable palm oil is chemically no different from the unsustainable form, while fair-trade coffee is indistinguishable from its "regular trade" alternative.

Facing the challenge of food safety emergency situations and the importance of food recall at both the national and global levels, major importing countries implemented new legal requirements on product traceability around 2004. Traceability – defined by ISO8402 as the "ability to trace the history, application or location of an entity by means of recorded identifications" or by Codex Alimentarius as "the ability to follow the movement of a food through specified stage(s) of production, processing and distribution" – appears to be ideally suited to addressing the above challenges (Olsen and Borit, 2013).

The European Union introduced the concept with the General Food Law 178/2002, making traceability "one up, one down" mandatory from 2004 onwards. The "one up, one down" system requires food business operators to keep records regarding their direct suppliers ("one up") and their direct clients ("one down"). Records reaching further into the past (or future) of a food item are not required. Once a food business operator keeps such records, it creates a chain of documentation, connecting right up to the source of any food incidence and limiting its impact on public health. It was noted that such a system also served to determine the chain of responsibility. Although traceability requirements were weakened significantly in the process of formulating the law, the European Commission hailed the General Food Law as a great leap forward to ensuring public health.

Figure 3: Total notifications in the Rapid Alert System for Food and Feed, 1997-2012



Source: European Commission Rapid Alert System for Food and Feed (RASFF), 2012.

When applied in food safety context, traceability is a tool that does not in itself improve food safety outcomes unless it is combined with appropriate measures and requirements; this can be clearly seen from figure 3, which clearly indicates that the introduction of mandatory traceability through laws and regulation for all foods produced or imported into the European Union is not enough to reduce the number of incidences, if measured by the number of notifications on the Rapid Alert System for Food and Feed. This is a system to make incidences encountered at the border or by internal controls known to the European member States and its citizens.

A variety of reasons contribute to the outcome depicted in figure 3 and it is unlikely that it can be attributed to any single cause. One important implication, however, is that various

additional control measures and requirements are likely to be put into place in the future, given the trend shown. This also strengthens the case for traceability as a tool that, when applied in a food inspection and certification system can contribute to the protection of consumers against deceptive marketing practices as well as trade facilitation on the basis of accurate product description (Codex).

An important factor that contributes significantly to the success of any measure, such as the ones featured in the European Union's General Food Law, is the availability of records – specifically electronic records – that are easily re-used and distributed along the food supply chain. Paperless record-keeping is as different from paper recordings as is the Library of Congress from Google. Availability of electronic records assists in bridging the inter-company gap, where most food information systems break down (Olsen and Borit, 2012), and in accessing information about a food item that is several stages removed from the information origin becomes important. In the "Horsegate" food scandal in Europe,[5] the abattoir told the public that it did sell horse meat and beef – separately. In part, due to the offline nature of records, pieces of information got "lost" somewhere.

Only paperless information systems have the depth of available information necessary to inform consumers, customs officials and trade partners as well as the speed to bring that information to the stakeholders when they need it. This is particularly true in the case of the agrifood sector, given both the amount and nature of information needed.[6]

Table 1: Comparison between paper and electronic records

Paper-based systems	Paperless systems
• Easy to implement • Time resilient • Not scalable; limited by capacity of personnel and physical transportation • Cannot be re-used • Usually not accessible; filed in a physical location • Information chains impossible to construct	• Require technical capacity • Subject to data format compatibility issues • More scalable; can be (semi)automated • Easy to copy and exchange; no transportation time • Easily accessible • An information chain can be established
Similar to Library of Congress	***Similar to Google***

Quite a wide range of information is needed about agro-food items traded internationally (see Table 2). However, all information needs concern consumers – be it for food safety, religious concerns or questions regarding the sustainability of certain crops.

Governments, as caretakers of their citizens, are primary stakeholders in food information management. Nevertheless, consumers also have a strong interest in information about the food they eat. In Europe, a 2006 study (EUROSTAT, 2008) showed that 50% of consumers believed more information was necessary on food safety while 30% identified the

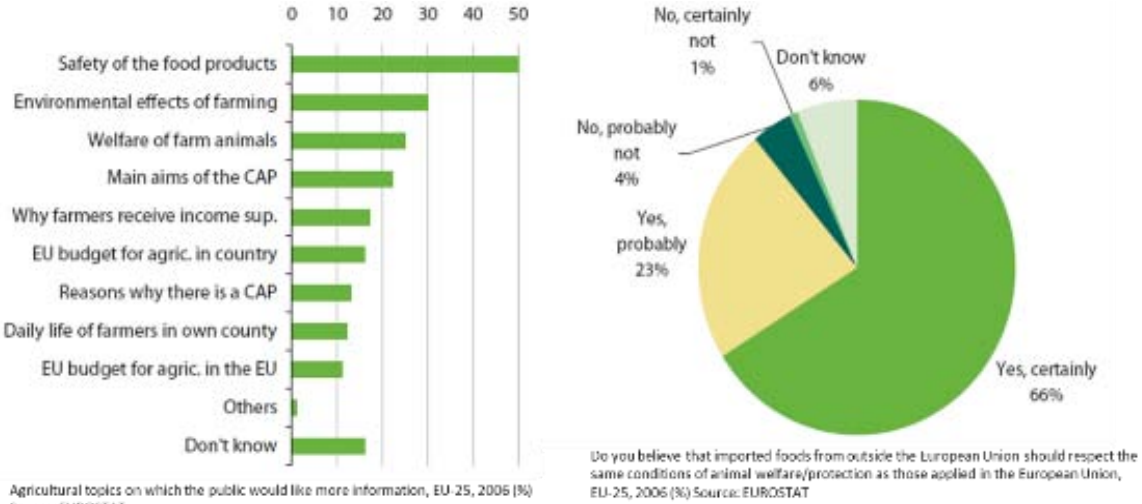
[5] www.independent.ie/irish-news/horse-and-pig-dna-found-in-some-supermarket-burgers-28958916.html.

[6] "Large industrial firms known for their established identity and a brand image appear to be distant from standard traceability practices, unlike agribusinesses that are subjected to regulations and [which] look forward to using [electronic] traceability for both complying with their downstream contracts and adding value to their regional specificities" (Galiano and Orozco, 2012). Available at http://ageconsearch.umn.edu/bitstream/43952/2/142.pdf.

environmental impact of farming and 25% cited animal welfare. Other information needs were also identified (e.g., the daily life of farmers – 12%). A total of 90% believed that any conditions on food production with regard to animal welfare/protection should also be applied to all imported foods.

Importantly, while agrifood products are subject to these additional controls and information needs, the perishable nature of the products requires their speedy movement, including across borders.[7] This provides a strong case for why, in the case of agrifood items, it is important to look at a full-chain integrated information management approach for trade facilitation, as opposed to looking simply at transaction processes and information requirements between traders and Governments, or between governmental authorities.

Figure 4: EUROSTAT study on consumers' needs for information, 2006



Agrifood chain facilitation needs to consider government-to-government (G2G) transactions, but if the end-consumers are not taken into consideration, trade might not happen after all – even if the trans-border issues are solved. When Cadbury attempted to use the perfectly legal ingredient palm oil for use in its chocolate,[8] consumer outrage made the company quickly retract the move, creating further pressure on the trading of this commodity – even of its sustainable variant.

Free and efficient trading of food requires a full understanding of where the food comes from and what has been done to it in the process. Although this requires a large concerted effort by all stakeholders, and would certainly require moving from paper-based to electronic information exchange, the potential benefits are large. For example, the Hermes project estimated that a shift from paper to electronic records would provide savings to the United Kingdom's perishable food supply chain of about £2.6 billion per annum, representing a saving of 7% of the gross GDP for the industry based on 2005 trade figures (SITPRO, 2009).

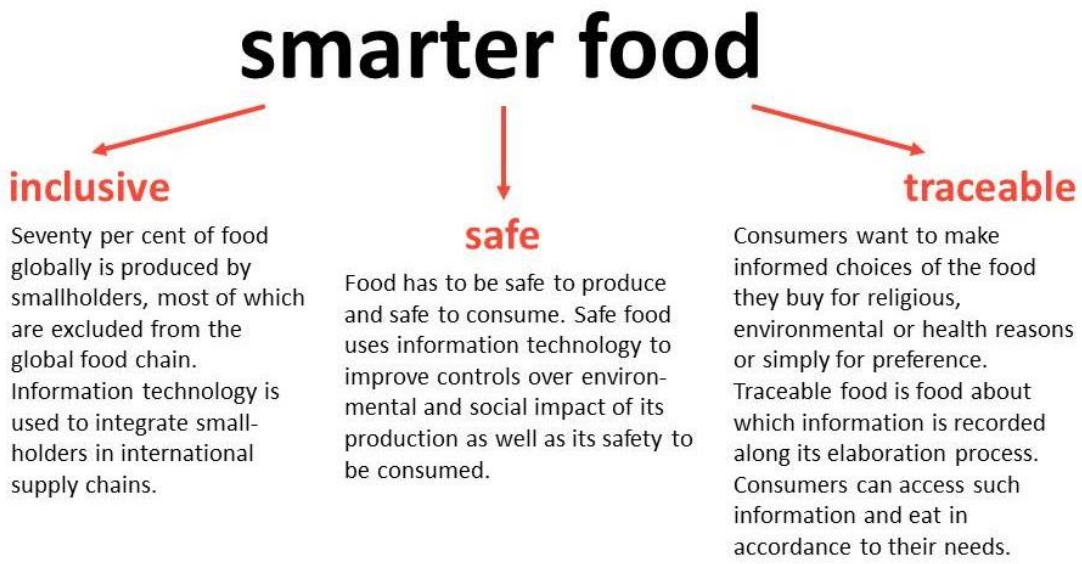
[7] Although this publication is primarily aimed at food, its recommendations can also be applied to non-food perishables.

[8] www.stuff.co.nz/national/2758975/Cadbury-stops-using-palm-oil-in-chocolate.

B. The vision: Smarter food

In many ways food is a special trade good. Efficient trade not only saves time and therefore reduces food waste; it also opens up markets and contributes to wealth. Embedded in efficient safety control, information management in agrifood chains can contribute to "smarter food", i.e., food that is safe to consume, connects producers to consumers and can be chosen in an informed manner. In other words, food becomes smarter if it is inclusive, safe and traceable (figure 5).

Figure 5: Smarter food production



1. Inclusive

Inclusive food production integrates all supply chain partners in the delivery of food to the market. Currently, and because of the difficult export/import processes, smallholders are mostly excluded from global food distribution, despite their great contribution to food production. Mainly, smallholders are excluded because of the lack of:

- Good practice and human capacity;
- Acceptable food production standards;
- An understanding of global trade requirements and mechanics.

On the other hand, global buyers have no access to consistent product supplies from smallholders, because of increased:

- Sourcing effort;
- Certification effort;
- Brand risk.

Information technology based on agrifood chain information management can provide a platform for training, keeping track of food safety measures, connecting buyers to sellers and assisting with the mechanisms of global trade. [9]

2. Safe

Food safety is a basic right of citizens and part of the International Covenant on Economic, Social and Cultural Rights. Governments have a mandate to ensure food safety, both for internal consumption and for trade. Nevertheless, food-borne diseases continue to have a major impact on public health and the public economy.

3. Traceable

Food is an essential part of everyone's life, health and beliefs. Consumers must be given the tools to live their lives according to their convictions, religious rules and general lifestyle. Fish-lovers look at aquatic products and wonder is they are really sustainable. Muslims face gelatine-based products, unable to decide whether they are Halal. Consumers with food-related health issues (e.g., gluten intolerance) face difficulties in finding whether products in supermarkets are suitable for them or not. Most of this information is available at some point in the supply chain, but it is lost in product transit, particularly in cross-border activities.

Agrifood chain information management as well as mobile and other modern information technologies can help to ensure that a food product adheres to certain standards, give detailed information to those who want or need it, assist consumers with responsible purchasing and assist government agencies in ensuring higher levels of food safety.[10]

> ***Smarter food*** *is a comprehensive vision of modernising food production by consistent use of information technology in its production, distribution, marketing and consumption. It is the purpose of this guiding document to describe the implementation for an essential cornerstone in this strategy, the underlying infrastructure. For want of a better term, this is referred to as "information management in agrifood chains".*

[9] With 9 billion people to feed in 2050 and little land to expand agricultural production, food will need to be produced and brought to market effectively. Approximately one-third of the food produced for human consumption, amounting to about 1.3 billion metric tons per year, is wasted globally for a variety of reasons (Gustavsson and others, 2011).

[10] For example, by calculating the shelf-life of a food product dynamically and providing alerts to breaks in the cold chain.

Definition of information management in agrifood chains

It is the underlying thesis of this publication that trade in agrifood can only be successfully facilitated if there is a way to electronically exchange information throughout the whole supply chain.[11] This is called information management in agrifood chains.

Information management in agrifood chains

– Refers to the distributed collection, storage and usage of information items, connected by traceability,[12] which can be accessed via electronic systems.

Agrifood chain information management is the use of technology to enable smarter food systems. Agrifood chain information management is similar to the farm-to-fork concept; however, while farm-to-fork systems can be paper-based, agrifood chain information management systems aim at fully paperless information management. Agrifood chain information management is also similar to traceability, but encompasses trade and related processes. For example, it can include information on transactions between trader and bank, or customs declarations. A traceability system does not necessarily capture this data. Many also view traceability as a tool purely for food safety risk management. Agrifood chain information management refers to the distributed collection, storage and usage of information for any type of purpose that helps in making agrifood trade inclusive, safe and accessible.

Similarly, ePermit and national single window systems are components of a full agrifood information management system, as they address only the small part of the full chain that deals with regulatory requirements in cross-border traffic. Animal passports in Europe, Australia and elsewhere are equally examples of components in agrifood chain information management systems, as they cover the whole life cycle of the animal, but not of the food made from it.

The relationships between a produced and a consumed food is rather complex. As a result, the information needs are numerous. Table 2 looks at the main information needs related to the agrifood trade.

Table 2: Main areas of world-wide information needs on traded food

Sanitary and phytosanitary information • Hygiene, food safety and related export procedures • Disease control • Food safety information for recall purposes Food nature and history • Origin (linked to compliance, consumer health and choice, food safety)	Customs and regulatory agencies • Information for efficient trade • Avoidance of illegal activities • Exporter blacklists Statistics • Continuous improvement • Mass balance • Avoidance of illegal activities Sustainability • Calculation of environmental,

[11] This is sometimes referred to as “from farm to fork”.
[12] For a definition of traceability, refer to section A.

• Certification and practices (e.g., Halal, fair trade, labour conditions) • Consumer information, in particular related to correct labelling Control of illegal activities • Import/export bans • Lack of trade permits • (For caught fish). Illegal, unreported and unregulated fishing (also called IUU fishing)	economic and social impact along supply chains Food security • Production prediction models based on history information • Avoidance of waste

C. Functions of information management systems in agrifood chains

While the functions of an agrifood chain information management system can be quite diverse, they can be summarized as (figure 6):

- Regulatory systems (food safety, customs, ePermit and similar systems);
- Standard compliance systems (GAP, GHP, HACCP, organic, sustainable, Halal etc.);
- Systems to increase the marketability of certain food products (sustainability, transparency, regional products, Geographical Indications, animal welfare etc.).

Figure 6: Functional types of agrifood chain information management systems with some examples

A great many actors intervene in the establishment of different components of the overall agrifood chain information management system. These actors typically have very different approaches or viewpoints, and they focus on developing systems related to the functions they are responsible for, with often limited awareness of what the other actors are doing and the possible synergies.

At the border, access to secure information on sanitary and phytosanitary (SPS) certificates is important, and such certificates are increasingly issued through specific electronic SPS systems managed by the relevant line ministry, or through more integrated national trade regulatory single window facilities. Certificates of origin of the agrifood product are also typically required; they are prepared and processed separately, although detailed origin information may be readily available from traceability systems put in place for private standard compliance or for

marketing purposes. Classic electronic traceability systems, such as the electronic cattle management systems run by several European countries (connected to animal passports) (Smith and Lehr, 2011) are another area where electronic food information systems help both internal and external trade.

Retailers following or driving consumer demand are building their reputation on compliance with ethical and other standards. Fair trade, no child labour, sustainable food and organic food standard compliance all require information about internationally-traded materials. Most companies engaging in such trade activities invest a great deal of effort and resources in selecting their trade partners and "handcrafting" supply chains, because there is usually not enough information available publicly or electronically. Making such information more easily available would certainly increase agrifood trade efficiency.

Legal compliance is another area of great concern to Governments, retailers and consumers alike. Illegal, unreported and unregulated fishing (IUU[13]) (Boyle, 2012a and 2012b) is reportedly a multi-billion United States dollar enterprise that severely hurts fish stocks and endangers survival of some of the caught species. European Union regulation 1005/2008, which became effective from 1 January 2010, effectively requires traceability back to the original catch. Blacklists of offending vessels have been established, which require knowledge of all fish dealings including which ship the material was caught on.

Fraud in food is now also on the rise, as seen in case of melamine incidents, the horse-meat scandal and adulteration issues among others. For example, honey – because of its scarce supply – is often subject to adulteration or other forms of fraudulent modification. The horse-meat scandal in Europe[14] is another example of a (non-food, safety-related) fraud. During the scandal, some United Kingdom retailers also recalled beef meatballs because they (potentially) contained pork – very serious matter for Muslim consumers. The sole reliance on certificates, and the lack of immediate availability of information on a specific product or batch of a product in the current systems, make it possible that customs officials, importers and retailers can be tricked into clearing or buying a product that is not what it is claimed to be.

Transparency is a powerful tool for increasing the market's belief in food – be it from a company, a country or even a region. Except perhaps food safety and illegal trade, consumers and their representatives generally understand the need to improve over time – as long as clear commitments are made and information is available in order to judge progress. Some food information management systems therefore attempt to create more transparent foods. The transaction system run by the Roundtable for Sustainable Palm Oil (RSPO[15]) attempts to control the production and use of this ubiquitous food ingredient. Internally, this requires full disclosure of supply chains – not very typical for the food industry.

Regulatory, food safety, marketing and other information management functions in the agrifood chain are usually implemented through a diverse set of systems – which are often, at best, loosely interconnected. While this is discussed in more detailed in the next chapter, an integrated agrifood information management system would comprise the following main elements:

[13] http://ec.europa.eu/fisheries/cfp/illegal_fishing/index_en.htm
[14] http://en.wikipedia.org/wiki/2013_meat_adulteration_scandal
[15] www.rspo.org

- An information backbone for agrifood chains, which transports information between business partners;
- A monitoring system, allowing Governments and private industry to analyse the information they need to ensure compliance;
- Food business operators who contribute to the backbone via their business systems;
- Certifiers (who are sometimes governmental agencies) would also be needed to fulfil the essential role of verifying the information contained in the chain information management system (i.e., ensuring the quality and accuracy of information).

D. Benefits of agrifood chain information management

Agrifood chain information management has many advantages, both for the private and the public sectors.

1. Benefits for the private sector

The private sector can enjoy the following benefits offered by agrifood chain information management (figure 7):

- Compliance with standards and regulations;
- Maintaining current markets and penetrating into new markets;
- Efficiency in business operations and, thus, reduced trade transaction costs.

In the private sector, current initiatives concentrate on compliance with standards and regulations as a prerequisite for market access, marketing and brand assurance, to guarantee market presence and reduce fraud. However, the private sector – either through self- initiative or driven by demand from consumers and their representatives – has also started to focus more seriously on the sustainability of food production.

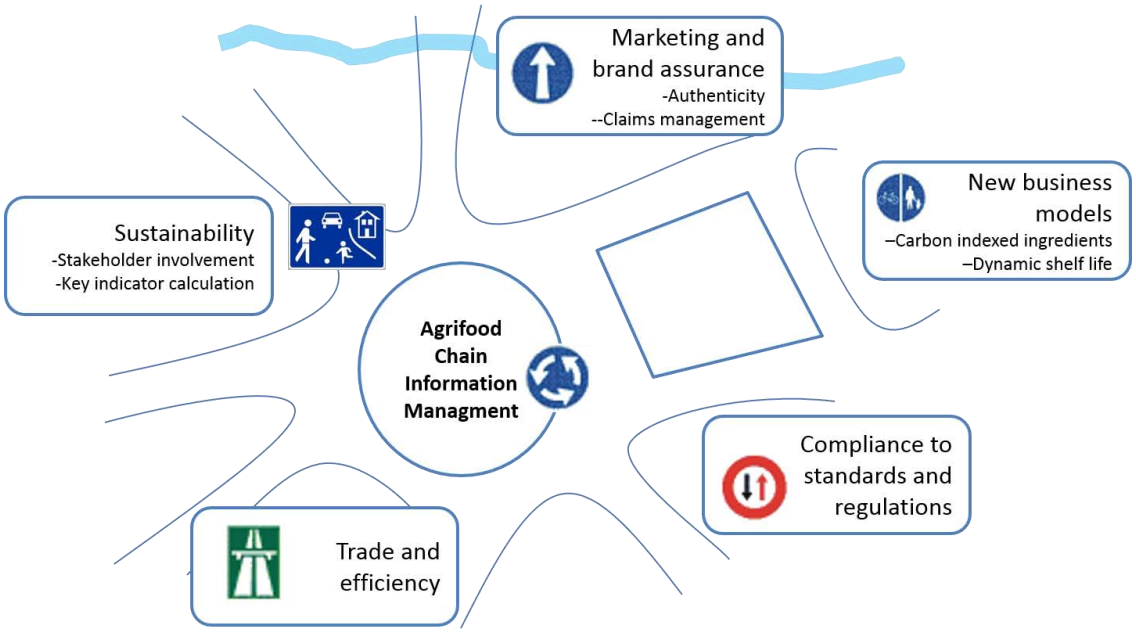
First initiatives attempt to calculate key performance indicators (KPIs), such as greenhouse gas emissions, along the supply chain (e.g., Tesco's direct carbon footprint initiative[16]). With the help of an agrifood chain information infrastructure, such KPIs could be determined continuously, and market differentiation strategies could then be built on top of water usage, GHG emissions, social sustainability etc. It is even feasible that, in the future, products could be sold with a carbon-indexed price (e.g., the lower the carbon footprint, the more expensive the product) similar to low-fat and health products.

Another benefit from better agrifood chain information management is avoiding about 30% food waste (Gustavsson, 2011) through, for example, the dynamic determination of shelf-life, from the time of temperature profile of a specific food item. Dynamically determining the shelf-life in relation to real spoilage would greatly reduce waste, both at home and in the food-producing sector.

Finally, development of agrifood chain information management through appropriate technologies (e.g., mobile technologies) can assist small producers to understand the requirements of agrifood supply chains, thereby putting them in a better position to integrate into national, regional and global agrifood supply chains.

[16] www.tesco.com/climatechange/carbonFootprint.asp.

Figure 7: Benefits of agrifood chain information management for the private sector



2. Benefits for Governments

For the public sector implementing the Smarter Food vision can bring about the following benefits:

- Industry statistics;
- Decreased poverty through smallholder access;
- Reduced food safety problems –
  - Improved public health
  - Less incidences of rejections in exports
  - More effective recalls;
- Assistance in the fulfilment of mandates, such as keeping food safe and its production legal;
- Improved trade security;

The public sector will mainly benefit from the assistance in fulfilling its diverse mandates, such as keeping food safe, its production legal and trade secure. The public sector will also greatly benefit from industry statistics drawn from such systems. Speeding up recalls and being able to hold food business accountable is also a great benefit.

To access the benefits, however, a concerted effort is needed. Both private and public sector need to work with consumers and their representatives to create the right combination of demand, legal framework and efficiency.

The Chapter II therefore discusses in more details four “macro-trends” driving current development in agrifood chain information management before outlining a structure for an integrated system. The appendix to Chapter I includes an implementation checklist, which can assist national stakeholders in assessing their progress towards enhancing information management in agrifood chains.

Chapter I Appendix: Implementation checklist for enhancing agrifood chain information management

The checklist below is an attempt to highlight some of the essential elements that need to be in place for successful implementation of agrifood chain information management systems. The list is not complete and needs to be adapted to each country and each case; however, it might provide a good starting point for addressing essential issues.

Area and subject	Cross-Reference	Achieved
Stakeholder collaboration		
Identify the key public and private sector stakeholders.	Chapter III, Box 3	
Establish a stakeholder dialogue for agrifood chain information management.	Chapter III, Box 3	
Specification of concrete scope		
Assess the needs of the public and private sector stakeholders.	Chapter II, Section B	
Establish the scope of the agrifood chain information management system during stakeholder dialogue. - Define the specific objectives of the system - Identify key indicators.	Chapter II, Section B	
Technical aspects and other enabling technologies		
Implement an Authorised Economic Operator (AEO) system, which allows for the identification of low-risk exporters who can partake in the technological developments required within agrifood chain information management.	Chapter III, Section F	
Develop and implement risk-based inspection and export certification systems.	Chapter III, Section G. Establishment of risk-based inspection system for issuance of licences and certificates	
Develop and implement a national single window system of which the Agrifood Single Window can be a part.	Chapter III, section Development of a Single Window for Agrifood Trade	
Develop a suitable architecture for the agrifood information management systems based on the layer model.	Chapter III, section B	
Governance		
Establish an appropriate legal framework for electronic transactions.	Chapter III, Section I	
Set up a system that allows for regulation of the collection, use, access and acquisition of data. Ensure that private sector actors are informed of the data elements required by them as well as the overall purpose of the regulations.	Chapter II, Section B	
Implementation		
Are there relevant electronic chain traceability systems in the private sector? • **YES:** Can such systems be standardized in such a way that	Chapter II, section 2: Private sector layer 2	

they allow building the private sector layer? • **NO:** Has a suitable system been specified and implemented, possibly with the assistance/guidance of the public sector?		
Choose a suitable entity to operate layer 2 system of the private sector. *(N.B It is important to choose an entity that has established general trust within the sector.)*	Chapter II; Section B	
Starting it up		
Select a suitable commodity to be used as the first case for the agrifood chain information management system.	Chapter III, Section K	
Identify and develop a suitably large pilot project for the agrifood information management system that will allow for early success cases.	Chapter III, Section K	
Smallholders		
Build appropriate systems (using mobile technology or a combination of paper-based and electronic systems) to encourage participation of smallholders.	Chapter II, Section B; Chapter III, Section C and Section J	
Driving adoption		
Conduct an analysis of the value propositions for all stakeholders ensuring that convincing arguments have been established for those stakeholders.	Chapter III, Box 3	
Establish socio-economic business cases for both public and private sector investment.	Chapter III, Box 3	
Standardization		
Develop and implement a harmonized data model based on international standards.	Appendix 1, Section 1.6 Data harmonization	
Establish an identification system that is internationally acceptable and globally unique.	Appendix 1, Section 1.3	
Conduct an assessment of the suitable international standards to be used for data exchange within the country. Choose a standard that is capable of extension to all food products traded in the country.	Appendix 1, Section 1.7	
Adopt and implement international standards for the G2G communication for food safety and quality.	Appendix 1, Section 1.2 Procedural Standards	
International cooperation		
Exchange experiences and best practices with countries who are experienced in agrifood chain information management.	Chapter III, Section K, Action 2	
Engage in bilateral discussions with major importing countries to increase the acceptability of fully electronic trans-border transactions.	Chapter III, Section K, Action 2	
Financial aspects		
Design a suitable long-term funding model that does not rely exclusively on subsidies nor assumes premium prices for standard food products.	Chapter III, Section J	
Conduct an assessment of Public-Private Partnerships (PPPs) for mixed funding from taxes and levies? [17]	Chapter III, Section J	
Identify sources of credit and/or funding for building the initial IT infrastructure for both the public and the private sector.	Chapter III, Section J	

[17] A levy is often a volume-based contribution from the private sector, typically matched by public money from taxes.

Chapter II: Structuring agrifood chain information management

A. Macro-trends in agrifood chain information management

The four "macro-trends" identified and discussed below are expected to drive the development of agrifood chain information management in the coming years.

1. Guaranteeing food safety

In international food trade ensuring food safety[18] will always be a major goal. There is increasing realization that paper-based assurance systems are not adequate for ensuring food safety on a global scale. The United States Food Safety Modernization Act[19] of 4 January 2011 is one of the first Acts to contain an explicit requirement for some form of electronic submission of information in certain cases. Notably, further explanation of precisely what data, under what circumstances and how – which has been delegated to the Food and Drug Administration – is still being studied.

Figure 8: Macro-trend: Food safety

Several efforts have been attempted to create electronic food safety networks world-wide (see figure 8). For example, eSporing, a Norwegian initiative, has built a notable infrastructure based on EPCIS (see Appendix 1, section 1.7. International data exchange standards and their

[18] For a definition see http://umm.edu/health/medical/ency/articles/food-safety.
[19] See, for example, www.gpo.gov/fdsys/pkg/PLAW-111publ353/pdf/PLAW-111publ353.pdf.

penetration for more details). Other efforts, such as the Malaysia Food Information and Traceability project (M-FIT) or the smallholder traceability projects in Viet Nam and Indonesia carried out by specialist traceability provider FoodReg[20] must be seen as proof-of-concept efforts. While the potential benefits – such as (a) decreased risk for public health, (b) decreased brand risk (in case of problems), and (c) decreased public and private costs in the case of a recall – are substantial, this area has not received the industry buy-in that it warrants.

Consumers quite understandably do not want to pay more for food safety. They assume that any food that can be purchased is safe and that all actors in the food chain have their methods and controls to guarantee that safety. In addition, food scandals rarely have long-lasting effects other than to increase general mistrust in the food industry. Moreover, the economic impact of such food scandals is very difficult to measure; hence, the market does not provide the right incentives for an increased effort in this area.

Nevertheless, food-borne diseases are more common than one might think. In 2012 in the United States there were about 48 million cases affecting about 15% of the population, as reported by the Centers for Disease Control and Prevention.[21] The economic impact is estimated at US$ 77.7 billion (Scharff, 2012), which is hardly a negligible figure. The World Health Organization estimated[22] that in 1998, about 1.8 million children died in developing countries from diarrhoeal diseases caused by microbiological agents, mostly originating from food and water.

This does not yet translate into paperless food safety-oriented, trade facilitation systems. Partly due to the general issues of governance, smallholder integration and standardization, little progress has so far been made in this direction. Norway's eSporing system[23] is one of the most advanced, but it struggles with industry buy-in. The Indian GrapeNet[24] run by APEDA (Agricultural and Processed Food Products Export Authority) – mandatory for all grape exports from India – is, with about 15,000 farmers, probably the largest system world-wide; however, it is not based on any international standards and therefore unlikely to be easily expandable to other commodities or other countries. In the United States, it remains to be seen what the Food and Drug Administration is going to request in the area of electronic traceability information; this might have a major impact on the development of food safety-oriented agrifood chain information management systems.

There is very little doubt that more and more electronic data will be required to ensure food safety, in particular across borders, i.e., in international trade. However, experience also shows that any initiative in this area will have to be driven by the public authority. Regulations and laws, together with subsidies for smallholders, will be a likelier route of adoption than voluntary adherence.

2. Increasing sustainability

Consumers in high-value markets, such as Europe, the United States and Japan, are increasingly interested in environmental and social sustainability. Large manufacturers such as Unilever

[20] www.foodreg.com.
[21] www.cdc.gov/features/dsfoodnet2012/
[22] www.who.int/foodsafety/micro/general/en/
[23] See,for example, www.tracefood.org/images/presentations/eSporing.pdf
[24] www.apeda.gov.in/apedawebsite/Archive/GrapeNet/

base their marketing on sustainability[25] while leading retailers in the British Retail Consortium launched their Better Retailing Climate initiative in 2008.[26] Sustainability of aquatic resources is a major concern for consumers in Europe. The European Union-funded project WhiteFishMaLL[27] has shown that sustainability is a major part of the purchasing decisions of United Kingdom consumers. While the European Union has not yet implemented any legislation on food, the renewable energy directive 2009/28/EC for bio-fuels fixes maximum greenhouse gas emission limits; similar regulations for foodstuffs are certainly feasible, particularly in relation to the controversial vegetable oils made from soy and oil palms.

Figure 9: Macro-trend – sustainability

A series of companies, associations and countries have made time-bound pledges for the increase of environmental and/or social sustainability. Most of these pledges require knowledge about the supply chain and/or the history of the product. Manufacturers of vegetable oil-based products using controversial ingredients (e.g., palm oil) are now putting palm oil traceability reporting into place. This will help them to monitor progress towards 100% traceable and sustainable sourcing of such ingredients.

The "downside" of this generally positive development is that producers who are not able to deliver evidence may be excluded from trade with key trade partners. (A study looking at the compatibility of the renewable energy directive with WTO rules found it generally wanting (Lendle and Schaus, 2010). It is therefore more than desirable that countries producing environmentally or socially "complicated" foodstuffs – for example, rice, fish (farmed or

[25] www.unilever.com/sustainable-living/
[26] www.brc.org.uk/brc_policy_content.asp?iCat=43&iSubCat=673&spolicy=Environment&sSubPolicy=A+Better+Retailing+Climate.
[27] www.whitefishmall.com/.

caught), palm- or soy-based products, coffee, cocoa and bananas – prepare for information requests/needs in order to avoid being excluded from trade in the future.

However, calculating sustainability indicators such as food miles, carbon footprint and water footprint requires doing so along the supply chain. Depending on the material, this can be technically very complex, e.g., in the case of bulk materials and continuous production processes. In the case of processed foods in particular, calculating some of these parameters requires careful consideration.

Also, communication with consumers has yet to be solved. While in some countries food miles (the distance a food item has travelled to the consumer) are taken into consideration and premiums paid, in general this is a niche market. Finding the right way to communicate sustainability to consumers for mainstream products is the key to unlocking the market differentiation potential (and perhaps even the premiums) that will finance an agrifood chain information management system in this area.

3. Ensuring food quality

Food quality is a combination of a product's characteristics valued by the consumer. It is subjective and can mean different things to different people. Quality may include nutritional facts, sensory properties (taste and smell), appearance (colour, firmness and texture), social considerations, convenience, species differentiation, product differentiation and qualities due to geographical origin (figure 10), which are all in addition to food safety parameters.

Figure 10: Macro-trend: Food quality

Since the 1980s, there has been growing consumer demand for food and other agricultural products that possess specific characteristics linked to quality parameters such as composition,

origin, production method or terms of trade. This has led to the emergence of numerous voluntary standards, brands, labels and regulations associated with such products, all of which have an impact on domestic and international markets. The rapid expansion of the use of voluntary standards in international trade is often linked to the effects of globalization, whereby the increased control of supermarkets over global value chains is coupled with consumer requirements and interests in social and environmental sustainability. While the market for certified products still accounts for only a small fraction of international trade in agrifood products (estimated at no more than 10%), these certified value chains are increasingly relying upon smallholder agriculture in developing countries.

One specific case of Voluntary Standard is when agricultural and food products are distinguished from others by certain characteristics, qualities or reputations resulting essentially from their geographical origin. This differentiation can be attributed to the unique local features of the product, its history or its distinctive character linked to natural or human factors such as soil, climate, local know-how and traditions. Generally, these characteristics are already recognized to some extent by consumers at the local, national or even international level. Asian countries all demonstrate a food culture that has been elaborated over time with agriculture and food systems, and the concept of food quality linked to its origin is natural to most Asian consumers. Such products include Basmati Rice (India), Thung Kula Rong-Hai Hom Mali Rice (Thailand), Kampot Pepper (Cambodia) and Darjeeling Tea (India)

Products with such certifications have higher value and brand equity because they relate to specific demands of quality-conscious consumers, or those with specific requirements, and therefore generally command higher prices. However, to be certain their special characteristics are either due to their origin or their processing – but which are not visible when examining such products – certification is important. This is where traceability accompanied by information flow across the value chain plays an important role. This also requires investing in certifications, establishing control mechanisms (both internal at producer level and external through third party certifications) and maintenance of records to demonstrate the quality claimed as well as aspects of marketing.

Food quality can be measured according to adherence to quality standards and managed under national intellectual property laws. E-certificates would be of benefit to this sector due to the importance of maintaining data and information throughout the food chain up to the customer.

4. Efficient trade

Efficient trade is at the heart of any trade facilitation process (figure 11). Gross differences still exist between countries, particularly in North-North and South-South trade (Arvis and others, 2012). Efficient trade is a major global concern and most economies are affected by inefficiencies in trade. Therefore a paperless system that assists in making the trade easier and quicker (or in increasing the Logistics Performance Index (Arvis and others, 2010) is highly desirable.

Figure 11: Macro-trend: Trade

Such systems not only include national or regional single window systems, but also ePermit systems for certificates that are required for trade (such as a sanitary or phytosanitary certificate). These systems should be integrated with other systems that hold data relevant to the trade process. For example, eCustoms systems having access to food safety and certification information will enable not only better but also faster controls. Faster and efficient movements and trade processes will reduce wastage and put fresher fruit on the table. Similar arguments apply to disease-related systems such as livestock disease management systems or food safety systems, where knowledge about the disease or contamination status is a highly relevant input in risk managing the cross-border traffic.

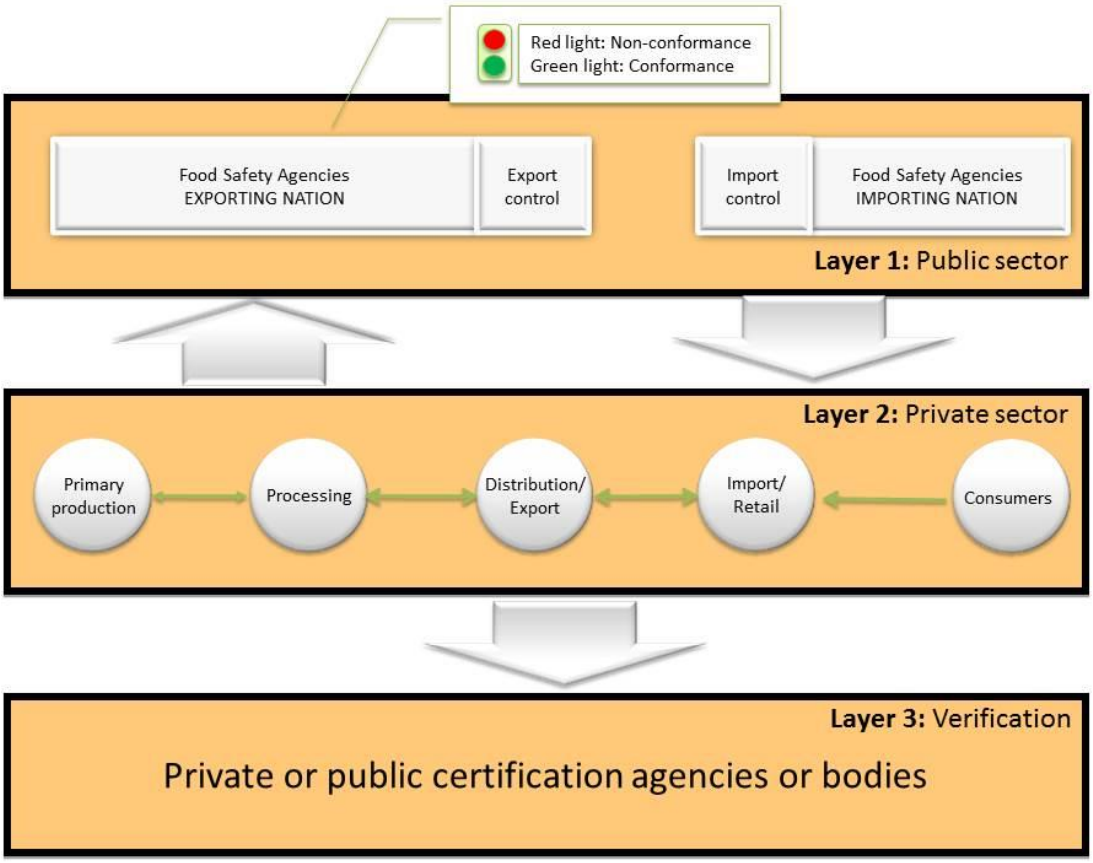
However, inter-operability between government departments responsible for agricultural produce (often the ministries of agriculture), processed foods (often ministries of health) and customs (often ministries of trade) is typically difficult. The lack of widespread international standards on data exchange and identification (to access data) further complicates the implementation. In addition, such agencies are often excluded from standard trade facilitation reforms, and lack human capacity and training.

B. Structuring agrifood chain information management

An essential question that needs to be resolved is the governance of agrifood chain information management systems. Strong privacy concerns and the highly confidential character of the information kept in such systems require a structure with very clear boundaries.

To this end, a layer model (figure 12) is detailed below (see also Asian Development Bank, 2009). The layered model represents a clear separation between private data and data required for fulfilment of the public mandate. It was designed not only to address the governance problem, but also to allow verification of data kept in the agrifood chain information management system – which greatly increases its value. It was also designed to allow easy government-to-government communication, especially for trade processes; in fact, it is suggested that the public sector layer is implemented as part of a national single window effort (see below). While all countries are different and any system architecture needs to be put into local context, it is strongly advised that this model be closely considered when designing an agrifood chain information management system.

Figure 12: Recommended structure of the agrifood chain information management system



1. Regulatory layer (layer 1)

This layer comprises the activities of government agencies such as ministries of agriculture, trade and transport as well as customs authorities that regulate the agricultural export and import trade. These agencies typically use their own, in-house information systems to perform the tasks mandated to them by their Governments. Typically, the in-house information systems of these agencies are not networked. Nevertheless, there is a high demand for information exchange between the agencies, e.g., for checking of licences and permits issued by other agencies or the collection of revenue and statistical data.

There are two particularities at the information exchange in the Government layer:

- Most of the information on which the government agencies base their decisions (such as the types of goods, names and addresses of parties involved, and the locations and dates of transactions) is provided by the private sector companies in layer 2.
- For information exchange, the government agencies will mainly use paper documents, conveyed by private sector participants (exporters, freight forwarders, customs agents) from one government agency to the other. For example, a ministry of agriculture will issue an export certificate to the trader, who will then present it to customs authorities when exporting the produce. Thus, government agencies today use the private sector companies in layer 2 as "postmen" for their internal data exchange.

As the private sector is not considered a trusted party, the government agencies spend a significant amount of time on validating and checking documents and information that have already been checked by other government agencies. There is a continuous need to re-enter data into the different systems and to perform plausibility checks. In addition, the use of private sector participants for data exchanges between the agencies prevents coordination of government agency interventions leading to inefficient procedures.

Therefore an important objective for layer 1 is to implement efficient electronic information exchanges between government agencies. This requires not only the development of the software systems for data interchanges but also changes in (a) laws and administrative instructions to transit from paper-based procedures to electronic information management, and (b) management to enable the adoption of new work procedures in government agencies.

As described above, government agencies depend on the quality and trustworthiness of information provided by the private sector for making their decisions. If electronic data exchange is implemented in layer 1, government agencies need to receive their information from layer 2 in electronic format. Experience in many countries has shown that companies will only be ready to engage in electronic data exchange with government agencies if (a) this does not create additional costs for them, (b) no penalties are levied as a result of their openness and transparency, and (c) information is treated confidentially. To reduce costs for the private sector, government agencies should provide a common, national exchange standard for all electronic data exchanges from and to the private sector business-to-government (B2G) and government-to-business (G2B). This will greatly reduce costs for the private sector and facilitate the transition from paper to paperless trade. Governments also need to ensure that any information generated is treated confidentially.

The governance policy to foster information exchanges between should be implemented following a national vision and in the form of national single windows (ESCAP and UNECE, 2012a) for agriculture. Chapter III provides recommendations to governments for an Agrifood Single Window and suggests a list of specific activities that lead to implementation.

Governments also need to address the issue of intermediaries or agents, as that is where data and transparency generally gets lost.

Government agencies can play an important role in establishing the inter-operability of private sector systems in layer 2. By providing a mandatory standard for all data exchanges between layers 1 and 2, Governments also provide lead standards for data exchanges between companies in layer 2; the G2G and B2G standard imposed by a Government serves as a crystallization point for business-to-business (B2B) data exchanges. To promote the use of

government standards in B2B data exchanges, government agencies should work with innovative private sector companies to push forward the adoption of the lead standard.

A Government can also fund the creation of "repositories" or cloud-based systems that provide easy access for food businesses to standard-compliant chain information management systems. Governments should also create joint funding programmes with the industry to incorporate smallholders into the chain effort.

Government agencies should also participate actively in resolving issues around globally unique identification by working with existing identity providers towards the vision of easily accessible identities for all.

Governments can also play a role in the process of finding the right governance structure for privately-run supply chain information management systems by providing (a) independent assessment criteria for governance including data security, (b) specific legislation regarding data access and (c) independent audits of providers of such services (where this does not conflict with the governance policy).

Finally, Governments should play a role in training the agrifood industry in the value of transparency in supply chains, in particular to address the low trust of consumers in supermarkets and food manufacturers.[28] This low trust level is the source of large economic losses through continuous increases of consumer demands for regulation and identification of alternative food sources and, therefore, is not in the best interest of the food industry.

2. Private sector layer (layer 2)

This layer includes the activities of private sector companies (producers, warehouse operators, exporters, importers, intermediaries, banks and other businesses) that manage the commercial aspects of trade transactions. Companies will use their own in-house systems for information management. They often participate in privately-organized information exchanges and management systems such as cargo tracking and tracing systems, or transport schedule systems where a data exchange is based on agreements between the parties.

In the agriculture trade it is unlikely that one single system can cover all the functions required by the parties. Instead, a number of independent systems exist, each focusing on a specific area of the supply chain. For efficient supply chain management, these systems should be able to exchange information in electronic format, the same way as government agencies in layer 1 exchange information. Due to the competition among companies in an open economy and the lack of a leading agriculture eBusiness standard (see chapter IV) there is currently very little inter-operability between these systems.

3. Verification layer (layer 3)

This layer addresses the fundamental need for the verification of data stored in layers 1 and 2. Verification agencies can be governmental, but often are third-party assessors, such as certification agencies. Their participation in the information management structure greatly increases its robustness. In simple cases, the agencies of layer 3 would simply allow the independent electronic validation of any claim based on the subject of their governance, such as private certifiers making available electronically a validity check for their certificates. In more

[28] www.foodnavigator.com/Financial-Industry/Consumer-trust-in-food-industry-fares-badly-in-EU-survey.

complex cases, the verification layer would confirm essential information elements from layer 2 (private sector), so that layer 1 (public sector) can be reassured that information acquired from layer 2 is accurate.

Chapter III: Practical recommendations for enhancing information management for agrifood trade facilitation

A. Development of a Single Window for Agrifood Trade

As part of a holistic national trade facilitation policy and action programme, Governments may initiate development of a Single Window for Agrifood Trade (SWAT) as an inter-organization information system aimed specifically at increasing the security and efficiency of agrifood cross-border trade through collaboration, electronic information exchange and efficient regulation.

If a national single window already exists in a country, SWAT may be developed as a sub-component of the single window or as an independent system that interfaces with a national single window (see box 2). Developing SWAT as a sub-component of a national single window or as an independent interfacing component would depend on institutional factors as well as the scope and functions of both the national single window under development and that of SWAT. Regardless, the development of SWAT should be based on the same data and other technical and legal standards than on the national single window to ensure full inter-operability. Regardless, the paperless platform would be a major enabler for the vision of inclusive, safe and traceable food outlined in chapter I (section B) and a key component of the overall information management structure for agrifood chains described in chapter II (section B).

As the layer 1 platform, SWAT drives adoption of private sector systems (layer 2) on which the operation and benefits of the overall system depends. Its scope and design should therefore be grounded in a national agrifood supply chain facilitation strategy focused on creating trust and collaboration between parties by enhancing access and management of information along the supply chain, implementing risk-based food control systems, and simplifying and standardizing business processes.

Layer 2 (businesses), as described in the agrifood chain information management structure, will use SWAT for one-time submissions of information, paperless licences and permits, and other communications with public authorities. Layer 1 (public authorities) will use SWAT for coordinating controls between national agencies in the country through automated risk assessment systems for risk-based controls. Layer 1 will also use e SWAT for trade and trade facilitation, including the promotion of national products associated with certain demonstrable qualities.[29] Ideally, SWAT is a simple component in a national single window, so that a one-time submission of information is guaranteed, even across product categories.

[29] For example, In the case of GrapeNet (chapter IV, section A), the export authority APEDA uses the layer 1 system to ensure compliance with import requirements. By certifying the quality of exported material and guaranteeing that such material reaching the European Union is of excellent quality, it also promotes Indian grapes among European importers, thereby increasing market access.

Box 2: Rationale for a dedicated Single Window for Agrifood Trade

In advanced economies, the public and private sector stakeholders use many different collaborative platforms to manage and regulate cross-border trade; such platforms are, and sometimes are referred to as inter-organization information systems (IOS). An IOS is a system for collaboration between independent stakeholders in international trade. It includes all aspects of the collaboration such as objectives, legal frameworks, business models, services rendered, and ICT infrastructure and data exchange. Examples of IOS systems are customs and port community systems, or the track and tracing systems of freight forwarders and express carriers. Today, trade between and with developed countries is fully reliant on these IOS systems.

Specific IOS systems are now evolving that have been developed especially for agriculture supply chains, such as automated risk-assessment systems for agriculture trade or the European Union's Trade Control and Expert System (TRACES). In the context of diversification and specialization of IOS systems for cross-border trade it may be a rational strategy for a country to plan and develop a dedicated IOS for advanced management of its agrifood exports and imports. Such a system will interact with other single window and IOS systems, both domestically country and across borders; inter-operability should therefore be given high priority.

In a simple economic scenario the simplification and automation of agriculture trade can be managed with a single window implementation process. In particular, in the early phases of single window development many countries have automated agriculture licences and certificates as part of their national single window project. However, there are a number of specific parameters that affect management and facilitation of trade in agriculture produce as compared to "ordinary" trade:

- In many countries, agriculture supply chains are highly complex;
- Agriculture trade, and particularly trade in perishable produce, is becoming increasingly sophisticated and involves the latest technologies and managerial concepts in order to leverage market and business opportunities;
- Agriculture trade is highly dependent on external factors such as weather patterns, diseases, energy prices, availability of natural resources, changes of consumer preferences and regulatory requirements. It requires innovative approaches to mitigate these risks and provide sustainable development for the national economy;
- Small stakeholders, rural communities, and small and medium-sized enterprises (SMEs) are an important part of agricultural production and trade, particularly in developing and least developed countries.
- Agriculture supply chains are end-to-end supply chains. While a national single window only focuses on the administrative documents at the border, SWAT needs to take into account the regulatory and business requirements of its foreign trading partners from the beginning.

Taking into account the development opportunities of agriculture, trading countries might choose to develop dedicated inter-organization information platforms or single window projects for the simplification and automation of their agrifood supply chains.

Box 3: Public and private sector stakeholders and their role in the implementation process

The establishment of a SWAT is a major challenge due to complex agrifood chains and the large spectrum of possible scopes for such systems. In such complex environments buy-in from stakeholders is essential.

The primary stakeholders relevant for a dialogue are:

- Supply chain players and trade partners (including producers, logistics service providers, retailers and others);
- Government institutions;
- Consumers;
- Standard management organizations;
- Certification and accreditation bodies.

However, within the private sector, influence is not distributed equally. In agrifood chains, the main power lies typically within distribution and retail. However, without buy-in from upstream, particularly from smallholders, the establishment of agrifood chain information management systems is very difficult. Typically, earlier stages of production have a shorter investment horizon, i.e., seeking a shorter payback time when making investments. In discussions about implementation of chain information management systems, the business case therefore needs to be very specific and to show a clear return of investment in a relatively short period.

In international trade, public administrations hold a key position and the relationship between trade partners is crucial. In many countries, interdepartmental collaboration is required, e.g. between the Ministry of Agriculture for agricultural goods, the Ministry of Health for processed foods and Ministry of Commerce/Trade for exports. However, this has proven to be challenging at times. The establishment of a single authority, e.g., for food safety, has helped in some countries; however, given the diverse nature of scopes (see, for example, the "macro-trends" discussed in Chapter II), it is unlikely that a single entity can deal with topics as diverse as food safety, increasing sustainability and efficient trade. Increasing the collaboration between different responsible public authorities therefore remains essential to the success of agrifood chain information management systems.

The case study of the establishment of an agrifood chain information management system in Malaysia (chapter IV) shows that, despite excellent collaboration between 14 public authority entities related to food safety, the project did not get past its pilot stage. There were various reasons for this failure, but the following were likely to have been decisive reasons:

- A lack of continued government funding for larger-scale implementation;
- A lack of buy-in from the private sector (missing business case);
- A lack of laws and regulations requiring data for food safety purposes

The main lesson here is that successful implementation of information management in agrifood chains needs motivation for food businesses (see Chapter I: Introducing information management in agrifood chains), a sound legal basis (see chapter III), a correct structure (see chapter II) and sufficient seed funding (see chapter III).

Implementation of SWAT should generally be based on:

(a) A national vision and master plan for the improvement of agrifood supply chains, developed in collaboration with national and international stakeholders involved in the agrifood supply chain;

(b) Analysis of business processes, documents and information flows of the national agrifood supply chains, and their simplification and automation in a stepwise process, as described in the previous UNNExT guides for single window implementation.

(c) Application of international standards whenever possible (see appendix 1)

(d) Use of electronic data and information along the supply chain wherever possible, with electronic information submitted only once and then reused.

Several milestones and practical recommendations are proposed below as a path to implementing SWAT as the recommended model for a layer 1 system (see chapter II) and to facilitate the establishment of layer 2 and layer 3 systems.

B. Establishment of a roundtable for agrifood chain information management

The establishment of a national roundtable for agrifood chain information management is recommended. In the case of establishing information management systems in agrifood chains, stakeholder buy-in is an essential element. Stakeholder interactions are discussed above. The main responsibility of the roundtable, however, would be to develop a national vision for information exchange on agrifood production. Such a national vision should be supplemented by a master plan for its implementation.

Participation of the private sector should be made a priority. The roundtable needs to be embedded in the establishment of national trade facilitation committees (Asian Development Bank, 2009) as a working group. Relationships with the relevant institutions established according to WTO Sanitary and Phytosanitary Agreements (SPS), Technical Barriers to Trade Agreements (TBT) and Trade Facilitation Agreements need to be considered.

Part of the responsibilities of the roundtable would be to generate a change of attitude towards increased transparency in food production, i.e., “open-source food”, similar to open source software. While this will be a major paradigm change for the food industry, the exceptionally low levels of trust in the food chain warrant such a change.

C. Identification of missing paperless systems for agrifood trade and their implementation

Electronic or paperless transmission of information has important and advantageous consequences for agrifood trade. Electronic information transmission is an essential enabler in making food inclusive, safe and traceable. Efficient information management in agrifood chains is not possible based on paper documents.

It is therefore reasonable to prioritise the adoption of paperless systems for agrifood trade. Adoption of agrifood chain information management systems should be made a priority and incentives provided for early adopters – be it public or private entities.

For the private sector, in particular, incentives can include the reduction of fees when submitting information electronically, reduction of tariffs in international trade plus loans or subsidies for the adoption of electronic systems.

For the public sector, the volume of electronic versus paper-based information should be made a key performance indicator of the respective agency. Time-bound commitments should be made by all relevant agencies in the agrifood chain for total elimination of paper records and in accordance with the national vision.

During a transitory period, particularly in the case of smallholders, the submission of paper information might be necessary to avoid social/business exclusion; however, such activities can be pushed back to service organizations working in the field of collecting information on behalf of operators that have no electronic capability. The fees collected for such a service should

initially be limited to avoid abuse and should be linked to the estimated time gain derived from the submission of electronic information.

As a practical first step towards this milestone, a gap analysis needs to be carried out with a focus on food stuffs that are strategic to the national economy and have particular trade issues. High-value food items should be preferred as the payback usually increases with the value of the item under consideration.

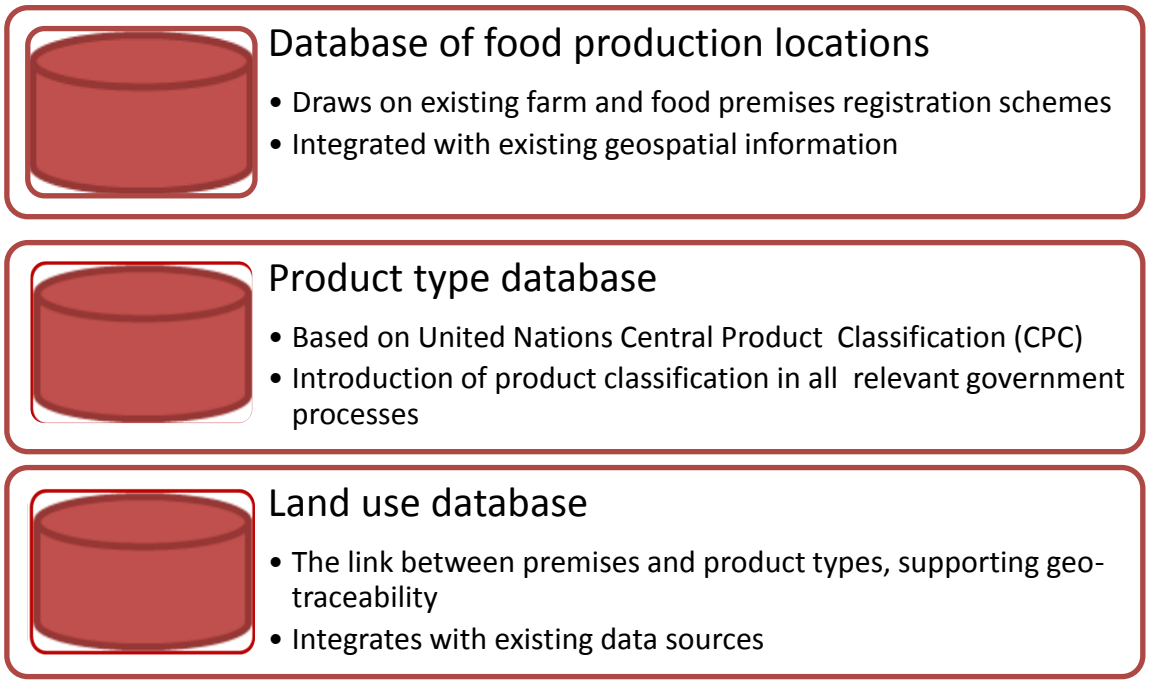
D. Establishment of normative databases for locations, products and land use

In order to facilitate the processes in SWAT, it is important that a normative single source of information is available to all relevant government agencies on:

- Food production locations with GPS coordinates;
- Product type classifications;
- Land use that interlinks product types with production locations.

The result is geo-traceability, which is of overall importance in disease and disaster control, and is very important for maintaining market access (and part of both the "safe" and the "accessible" properties of the Smarter Food vision).

Figure 13: Normative databases needed for effective disease and food safety control



Being able to resolve geo-traceability is important for zoning and other tools that the World Organisation for Animal Health (OIE) has designed for countries to deal with animal diseases, which are one of the main sources of food safety issues in international trade, either directly or indirectly (e.g., residues of treatments).

The normative databases also streamline governmental operations where businesses have to register with several institutions and Governments maintain several unconnected registers of businesses.

E. Establishment of a standard framework for identification and information exchange

As already discussed in some detail in chapter I, globally unique identification is essential for successful agrifood chain information management. Therefore, an important milestone in its implementation will be the adoption of a globally unique numbering system for identifying:

- Product types;
- Batches;
- Trade units;
- Logistic units;
- Business partners;
- Business locations.

If several ISO15459 registered identification schemes are adopted, inter-operability between the schemes must be addressed. For example, if a decision is made to accept identification by GS1 and any other identification scheme, it needs to be determined how the two systems can co-exist. Information systems need to be able to deal with both systems and establish links independently, regardless of which system is used.

It is also important to remember that for smallholder adoption, in particular, identification needs to be easily accessible both in terms of sign-up as well as recurring fees.

In addition, Governments should play a facilitating role in establishing a framework that:

- Uniquely names all relevant parameters for a food product;
- Defines a set of exchange protocols on how to exchange data;
- Allows interconnectivity with variety of information systems;
- Implements effective safeguards against unauthorized governmental data access;
- Maximizes efficiencies with other information needs (B2B, Certifiers, business-to-consumers etc.)

F. Establishment of authorized economic operators

As a practical first step in the facilitation of agrifood trade, it is essential to create a register of authorized economic operators.

The authorised economic operator (AEO) concept is one of the main building blocks within the World Customs Organization SAFE Framework of Standards (SAFE) (WCO, 2012). The latter is part of the future international customs model set up to support secure trade. SAFE sets out a range of standards to guide international customs administrations towards a harmonized approach based on customs-to-customs cooperation and customs-to-business partnership.

Authorized economic operators (AEOs) are those exporters that have proven to be highly qualified and reliable entities with a low risk profile. It is a reasonable strategy to implement single window operations with AEOs before extending it to all operators.

G. Establishment of risk-based inspection system for issuance of licences and certificates

An essential milestone in practical information management of agrifood chains is the establishment of risk-based inspection systems for licences and certificates, i.e., risk-based trade authorization systems (FAO, 2008).

Risk-based trade authorization is:

- Management by priorities;
- Optimization of scarce resources in the avoidance of food-borne illnesses;
- The consequent application of Hazard Analysis and Critical Control Points (HACCP) to trade processes.

The purposes are to:

- Provide adequate evaluation of food-borne risks;
- Detect and categorize risk factors;
- Measure/estimate risk for society.

Risk-based trade authorization recognizes the different risks that different foods, origins and processes represent, and matches them with differentiated attention such as inspections. The gravity of risk and its impact on society are key issues, but product history and production process are also taken into account in order to apply adequate inspection intervals and methods. The main aim is not to provide a full coverage of existing food safety issues, but to prevent future issues.

Risk-based trade authorization systems are a key component in the establishment of information management of agrifood chains, because they rely on chain information on the one hand, while also providing an immediate return to both the public and the private sector, because they put the effort where the risk is.

Data and system ownership is a key element

One of the main causes of failed adoption of information management systems is the absence of clear and legally enforceable rules for data and system ownership. It is natural to say that it might be the same for the Single Window for Agrifood Trade. This creates reservations on all levels of food businesses from SME to global scale. Clear and enforceable rules will also help operators of layer 2 systems that enjoy trust by stakeholders.

Governments are advised to monitor government agencies to ensure that they strictly comply with such laws and regulations in order to avoid an unrecoverable breach in trust. In particular, it should be carefully considered whether law enforcement and tax authorities are allowed to use the data stored in layer 2 systems. While tax avoidance practices clearly skew competition unfavourably against entities operating fully in accordance with the law, the goal of building trust in the agrifood community should prevail in any introductory period.

Governments should also play a facilitating role in identifying suitable entities for operating layer 2 systems. Such entities must be guaranteed as being independent of the government and serving layer 2 stakeholder interests only. What kind of entities warrant the trust of layer 2 stakeholders is country-specific, but potential candidates may be industry associations, multi-stakeholder associations, universities and purposefully set up entities.

H. Establishment of a food safety emergency system

This is important in relation to food safety incidents and emergencies that will require information to be processed not only for information to buyers, Governments and other stakeholders, but also for immediately processing global recalls. Hence in order to facilitation the exchange of relevant information and facilitate the operation of entry and exit points, it is important to establish linkages between the agrifood chain information management system and Rapid Alert Systems where they exist, such as the RASFF (Rapid Alert System for Feed and Food) of the European Union or ARASFF in the Association of Southeast Asian Nations (ASEAN).

I. Addressing legal implications of information management systems for agrifood chains

Both layers 1 and 2 (chapter II) have separate legal implications and require a firm legal framework to function properly. SWAT (layer 1) requires clear regulation on what data are required from food business operators. The capture of data elements needs to be motivated by the scope of SWAT implementation, and in particular by the national vision and the master plan. Government agencies must refrain from attempting to capture more data than absolutely necessary.

The regulatory framework may decide to employ internationally accepted categories such as **must, shall** and **may** to distinguish required data from voluntary data. In general, it is good practice to refrain from capturing any data that are not absolutely necessary.

Provisions should be made in the regulatory framework for data to be delivered via a trusted third party in order to remove any barrier to implementation of the regulation. More guidelines on establishing a legal framework for paperless trade systems are available in the UNNExT Legal Guide for Electronic Single Window and Paperless Trade at http://unnext.unescap.org/tools/default.asp.

In order to facilitate collaboration between layer 2 systems and SWAT, it is recommended that relevant laws on data ownership and confidentiality already exist and that a governance policy is put into place and is regularly assessed by an external party.

J. Funding development of core components

Governments should fund core components that improve internal efficiencies and prove the viability of the agrifood chain information management system. This will include SWAT and those components/projects necessary to convince the industry of the advantages of establishing layer 2 systems.

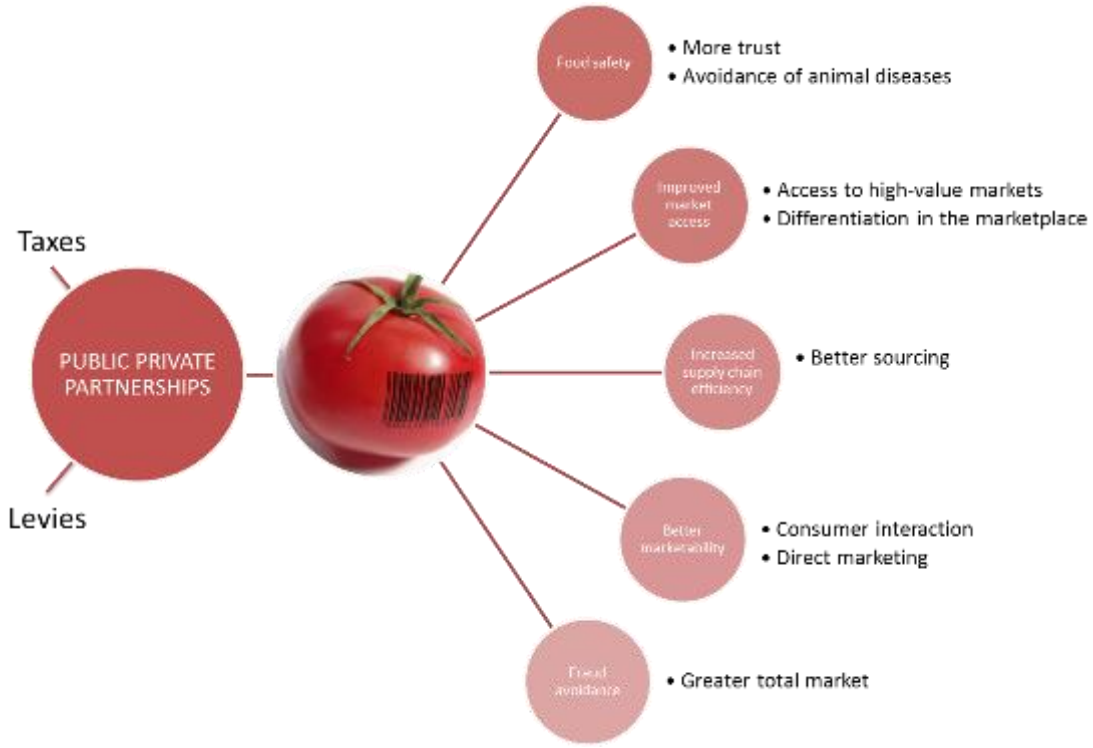
Governments may provide financial support for the adoption, including the development of national infrastructure as well as the promotion and use of the agrifood chain information management system used by food business operators; however, most of the cost should be borne by private industry.

However, Governments should recognise the fact that smallholders and other smaller-sized actors in the food chain are naturally less ready to adopt electronic systems. Therefore, Governments should help them with the introduction of electronic systems by (a) providing the necessary tools, (b) facilitating the creation of independent data collectors and (c) direct incentives for adoption. In particular, mobile technologies will be a key to gathering data from smallholders, as can already be seen in many developing countries.

It is advisable for a multi-year financial plan to have already been developed for the adoption of the national vision and that relevant agencies seek buy-in from relevant decision makers on budgetary questions. Investment in agrifood chain information management is long term in nature. Time and time again, efforts to establish such systems have been made in vain because no follow-up funding was available. This will be even more crucial for agrifood chain

information management, given the support needed for engaging small producers and other actors.

Figure 14: Taxes and levies as funding sources of public-private partnerships



For the longer term, funding will have to come from a diverse range of sources. It is tempting to assume that internal efficiencies alone will fund the operation of the agrifood chain trade facilitation system. The Hermes project report (SITPRO, 2009) estimated the cost savings in the United Kingdom at approximately 7% of the GDP contribution by the perishable sector. While in the United Kingdom alone this represents US$ 4.5 billion, the direct savings by the private and public sectors are, of course, much lower.

Public-private partnerships funded by taxes and levies are much more likely to be a sustainable operational model for agrifood chain information management systems (figure 14). Taxes here are meant to be contributions by all citizens, whereas as levies are meant to be specific contributions by companies into an industry fund.

The use of taxes appears to be justified, because consumers will receive fresher, safer and better-priced food through the Smarter Food attributes of accessible, safe and inclusive. Consumers with specific needs (e.g., Halal or gluten-free food) or consumers with specific preferences will be assured that such requirements can be satisfied. Fraud avoidance will guard consumers from illegal, unreported and unregulated foods such as fish, honey, alcohol and a whole series of other fraud-affected foods. More efficient trade will also benefit society as a whole, as it will create employment and entrepreneurial opportunities.

The use of levies appears justified because, as a result of operating SWAT, companies will improve their market access and market permanence – particularly in high-value markets – as well as streamline their interaction with public authorities, simplify trade and increase supply chain efficiency. Avoidance of fraud will also increase the overall legal market and provide opportunities for players operating with full legality. In addition, layer 2 systems will provide with better sourcing opportunities through the accessible and inclusive properties of the Smart Food vision. Such systems should also provide the industry with better and more direct access to the final consumer.

K. Kick-starting SWAT through four priority actions

The above milestones are essential to achieving a full implementation of a SWAT. However, an endeavour of this complexity requires some quick action and "early wins" to provide momentum and support for long-term development. In that way, the SWAT project can establish its value to the public and private sectors and secure its positioning with policymakers.

The following four actions may ensure these early successes. However, the selection of actions will depend on the country of implementation.

Action 1: Implement electronic agrifood licence/permit/certificate and audit system

As a first step towards SWAT, electronic systems should be implemented that allow issuance of agrifood licences, permits and certificates. Major savings can be made in cross-border trade if such systems are put into place (ESCAP and UNECE, 2012a). Such systems need to allow for machine-to-machine interfaces as a preparation for the integration of layer 1 and layer 2 systems. Providing simple and user-friendly interfaces will also help to increase the goodwill of private industry. The guidelines, principles and examples in various UNNExT Guides can be extremely useful for implementing such systems.

Mobile technology should always be considered when developing a licence/permit/certificate system. Key performance indicators should be established for turnaround times of licence/permit/certificate applications and the progress should be made public.

As a counterpart, a semi-automatic electronic audit system should be developed that uses risk-based methods and information from SWAT to detect irregularities. Companies should be invited to submit additional electronic data, either directly or through their traceability systems, for online inspection. Physical inspections should be reserved for cases where this electronic inspection does not yield conclusive results.

Governments are advised to use a sub-sectorial approach for the implementation of such systems, i.e., start with a selection of food items. While the technology will be sector-independent, a sectorial approach has been shown as better for buy-in from the private sector – which usually has a strongly sectorial structure. A sectorial approach also helps with industry feedback through industry associations, which are also mostly sectorial. High-value food items, especially those with trade-related issues, make excellent candidates for an initial implementation. Examples are bird nests because of their value and the related highly fraudulent trade, caught fish because of illegal, unreported and unregulated fishing as well as aquaculture fish because of concerns regarding environmental sustainability. For e-Permit and

similar systems, sectors with considerable wastage due to slow paper processes are also good candidates.

Action 2: Establish international cooperation on SWAT and inter-agency information systems

Countries implementing SWAT should exchange experiences with other countries with the objectives of:

(a) Creating collaborations and learn from past experiences;
(b) Establishing electronic information exchange for key agriculture export and import products between the exporting and importing country.

When implementing a single window, many economies face similar challenges. These relate not only to the technical aspects of the single window system but also to the organizational and inter-organizational, managerial, financial, political, legal, and national and international settings (ESCAP and UNECE, 2012a).

It is therefore good practice to attempt to learn from existing experiences in countries that have successfully established national single windows and/or electronic traceability systems. Governments may also want to consider using the resources and network of UNNExT[30] for this purpose.

As a second objective, such international contacts should have the experience of bilateral establishment of electronic information exchanges between public authorities on the exporting and importing side. First implementations should follow the general remarks made above on suitable first adopter sectors.

When implementing agricultural single window, Governments and traders are strongly encouraged to consider the use of existing recommendations, standards and tools that have already been developed over a number of years by intergovernmental agencies and international organizations such as UNNExT, WCO, UNECE, FAO and UNCTAD.

Action 3: Implementation of an automated risk-based inspection system using cross-border electronic information exchange of agrifood permits and certificates

Establishing a risk-based inspection system, based on the electronic information exchange of agrifood permits and certificates, is the third recommended action. This action combines the results of actions 1 and 2 together with a risk-based approach.

Implementation of risk rather than product-based inspection systems is an early user of information collected in SWAT from national or international food businesses. Risk-based systems are known to be more effective and efficient, aspects which are always a concern in the international trading of food.

The final aim is to establish an import and export inspection system that takes into account all historic data held in own systems as well as that received through electronic exchanges with other SWATs. Such a risk-based inspection system should make decisions on whether or not to inspect based on criteria such as:

- History of non-compliance with provisions related to food-borne illness risk factors or critical items;
- History of food-borne illness and/or complaints related to the product type;

[30] http://unnext.unescap.org/.

- Risk profile of production methods;
- Evidence for adequate food safety management, in particular HACCP, of the entity or the certifying authority in the originating country;
- Provenance of the item, history of non-compliance and disease status of the region;
- Relevant and updated certifications;
- Possible scope and impact of contamination.

For more information and more complete lists of criteria see also: FAO (2008); Hoag and others (2007); and National Research Council (2009).

For exports, such a system will help to project the image of the country as an efficient supplier of safe food. If the importing country uses a risk-based inspection system, such categorization may well result in faster border-crossing times.

For imports, such a system can be used to increase the public interest in the national vision and SWAT by demonstrating that critical food contamination is intercepted at the border. Faster cross-border times can also make a country more interesting as a trade partner. Particular emphasis should be placed on avoiding food waste at the border; countries should consider making this a key performance indicator.

Automated risk-based inspection systems can also be integrated with alert systems, such as the European RASFF.[31].

Action 4: Implementation of an automated food safety emergency management system using national as well as cross-border electronic information exchanges

It is important to establish an automated system to deal with food safety incidents and emergencies. A food safety emergency is a situation, whether accidental or intentional, that is identified by a competent authority as constituting a serious and, as yet, uncontrolled food-borne risk to public health that requires urgent action.

Due to the uncontrolled nature of the food-borne risk and the need for urgent coordinated action, which are two important characteristics of a food safety emergency, it is important to have planning, suitable coordination and timely risk communication both within the country and with other countries. This underscores the importance of internal and cross-border information management as well as providing information to buyers, Governments and other stakeholders. This also links into the risk-based approach described in Action 3, although risk assessment may differ in an emergency situation from normal situations, given the need to begin risk management before a full risk assessment is completed.

Risk communication also differs in emergency situations because of (a) the need for frequent updates to match an evolving situation, (b) the complexity and uncertainties that characterized the emergency and (c) the short timeframes available for preparation of relevant media messages. An important factor is food recall, both national and global, which needs to be expedited due to the emergent nature of the risk. Establishing database systems and single window approaches would therefore be extremely useful.

These would also link well into any Rapid Alert Systems where they exist (e.g., RASFF of the European Union and ARASFF in ASEAN), the EMPRES (Emergency Prevention and Early Warning

[31] ec.europa.eu/food/food/rapidalert/index_en.htm.

System) and INFOSAN of FAO/WHO (International Food Safety Authorities Network). EMPRES provides a comprehensive framework for animal, plant and food safety by focusing on capacity development for early warning tracking, early detection, preparedness and timely reaction, coordination and communication. INFOSAN, which is aimed at preventing the international spread of food-borne diseases, was put into operation by promoting the rapid exchange of information, sharing information, promoting partnerships and strengthening capacities. Currently, 178 countries are part of the INFOSAN network, with each nominating a single INFOSAN emergency contact point.

Routine operations of INFOSAN include the dissemination of information notes on food safety issues of global interest, sharing publications and providing a platform for exchanges of information between focal points. In an emergency situation, INFOSAN plays the important role of identifying, verifying and sharing information on food safety-related events. The INFOSAN emergency contact points have a key role in this regard, by verifying information about possible incidents and determining the need to share with other INFOSAN members.

Beyond the "kick-start" actions

The above four actions are recommended initial activities for starting the journey towards the vision, as laid out in chapter II. In some contexts, countries will decide to implement SWAT in a different manner.

Striving for continuous improvement firmly on the path of electronic communication, and with the strong belief that collaboration and transparency benefits all stakeholders in the agrifood chain, many paths exist for reaching the Smarter Food vision.

Experience has shown that the path towards an agrifood chain food information management system is not easy. So far, no country has developed a model that can be simply adopted and followed step-by-step in other countries, and most agrifood information systems remain limited in scope and scale – as shown in the case studies presented in the next chapter.

However, structuring the problem in the way laid out in chapter II, and by taking into consideration the milestones discussed in this chapter, will provide countries with a good foundation, based on a decade of practical experience, for successfully enhancing agrifood chain information management that will benefit citizens, consumers, private industry, public authorities and the international community. The implementation checklist provided in the Appendix to Chapter I may be useful in assessing where a particular country stands on its journey towards paperless agrifood trade.

Chapter IV: Selected case studies

This chapter discusses four cases of agrifood information management system development and operation for trade facilitation. The cases provide useful lessons for those countries intending to move forward with agrifood trade facilitation. Additional cases will be added as they become available.

Case 1: GrapeNet – facilitating trade through validated information in India

GrapeNet[32] is an Internet-based traceability system for monitoring fresh grapes exported from India to the European Union. GrapeNet is offered by APEDA, the Indian export authority for agricultural and processed food.

GrapeNet is a first-of-its-kind initiative in India that has put in place an end-to-end system for monitoring pesticide residue, achieving product standardization and facilitating tracing back from retail shelves to the farm of the Indian grower, through the various stages of sampling, testing, certification and packing.

How it works

The first step in GrapeNet is the registration of farmers and farms at the plot level by the State Horticulture departments and subsequently the issuance of a Registration Certificate to the farmers. Each plot is identified by a 12-digit Registration Number.
State Horticulture Departments can recommend laboratories that can take samples for testing for pesticide residues. Farmers can approach any of the APEDA-recognized laboratories for produce testing.

The laboratories record the details of the samples drawn from each plot and conduct stringent testing for residue levels of about 90 pesticides. This system automatically finds from the test measurements entered whether the sample qualifies for export to specified countries.

In case the tests fail, the National Referral Laboratory or NRL is informed and they confirm whether an internal alert is required for that particular farm's produce, restricting it from exporting to the European Union.

Exporters can only source produce from the plots of the farmers whose samples pass these tests. Then they can apply for the necessary AGMARK certification for quality and grade.

Lessons learnt

District AGMARK officers employ accredited laboratories to check compliance through a physical inspection at the packing house. Laboratories use the online system to generate a unique AGMARK Inspection ID for each lot to be inspected and this ID is pasted on the pallet of grapes. Only those lots that have passed the residue tests for the destination country are accepted by the system. AGMARK officers issue an AGMARK Certificate to the exporter through GrapeNet. The plot number of the farmer and the exporter's Registration Number are all linked at this stage to the AGMARK Inspection ID and the CAG ID.

The next in the chain are the Phytosanitary Departments at the district level who carry out verification of the consignment at the registered packing houses and issue phytosanitary certificates through this system. CAG is mandatory for the issue of phytosanitary certificates.

Once this comprehensive 360-degree evaluation procedure has been completed, the consignment is declared fit and ready for shipment.

Thanks to the success of GrapeNet, APEDA is now building the next stage system with HortiNet for a variety of horticultural products. One of the goals of the future version is the adherence to international standards for identification.

Analysis

GrapeNet currently has about 16,000 farmers in the system. The combination of training, ease-of-use and being able to demonstrate quality is a good incentive for farmers. For importers facing the decision on where to import grapes from, the availability of verified quality data helps considerably. Since GrapeNet is a mandatory system for grape exports to the European

[32] www.apeda.gov.in/apedawebsite/Grapenet/GrapeNet_new.htm.

Union (backed by respective legislation), exports are strictly controlled and quality is assured, which makes India a good trading partner and benefits Indian farmers wanting to export.

Case 2: Malaysia Food Information and Traceability Project

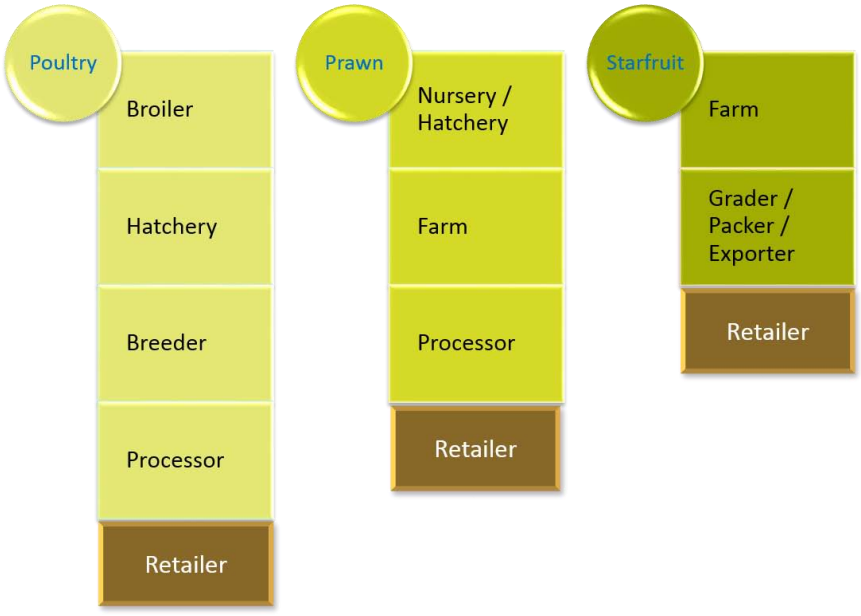
The Malaysia Food Information and Traceability Project (M-FIT) is a government-initiated pilot project where a fully paperless food information and traceability system was established with more than 100 companies in three sectors – poultry, starfruit (carambola) and prawns.

M-FIT was started by the Multimedia Development Corporation, because it was seen as a flagship project for IT capacity-building in the agricultural sector. The project was implemented by FoodReg, a specialist traceability service provider.

Fifteen government agencies from different ministries collaborated in the project. Several agencies represented agriculture, livestock management, aquaculture and processed foods. Trade was included as well as ICT.

The main purpose of the pilot project is to identify the needs and to define the methods for improved food information and traceability in Malaysia.

Figure 15: Information chains in M-FIT



Scope and governance

The project was aimed at defining and demonstrating the structure and methodology for implementing a Food Information and Traceability System that could be shared by all in the food chain.

It set out to develop and demonstrate an electronic system platform that is used nationally and across borders to communicate food information, traceability data and documents within the supply chain.

Technology

The project assumed that data capture technology would be essential for its success. Therefore it included the following components:

- Mobile phones for data capture;
- Barcode readers;
- Fully electronic, web-based traceability system;
- Training for government officials and for farmers;

The mobile phone solution was purposefully built on a

In addition, the project was obligated to report on the administrative and legislative steps that would support the implementation of improved food information and traceability.

A steering committee comprising members of the 15 government agencies provided input and monitored progress of the project. The private contractor FoodReg was the driving partner and acted autonomously on the basis of the indications from the steering committee.

very low-tech stack. Farmers installed a small application over the air. The application had simple forms, e.g., for despatch, receive, treat etc. Data were transmitted internally, using the SMS protocol, so that the application worked even in remote areas.

One large poultry producer used the mobile system on its premises for quick data entry by its staff.
For more complex tasks, access to electricity and computers was a challenge. Some participants used the M-FIT system from home. At the time of the project, tablet computers were not available.

Analysis

The project achieved all its goals. The system was deployed successfully to more than 100 participants, and relevant agencies were directly involved. The project had full ministerial support.

However, the industry's interest in a pure food safety solution was very limited. As soon as subsidies stopped, adoption dwindled. It became clear that full public funding was a double-edged sword; as soon as the funding stopped, companies discontinued their participation, since the perceived value was not sufficiently well-defined and no business cases had been built. One important implication of this case is that traceability may need to be embedded in other processes, such as market access and trade facilitation initiatives, so that the value proposition becomes clearer to the private sector.

Case 3: Building trust for fish export facilitation in Viet Nam

TraceVerified is a Vietnamese traceability service provider, created by a laboratory company seeking to diversify its offerings to the market. TraceVerified is an interesting example, because it has chosen a very different path from its competitors.

Its mission is to:

- Offer the full advantages of electronic traceability to Vietnamese producers;
- Provide importers with hard facts about the fish they buy – anytime, anywhere;
- Provide a service from Viet Nam that importers in high value markets can trust.

The company builds its image around locality, verification and a sector-based approach. It attempts to create more trust through aggressive transparency.

How it works

TraceVerified is built around the combination of traceability with verification. The company not only captures information from its paying clients in Viet Nam and displays it to their customers in Europe and the United States, it also guarantees within certain limits that the data are correct.
In order to achieve that objective, traceability data is first checked to ensure compliance with the principles of the system. Second, information is controlled as it

Approach

TraceVerified has some distinct advantages – it is a Vietnamese company acting in the Vietnamese market, and it has a parent company with experience in testing and with laboratories in the Mekong delta. Its founders have significant sectorial experience in aquaculture. Finally, aquacultural products from Viet Nam, in particular *pangasius*, have seen a dramatic decrease in consumption. Bad press stories have played a major role in that.

flows through the supply chain. Finally, TraceVerified uses regular and surprise visits as well as a fully-equipped testing laboratory to ensure the quality of the data.

The company uses five key components in its work: implementation advice and training, its TraceLabel, the TraceVerified information system, data verification and finally the TraceReport, which collects the verified information and presents it to buyers. A less-detailed version of the report is available publicly (e.g., for consumers or non-governmental organizations).

TraceVerified's founder and former vice-minister, Nguyen Thi Hong Minh, believes that with aggressive transparency the wheat can be separated from the chaff, and trust can be built up based on readily available information – if that information is trustworthy.

However, precisely what that information is cannot be easily determined. The company organized major events at relevant fish expositions and attempted to form close collaboration with relevant non-governmental organizations operating in the area. However, willingness to collaborate on the buyer's side was limited. Most buyers did not realize the advantages that paperless information management offered them.

Analysis

TraceVerified is a very interesting example of a private approach to implementing paperless trade facilitation. However, even fast-moving buyers do not yet fully understand the advantages of paperless trade. At the other end of the scale, Governments are slow to mandate paperless food information systems. As a result, the private approach to implementing such systems is, at least for the time being, slow.

This case – as with other cases in developed countries – suggests that a combination of positive and negative incentives is needed to succeed in enhancing agrifood information systems.

Positive incentives are typically based on business cases related to:

- Access to new markets;
- Permanence in existing markets (by anticipating new regulations or other factors that threaten the current market access)
- Removal of sector bottlenecks
- Ease of efficiency in supply chain management
- Better and more efficient recalls

Negative incentives are related to the introduction of new laws and regulations, thus exposing the private sector to new requirements.

Approaches based only on positive incentives have shown to be very slow in their adoption – so slow that they endanger the whole process. A good example is the eSporing project in Norway, which is a government-facilitated, bottom-up implementation attempt to introduce a national electronic traceability system. Despite an excellent technical architecture and an initially clear industry buy-in, the project is finding scaling up very difficult.

Pure government-based approaches based on negative incentives in Indonesia, Malaysia and Viet Nam as well as other countries in South-East Asia have led to a lack of buy-in from the private sector that, in turn, necessarily has led to an unsustainable funding situation.

On the other hand, the GrapeNet example in India is successful because it combines legal exportability of grapes to the key market in the European Union with assistance, training and a trusted certification scheme.

Government agencies will have to implement laws and regulations requesting the supply of relevant information elements from the private sector for management purposes. It is important to note that (a) submission of such information should be electronic, and (b) only essential information should be requested. Government agencies should at the same time design a governance structure that clearly explains who has access to what data and under what circumstances. The private sector should be assured that competition is not affected by data sharing. The governance policy should be subjected to external scrutiny and its implementation subjected to audits in order to generate trust.

In building a base, the role of government agencies is one of facilitation. Such agencies can help to:

- Contribute to the standard setting process for data capture and transport;
- Facilitate the process of identifying business cases and "sweet spots";
- Fund needs assessments in significant subsectors;
- Contribute to the return of investment by streamlining its own services, in particular by incorporating needs of the private sector into Single Window Systems;
- Find suitable operators of agrifood chain information management systems;
- Incentives in terms of lower inspections and controls;
- Develop IT based systems that allow private sector to have easy access.

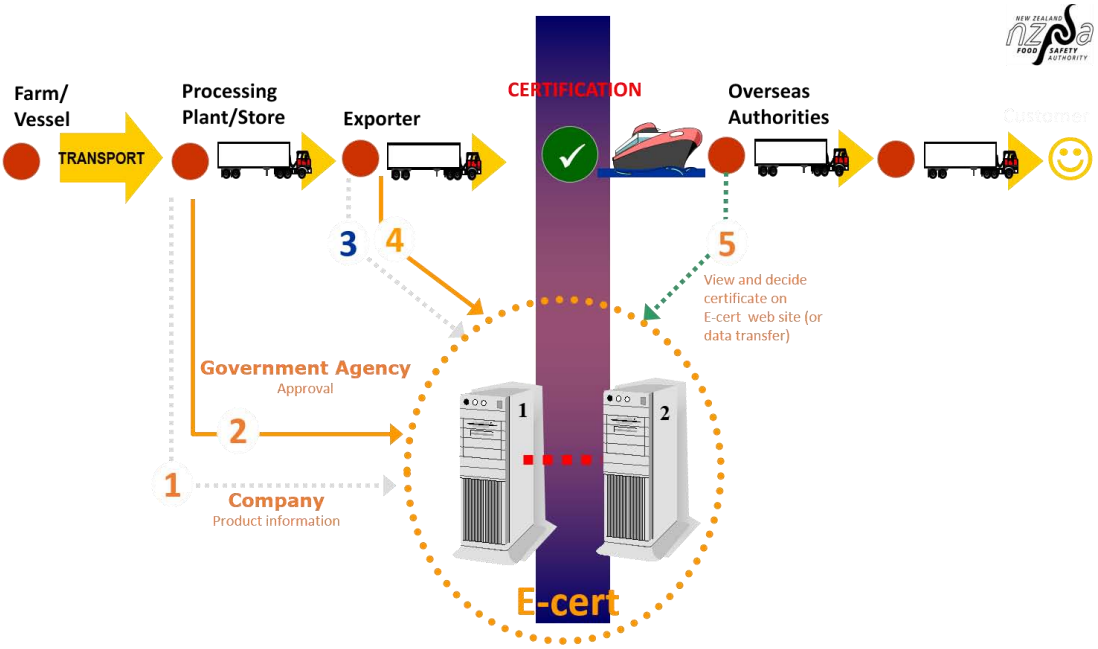
Case 4: New Zealand Information System for Meat Products – e-Cert[33]

Australia and New Zealand trade with 120 economies, use 1,900 forms in 30-plus languages and exchange about 250,000 certificates for edible meat products every year.

The e-Cert is an Internet application provided by the New Zealand Food Safety Authority (NZFSA) for providing government-to-government assurances about the compliance of New Zealand's animal products with importing country regulatory requirements. The e-Cert's purpose is to track market eligibility and product status from the time of production until export and the approving of an export certificate.

[33] This case study was provided by Dr Drasko Pavlovic, Ministry of Primary Industries, New Zealand

Figure 16: The e-Cert system of the New Zealand Food Safety Authority



Source: NZFSA.

How it works

When the product is ready for export, an export certificate is created in e-Cert and approved by NZFSA. An approved certificate is then made available online to importing country officials. An automated, secure certificate data exchange method is also available to importing country officials. If required, an approved certificate may be printed and signed by an NZFSA certifying officer.

Technically, the e-Cert system is based on the UN/CEFACT (SPS) Certificate Scheme, implemented in the eXtensible Markup Language (XML). XML is particularly suited for international trade standards because of its inherent flexibility, extensibility and readability by humans. This standard adopts an XML Schema-based solution and uses data elements from the published UN/CEFACT core component library. Data is transmitted usually via SOAP, but other methods exist.

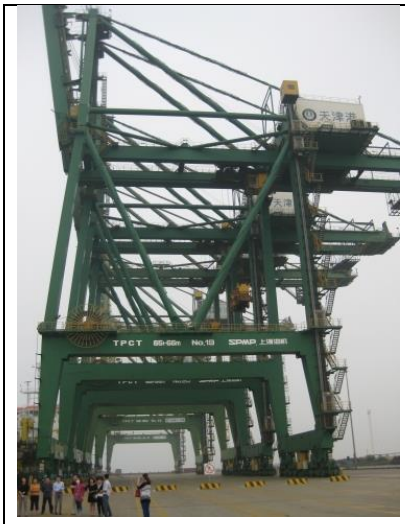
Status

The e-Cert system was constructed in 1999. The first export certification started in 2000 and data exchange started in 2005. Now there are data exchanges with all European Union member States (via TRACES), the United States (FSIS of USDA), Canada (CFIA) and China (AQSIQ; see box text below, "Development of e-Cert system in China"). Other countries are working on developing their systems for data exchange, particularly in Asia. In 2014 the system is expected to become 100% paperless with Canada, the United States and the European Union.

Conclusion

The e-Cert system has contributed to a reduction in costs, increased speed and greater transparency of product supply chains. The traceability and export certification complies fully

with UN/CEFACT e-Cert data standard as well as with relevant international standards such as CODEX (CCFICs), IPPC (ISPM12), OIE and others. Early notifications of shipments have led to better planning of product inspections among others.



Development of e-Cert system in China

In September 2009, the General Administration of Quality Supervision, Inspection and Quarantine of China developed an e-Cert system. Such a system plays an active role in facilitating the clearance of imported goods, enhancing the security of the official certificates, effectively preventing fake certificates, ensuring the quality and safety of imported and exported products as well as promoting international trade facilitation.

In January 2010, the system was officially launched. Inspection and Quarantine Services Tianjin (Tianjin CIQ) made trials of the e-Cert system by uploading some electronic certificates to the platform, so that official institutions from abroad could query and download information. Verification of electronic certificates from Australia, New Zealand and the Netherlands was implemented. Currently, Tianjin CIQ uploads data for some certificates by e-mail, which is both slow and insecure. It is expected that an online web platform to upload and download information will be constructed.

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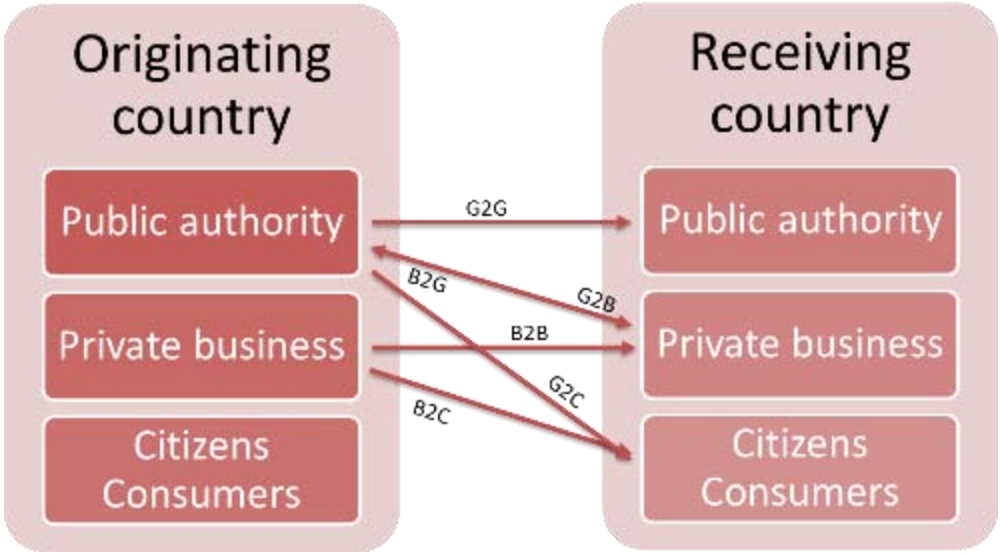
Source: Provided by Tianjin Inspection and Quarantine Services, June 2013.

Appendix 1: Relevant international standards for SWATs

1.1. The standards ecosphere

Figure A1. 1: Complex relationships warrant large standards ecosphere



Agrifood chain information management systems are a complex matter because they vary hugely in scope (purpose), depth (length of the chain), width (who is involved), breadth (attributes carried) and precision (how accurate forward and backward traceability finds sources and destinations).

In addition, in cross-border trade a large number of relationships exist between entities from the originating country and the receiving country. There are government-to-government (G2G) relationships between public authorities, government-to-business (G2B) relationships between the public authorities and private businesses, counterpart business-to-government (B2G) and business-to-business relationships (B2B). Obtaining an export permit is an example of a country's internal B2G relationship while verification of such a certificate by the importing nation is an example of a G2G relationship.

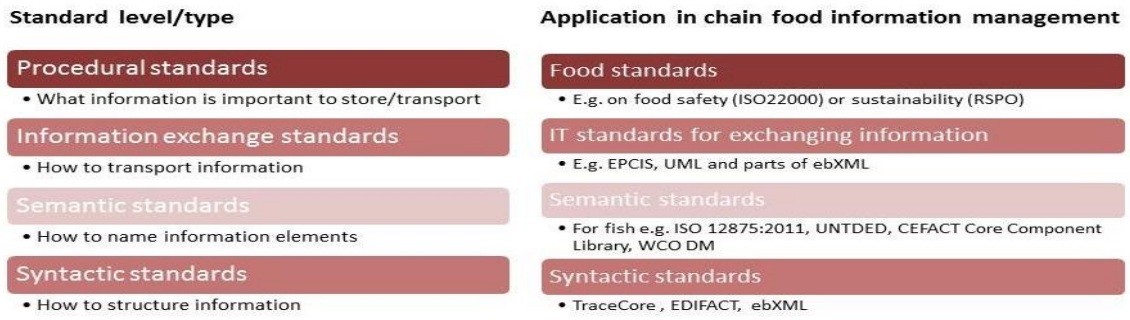
The public authority also has a relationship with citizens and consumers (B2C), both of its own country as well as of the receiving country. The European Union, for example, delegates responsibility for food safety to competent authorities in the originating country. The public authority in that country therefore is directly responsible for the delivery of safe food to European consumers. Businesses in the originating country have a similar relationship with citizens and consumers in the receiving country. Many consumers in rich countries have a particular interest in sustainable food ingredients, and businesses in originating countries need to demonstrate to consumers and their representatives that they comply with international sustainability standards.

Figure A1.2 only lists possible types of interactions and therefore areas of standardization. It hides some of the complexity of the standardization problems, because each interaction has

different dimensions. For an agrifood chain information management system the following aspects need to be agreed on or standardized:

(a) Procedure (what information in what circumstances and when);
(b) Information transport (how and when to transmit information);
(c) Semantics (how to name information elements);
(d) Syntax (how to structure information).

Figure A1. 2. Levels of Standardization



Information management standards do not always use such a structured approach. There is a general trade-off between ease of application and specificity of a standard set. Generic standards have a tendency to be too abstract and are difficult to apply by food business operators. More specific standard sets create interface problems between different subsectors (e.g., fish standards not applicable to dairy production). The Universal Business Language (UBL[34]) is a good example of a generic business information exchange standard. Concrete food businesses, however, find its application difficult, because it leaves them with the question of what specific information should be transferred; However, ISO 12785:2011 explains quite well what information elements should be transferred and how they should be identified, but does not prescribe how the information should be transferred from A to B.

1.2. Procedural standards

A few important procedural standards for the "macro-trends" are listed below.

Guaranteeing food safety

- Codex Alimentarius:[35]
  - International reference standards for consumer protection and food safety, used as the legal basis of international trade;
  - Created by joint effort of FAO and WHO;
  - Specific reference to Guidelines for design, production, issuance and use of generic official certificates (CAC/GL 38 2001 - Rev 2009), which refers to use of electronic certificates.
- ISO 22000 family:[36]
  - Family of voluntary industry standards on food safety;

[34] https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ubl.
[35] www.codexalimentarius.org/.
[36] www.iso.org/iso/ES/home/standards/management-standards/iso22000.htm.

  - Main building block – Hazard Control and Critical Control Points (HACCP), which includes traceability as a pre-requisite;
  - Recognized by the Global Food Safety Initiative.
- GlobalGAP[37] (and similar efforts such as BRC, IFS etc.):
  - Buyer-driven private standards;
  - Based on general principles and ideas of international food standards;
  - Application-oriented with the aim of being practical;
  - Often include a general traceability requirement.

Increasing sustainability

- There are no generic standards for sustainable food production; all efforts in that direction are sector based. There are, however, generic high-level standards for two areas of sustainability:
  - ISO14000 series on environmental management;
  - ISO26000 series on social responsibility (non-certifiable).
- Some sector-specific examples:
  - Palm oil – Roundtable for sustainable palm oil (RSPO) – www.rspo.org. Very complex standard attempting a holistic approach to sustainable palm oil production. Takes into account the environmental and social aspects as well as business profitability. Has supply chain certification and runs a traceability system;
  - Aquaculture – Aquaculture Stewardship Council (ASC) – www.asc-aqua.org. A relatively new player in aquaculture sustainability. Created with a stakeholder-driven approach. Looks primarily at environmental sustainability, but also animal welfare. Uses a weaker chain of custody approach;
  - Fair trade – Fairtrade International (FLO) – www.fairtrade.net. Internationally-used standard for fair trade. Contains generic rules for different organizations related mostly to fair distribution of gains along the value chain. Contains specific standards for food subsectors. Requires membership.

Efficient trade

- eCert:[38]
  - UN/CEFACT Standard for sanitary and phytosanitary export certificates to facilitate trade of agricultural products:

    (a) Assures that the commodity has met the importing government requirements;

    (b) Improves business processes for import clearance through consistent quality data;

    (c) Facilitates real time clearance, e.g. through early shipment notifications.
  - In use in a number of countries (European Union members, United States and Canada; fully paperless by 2014.
- eCustoms:[39]

[37] www.globalgap.org.
[38] www1.unece.org/cefact/platform/pages/viewpage.action?pageId=5964708.
[39] http://ec.europa.eu/taxation_customs/customs/policy_issues/electronic_customs_initiative/index_en.htm.

- Main goals:
  (a) Control and facilitate the movement of goods into and out of the internal market through efficient import and export procedures;
  (b) Increase the competitiveness of European trade through a reduction of compliance and administrative costs and improved clearance times;
  (c) Facilitate legitimate trade through a coordinated approach related to the control of goods;
  (d) Improve the safety and security of citizens with regard to dangerous and illicit goods;
  (e) Offer improved protection of the financial interests of the European Union and its member States;
  (f) Contribute to the fight against international crime and terrorism by providing rapid and relevant information with regard to the international supply chain;
  (g) Allows a seamless flow of data between the authorities of exporting and importing countries.
- Project to be implemented by 2020.

- UNECE Working Party on Agricultural Quality Standards (WP-7):[40]
  - Quality standards for a wide variety of foods:
    (a) Fresh fruit and vegetables (FFV);
    (b) Dry and dried produce (DDP);
    (c) Seed potatoes;
    (d) Meat;
    (e) Eggs.

For trade facilitation, in particular, it is important to mention the technical standard(s) collected in the UNECE Trade Facilitation Implementation Guide[41] (figure A1.3). This guide can be referred to for many relevant concepts of the agrifood sector.

The United Nations has developed a standard for information exchange in three different areas

1. Data harmonization dealing with semantics, i.e., making sure that data are understood in the same way by emitter and receiver;
2. Document alignment dealing with syntax, making sure that document structures are aligned between emitting and receiving ends;
3. Methods to expose data, making sure that data are made available over standardized channels.

All of these e-business solutions require certain pre-requisite standards, in particular:

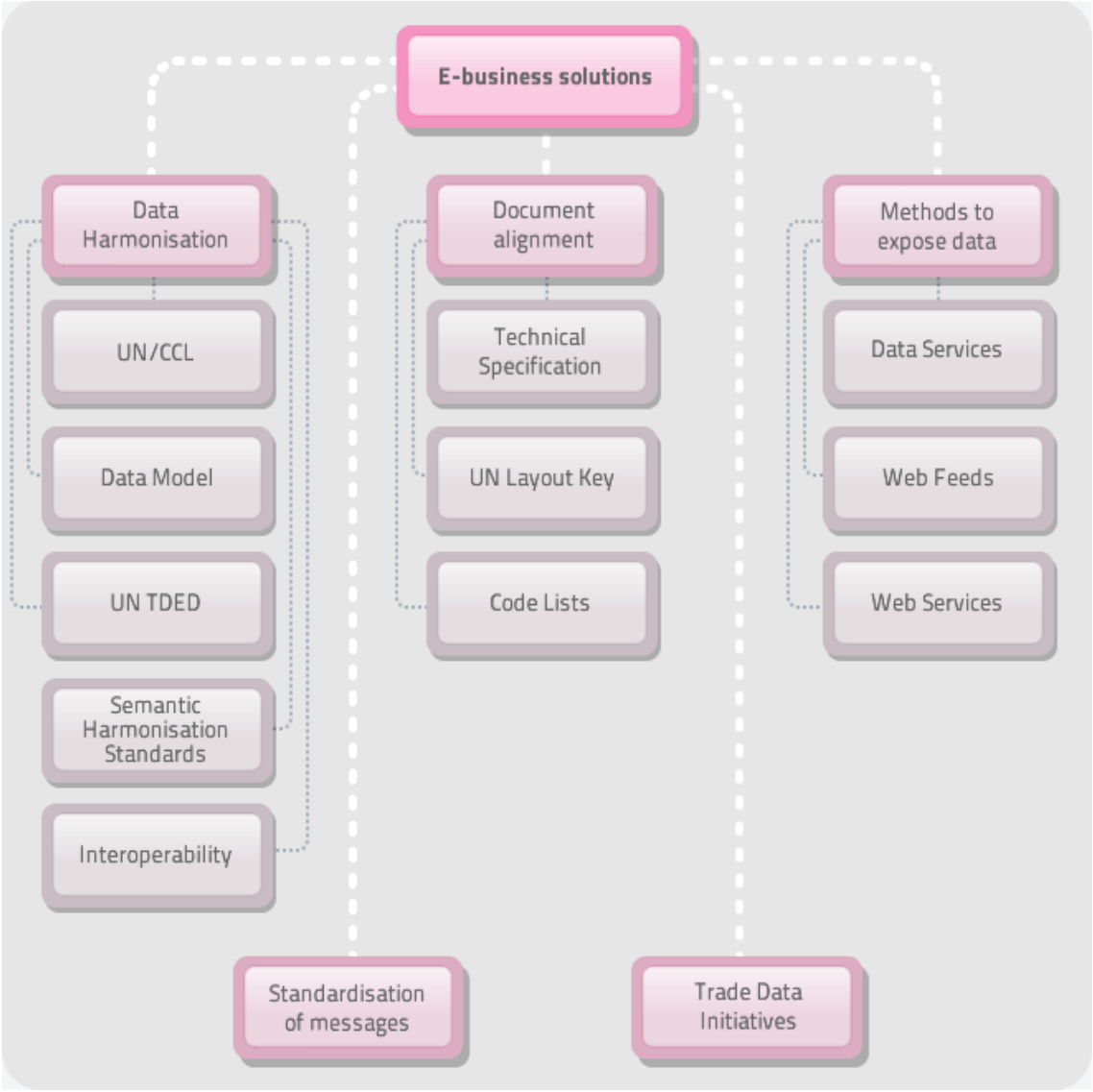
Unique identification of:
- Traceable units (TU);
- Logistic units (LU);
- Locations;
- Contractual relations.

[40] www.unece.org/trade/agr/welcome.html.
[41] tfig.unece.org/contents/intro-domain-ebs.htm.

Data carrier standards:

- 1D and 2D barcodes;
- Radio Frequency Identifiers (RFIDs).

Figure A1. 3. Domain map of e-business solutions for trade facilitation



Source: UNECE Trade Facilitation Implementation Guide.

Identification standards are considered below.

1.3. Identification systems used world-wide for agrifood information management

Globally unique identification is one of the key principles required for agrifood chain information management. Any food being globally traded requires globally unique identification, so that its particular history can be retraced, the processes and procedures applied to it identified and any risks/hazards (for example, related to cross-contamination) avoided. Local identification of products, traceable units (such as product instances), logistic units, business sites etc. are not globally unique and generally not acceptable if the identified product can leave the premises of the food business.

In particular, globally unique identifiers are required for:

- Businesses;
- Locations;
- Product types;
- Product instances (trade units);
- Logistic units (cartons, pallets, containers).

Other identifiers are used to identify, example, returnable or fixed assets, business relationships etc. However, for agrifood chain information management the above are the most important identifiers.

In most cases, the implementation of globally unique identification carries a very similar or the same cost as the implementation of locally unique identification. In the vast majority of cases, locally unique identification carries no advantages, particularly if the globally unique identification system is made up of GLOBALLY UNIQUE ID = PREFIX + LOCALLY UNIQUE ID.

Unfortunately, many government departments are unaware of the advantages of globally unique identification and issue local identifiers. This malpractice then leads to unnecessary proliferation of identifiers that businesses have to use in their official communication with the relevant authority, but cannot use in international trade because of their lack of uniqueness.

The cost of using locally unique identifiers created along the chain should not be underestimated. As a consequence of using locally unique identifiers, businesses often need to relabel goods to fit their internal procedures or to assign a globally unique identifier to a good. Relabelling is a major source of errors and typically a break point where information from the originating system is lost.

Also, globally unique identification facilitates identification of parties for the public authorities involved in the agrifood chain. Export permits often require collaboration between different authorities. This collaboration is often made difficult by the used of different identifiers for businesses, locations, trade units and logistic units.

A major obstacle in globally unique identification is that there are currently no globally unique identification products available free of charge for businesses and public authorities. Since the costs for adopting locally unique identification schemes are seldom explicit, and most often do not affect the issuer but rather the receiver, governmental agencies more often than not design their own non-unique schemes.

Globally unique identification schemes are standardized under ISO 15459. ISO also runs a register of all identification schemes, so that entities in need of identification products can identify possible suppliers of those products that are guaranteed to comply with ISO 15459. Such entities are called issuing agencies and are identified with an issuing agency code (IAC). The IAC is a prefix that differentiates the identification schemes and tells the user how to interpret the code after the prefix. Issuing agencies have full liberty with regard to structuring their code segment after the IAC.

GS1 (Global Standard One), a global not-for-profit organization dealing in standardization, particularly identification, has a special IAC; any globally unique identifier starting with a number (0-9) has to be considered in the context of GS1's set of identifiers.[42]

In the context of agrifood chain information management, GS1 provides the following identifiers:

- Global Trade Item Number (GTIN) for trade items (not instances);
- Serial GTIN (SGTIN), a serialized version of the above;
- EPC, the electronic product code;
- Serial Shipping Container Code (SSCC) for logistic units;
- Global Location Number (GLN) for businesses and business locations.

Different suppliers of identification products target different markets. Some are, in fact, only internal issuers while others supply identification products for all sectors. The list is available online.[43]

For the agricultural part of the agrifood chain, or in general in the early stages of the food supply chain, there is no predominant supplier of identities; in stages, particularly distribution and retail, GS1 is a leading supplier of identification schemes. In the early stages, mostly non-global identification systems are used.

Example

Bovine identification in Europe is regulated in regulation EC/911/2004. The regulation sets a framework for identification, but leaves member states to provide more detailed regulations. The following is regulated:

- The first two characters should identify the country
- Following there should be a numeric code of up to 12 digits
- A barcode may be added
- A replacement tag may be marked as such

Tags are required to fulfil certain conditions and are not re-used. All member states are required to communicate to each other the ID formats and tag models. Each member state is allowed some liberty in the coding system. Estonia uses a 10-digit code as Germany and France, Denmark uses 11 digits and the UK 12 digits. As a consequence, a live animal exported from Estonia to Poland needs a new passport with a new ID – most information about the former live of the animal is then lost.

In particular, for smallholders identification is an unresolved issue. For smallholder, who are responsible for most of world's food production (International Fund for Agricultural Development (2010), the identification of sources and enabling traceability is absolutely essential. However, smallholders are mostly excluded from the benefits of globally unique identification because: (a) their direct trade partners most often do not value it; (b) the individual production volumes are small; (c) their trade base is limited; and (d) their record-keeping systems are typically simple. In addition, particularly in developing nations, the percentage of illiteracy is higher among smallholders than among larger players. As a consequence, it is difficult to obtain buy-in by smallholders into any globally unique identification scheme, especially if such system requires a direct contract between the smallholder and the issuing agency, and regular payments.

This is an open area of concern in the international community when looking at global-scale food information exchange. In particular, GS1 has been trying to address its shortcomings as a

[42] www.gs1.org/barcodes.

[43] www.nen.nl/web/file?uuid=3df266bb-b3fc-4e93-9de1-789ec1bf91da&owner=b7d9b9d1-e2e8-431e-b3a5-96006651c04b.

member-based organization[44] where both a direct sign-up is necessary and annual fees have to be paid. Grouping farmers into producer groups (e.g., villages) is one approach. GS1 Germany recently started[45] dealing out prefixes that uniquely identify a party but are excluded from bar-coding. A conclusion of the process has, so far, not been reached.

Alternative schemes are known. The private for-profit company Xifrat Daten AG is an identification-issuing agency. Xifrat issues RGCodes that are used in its traceability products under the FoodReg brand.[46].In Viet Nam, RGCodes were chosen over GS1 codes (for the above reasons) in a National Traceability Day. Since RGCodes are not based on a membership model, government agencies can make arrangements with the code scheme owner to deal out sub-segments of the codes under their own responsibility and without the need for direct contract between the final code beneficiary and Xifrat Daten AG. However, RGCodes do not enjoy the same market penetration as GS1 Codes do (Lehr, 2009) and the amount of marketing needed to implement a new identification system at distribution and retail should not be underestimated.

Example

Viet Nam is estimated to have more than 500,000 fish business operators, out of which 480,000 are micro-enterprises. As a comparison, GS1 Viet Nam – as a major local player in the identification market – has a total of about 60,000 members from all sectors, including manufacturing. Even if on average convincing and signing up a smallholder fish business operators takes 5 working minutes, the total signup cost would amount to 25 working years – and this for a single subsector of agriculture.

It is perhaps worth considering the fact that food (and other) businesses worldwide should have a right to free identification products. It is in the interest of the greater good that food and food chain actors can be identified uniquely. It is therefore logical to think that an international body could issue code prefixes free of charge. The management of the prefixes could be outsourced to existing identification providers.

It is recommended that government agencies collaborate with GS1 and other issuing agencies registered under ISO15459 to come as near as possible to a point where all FBOs and their products can be identified globally uniquely.

1.4. Data carrier standards

An area of some confusion is the difference between identifiers, chain information management and data carriers (figure A1.4).

[44] Private conversations with various GS1 representatives and, in particular, Carolyn Lee, Food Traceability Manager, GS1 Global.
[45] In the context of its new tool, f-Trace.
[46] www.foodreg.com.

Figure A1. 4. Data carriers often used in the agrifood chain

Data carriers have the simple function of carrying information independently of the memory of a human. Data carriers can be humanly-readable labels, but in the interest of automated identification and data capture (AIDC), data carriers today are understood as machine-readable information carriers.

There is an on-going dichotomy between data carriers carrying only identifiers, where the associated information is held elsewhere – typically in an IT system – and those data carriers that attempt to carry relevant information independently (Lehr 2013a and 2013b). For the purpose of this discussion it is assumed that only identifiers are transported.

The most important data carrier today is the one-dimensional barcode. Although a number of different formats exist, the EAN/UPC Code128 barcode is by far the best known, because it is represented on most items globally that are sold through supermarkets.

- EAN/UPC:
  - Specified for retail point-of-sale (POS) because they are designed for the high-volume scanning environment;
  - Used at POS and in logistics;
  - Limited to carrying GS1 Keys and special identifiers for restricted applications such as variable measure trade items and internal numbering.

For logistical operations the GS1-128 (UCC/EAN-128) bar is used most often to code Serial Shipping Container Codes (SSCC). It can be used to carry all GS1 keys, but is not to be used for items crossing the point of sales (POS).

Recently, two-dimensional barcodes have enjoyed some attention. Two standards are most widely used.

- DataMatrix:
  - DataMatrix is a "2D Matrix" symbol and is used in logistics and health care;

(01)07612345678900(17)100503
(10)AC3453G3

  - (GS1) currently specified for items not crossing POS;
  - Can typically contain up to 2,335 alphanumeric characters;
  - Size determines readability; error correction codes attempt to increase reliability.
- QR Code:
  - QR Codes are a "2D Matrix" symbol used in consumer facing activities;
  - Can encode URLs;
  - Can contain up to 4,296 characters, but readability depends on size;
  - (GS1) currently restricted for use with applications that will involve imaging scanners within mobile devices and not for POS processing.

The data matrix standard is used mostly for B2B business transactions. Its main purpose is to hold serialized information such as a lot number, expiration/best before date and similar data in a machine-readable format.

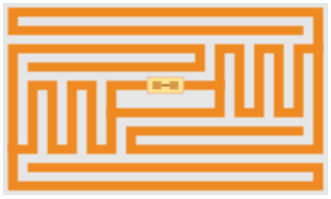
The QR Code, on the other hand, is mostly used in B2C) transactions and, within this, to encode URLs for marketing and easy consumer access to information. The unique capability to store URLs and its optimization for mobile devices makes the code ideal for such activities. Most companies today that want to transport agrifood information to consumers would opt for a QRCode. However, its use in B2B transactions is limited – for no particular reason.

The above data carriers require line-of-sight when scanning them. At the reception bay, pallets would therefore potentially have to be unpacked, individual cartons scanned and the pallet rebuilt. In a further automation step, RFID was invented to remedy the shortcomings of line-of-sight barcodes.

RFIDs make wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. As with other data carriers, they can transmit identities or other data. For the purpose of this discussion it is assumed that they transmit identities only.

There are two basic RFID types:

- Active tags using a battery to emit a signal;
- Passive tags respond to an external activation by a reader.



EPC RFID tag used by Wal-Mart.
Source: Wikipedia.

With active tags, it is typically easier to achieve 100 per cent read rates, which is why they are often used in anti-theft systems. However, given their higher price, their use is limited for simple identification purposes. Different frequency bands are employed for different purposes in the agrifood chain. In particular, LF tags are used widely for animal identification and UHF tags are used in logistics. However, the particular frequency bands are not standardized globally. Modern readers can deal with this easily, but tags issued in one country may be illegal in another country.

It is important to stress that data carriers alone do not establish traceability. The use of RFID facilitates chain information management because it eases the automated data capture

process, but it does not establish traceability itself. Traceability requires association of identifiers with locations and processes, and following such identifiers through the chain from their emergence until their obliteration.

1.5. Case study: RFID in inspection and quarantine services at Tianjin port in China

(Information provided by Tianjin Inspection and Quarantine Services)

The Internet, Global Positioning System (GPS), and RFID contribute to efficient exchange of trade and logistics information. The Tianjin Entry-Exit Inspection and Quarantine Bureau have studied the feasibility of RFID implementation in transfer inspections.

RFID technology

Tianjin CIQ pioneered a study where imported goods used electronic seals at the port. GPS, GPRS and RFID technology make it possible to place the route and time of transfer, inspection, transport and location of goods under comprehensive supervision. Closed-loop management was made possible by the exchange of information on each good, seals and other items related to inspection and quarantine between port CIQ and destination CIQ.

Tianjin CIQ chose the Tianjin Zhenhua International Logistics Group to conduct a trial. With good software and hardware available, the group is collecting inspection site information. In addition, the Pinganxing System (GPS monitor system) has been combined with RFID since November 2008. Ten vehicles were chosen to be monitored.

Lessons learnt

In the trial, it was found that the high cost of empty containers returning and RFID problems became restraining factors for widespread use of RFID in cross-border logistics.

First, it was found that with high-frequency RFID tags the stability of system integration was not satisfactory. Some defects in physical hardware were observed. China does not currently have access to stable HF RFID technology.

Second, RFID is not properly standardized. Electronic tags should be connected to readers over the air; this requires a standardized protocol for mobile communications. The International Standardization Organization (ISO/IEC) developed a series of RFID over-the-air standards. Among those standards, ISO/IEC14443, ISO/IEC15693 and ISO/IEC18000 have the greatest importance in this context.

So far, China has not promulgated and implemented the above standards as national standards due to patent problems. The lack of proper standardization of RFID makes wide-spread use difficult.

Third, the cost of RFID implementation is too high. Although the cost of chips continues to decline, widespread application would increase logistics cost.

Conclusion

It is foreseeable that the stability, standardization and cost of RFID will be improved. However, at present, the cost and benefits of introduction of RFID in agro-trade paperless system should be carefully considered.

1.6. Data harmonization

UN/CEFACT defines data harmonization as an iterative process of capturing, defining, analysing and reconciling government information requirements, and data standardization as the mapping of this simplified data to international standards.

Data harmonization therefore is an activity that crosses from procedural over semantic to syntactic standardisation, often including information exchange standardisation. eCert is such a standard.

Data harmonization is very complex activity when it applies to global agrifood trade and chain information management. The main reason is the large difference in scope of the different systems.

The International Standards Organization (ISO) has long refrained from attempting to engage in standardizing chain food information management. However, it recently published two semantic standards:

- ISO 12875:2011 – Traceability of finfish products, specification on the information to be recorded in captured finfish distribution chains;
- ISO 12877:2011 – Traceability of finfish products, specification on the information to be recorded in farmed finfish distribution chains.

These efforts supersede the rather successful TraceFish standard, originally developed under the Norwegian research institute NOFIMA and funded by the European Commission.[47] It is to be expected that, after the successful publication of these standards, ISO will produce similar semantic standards for other sectors.

In particular for fish, there are some internationally accepted code lists (semantic standards), e.g., the FAO-maintained AFSIS list of fish species.[48] For cross-border trade, the Harmonized Commodity Description and Coding system (HS) maintained by the World Customs Organization warrants mention.[49]

Within UN/CEFACT, data harmonization is based on the United Nations Trade Data Element Directory (UNTDED or ISO 7372), which provides definitions (semantics) for the most common data elements used in cross-border trade in a format that is understandable to trade experts. For the purpose of electronic information exchange these data objects need to be defined in further detail and in a more technical format. This is done by using definitions from either the WCO Data Model or the UN/CEFACT Core Component Library (ISO 15000).[50] From both standards, users can develop electronic trade documents in UN/EDIFACT or XML syntax.

1.7. International data exchange standards and their penetration

A number of projects are under way to develop the eBusiness standards for agrifood supply chain management. So far, no standard has gained full market support and adopters continue to run the early adopter risk of betting on the wrong horse. The following is a short but not complete list of eBusiness standards for agriculture trade.

UN/EDIFACT: The United Nations rules for Electronic Data Interchange for Administration, Commerce and Transport (UN/EDIFACT) comprise a set of internationally agreed standards, directories and guidelines for the electronic interchange of structured data between independent computerized information systems. EDIFACT is the world's most commonly used standard for electronic data exchange. Recommended within the framework of the United Nations, the rules are approved and published by UNECE in UNTDID) and are maintained under agreed procedures.[51]

[47] See, for example, www.extension.iastate.edu/NR/rdonlyres/339C767B-96C0-472B-B214-AFDDC02E3F9E/108493/TraceFoodFrameworkJosteinStorov.pdf

[48] www.fao.org/fishery/collection/asfis/en.

[49] www.wcoomd.org/en/topics/nomenclature/instrument-and-tools/hs-online.aspx

[50] Both WCO DM and the Core Component Library are based on UNTEDE definitions. The stepwise process of defining and harmonizing data elements is described inter alia in the UNNEXT Data Harmonization and Modelling Guide.

[51] www.unedifact.org.

ebXML (ISO 15000):

- Developed by UN/CEFACT and OASIS;
- Based on the UN/CEFACT Core Component Library;
- Open, XML-based infrastructure that enables the global use of electronic business information in an interoperable, secure and consistent manner by all trading partners;
- Framework standard covering business interactions and addressing, in particular, information transport;
- Electronic trade documents based on ebXML are developed by UN/CEFACT and published on their website.[52]

The ebXML standard is a complete generic approach to paperless business transactions. It attempts to cover all stages of business transactions, from discovery to billing.

The WCO Data Model was developed by the World Customs Organization (WCO). Its focus is on standards for electronic data exchange between customs and government organizations for the control of exports and imports. The WCO Data Model supports the implementation of a single window as it allows the reporting of information to all government agencies through the unique way it organizes regulatory information. The data model is consistent with other international standards such as the UNTDED, UN/EDIFACT and XML.

Both ebXML and WCO DM (within its domain) are the most complete attempts at creating a universal electronic language for business transactions. The standards are rather complex in their application and their technical implementation. As a consequence, adoption of ebXML and WCO DM has been rather slow.

The TraceFood framework[53] Is an attempt to standardize chain food information management This work was undertaken within the European Union research project TRACE IP, Europe's largest research project on food traceability with a total budget of about €20 million. The TraceFood framework contains three main components:

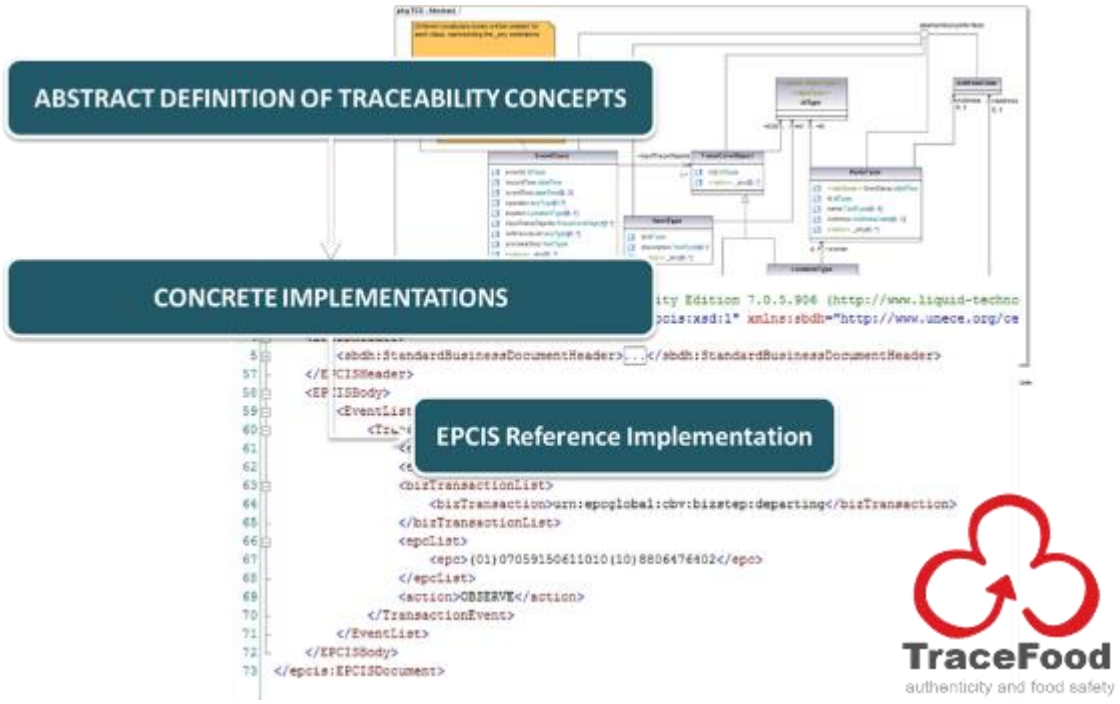
(a) Good Traceability Practices;
(b) Ontological or semantic standards for a (limited) number of foodstuffs;
(c) TraceCore: An abstract definition of a traceability exchange standard that can be mapped, for example, to EPCIS (figure A1.5).

The difference between TraceCore and other food information standards is that TraceCore is an abstract definition that attempts to map food traceability generically, using the Universal Modelling Language (UML). For a concrete application, TraceCore can then be mapped to more concrete XML standards, such as EPCIS. TraceCore can therefore be a cornerstone in interoperability of different standards.

[52] www.unece.org/cefact/.
[53] www.tracefood.org and www.foodtraceability.eu.

Driving the adoption of the TraceFood framework, however, requires intensive marketing in the international business community. This was not possible within the constraints of the project and TraceCore has therefore remained an academic concept, rather than a business reality.

Figure A1. 5. **TraceCore data exchange standard within TraceFood**



The Electronic Product Code Information Services (EPCIS[54]) was created and promoted by GS1. The origins of EPCIS lie in the RFID world. GS1 cites the goal of EPCIS is to "enable disparate applications to leverage Electronic Product Code (EPC) data via EPC-related data sharing, both within and across enterprises. Ultimately, this sharing is aimed at enabling participants in the EPCglobal Network to gain a shared view of the disposition of EPC-bearing objects within a relevant business context." EPCIS has, however, outgrown its EPC-centric beginnings. In particular, the set of standards works with any globally unique identifier, which is a strong advantage. Version 2.0 of the standard, which was presented in November in Lisbon but is not yet available to the general public, addresses limitations that required a (non-standardized) extension of the standard for food traceability.

The Electronic Product Code Information Services (EPCIS):

– Standard for sharing Electronic Product Code (EPC)-

Norway: eSporing

A unique effort to implement electronic food traceability

country-wide, eSporing is based on EPCIS V1.0 and therefore has had to extend the standard for food.

A workshop in Oslo in 2011 reviewed the status of EPCIS as a basis for a globally acceptable food information exchange standard.

www.tracefood.org/index.php/Application_of_EPCIS_in_food_supply_chain_management.

[54] www.gs1.org/gsmp/kc/epcglobal/epcis.

related information between trading partners;
- Defines standard set of messages for both data capture and data exchange;
- The what, where, when and why of events occurring in any supply chain is exchanged;
- Stores important business information such as time, location, disposition and business step of each event that occurs during the life of an item in the supply chain;
- Not originally created for food;
- Two main areas – Event Capture and Query Interface.

Not all standards are yet completed. There is also a lack of international governance of EPCIS repositories, so that currently businesses looking for information about a particular item have to know where to start their search. (This would be equivalent to a non-networked Domain Name Server (DNS) that would only know the IP addresses of such websites that it has in its own tables. The strength of DNS is precisely the global network of such servers that allows any user to resolve the IP address of a domain within fractions of a second.)

EPCIS is backed by larger companies in the food sector (mostly downstream). It does, however, have a larger and growing following. The standard is in itself limited. Much of the information required for more specific information services, e.g., with regard to sustainability and trade, will have to be incorporated via extensions or via specific dictionaries.

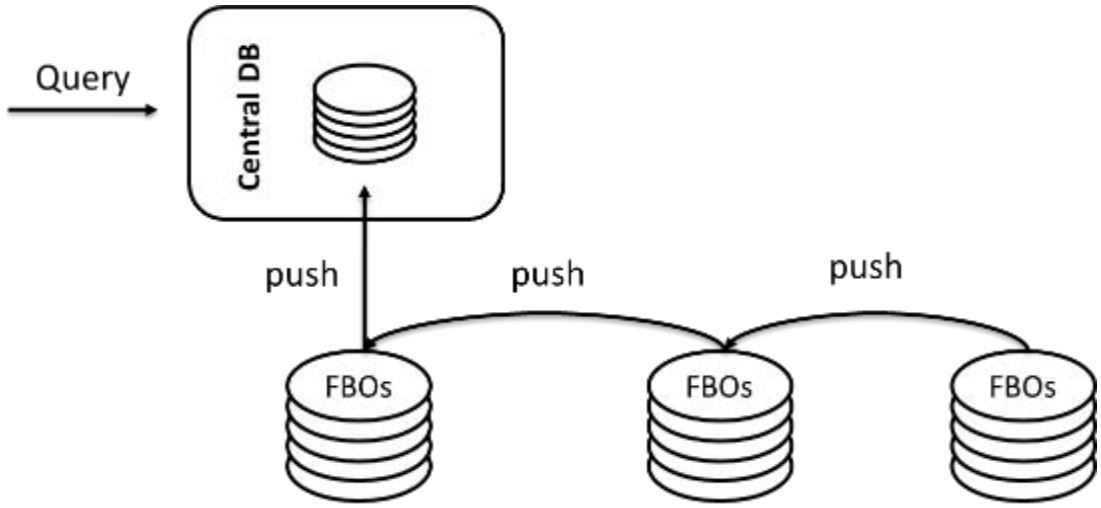
Appendix 2: Architectures for agrifood information management

From a technical point of view, there are a number of implementations of the above systemic view. Most of the currently-run systems adhere to one of the models below. The models are, in principle, compatible with each other, i.e., a real-world implementation could use a mixed model where all four options presented below operate in parallel.

In practice, however, most architects of electronic agrifood chain information management systems do not look for interoperability as much as for adoption. Consequently, there are quite a few efforts worldwide to provide the same kind of information to the supply chain, none of them successful on a large scale.

The cumulative push model (figure A2.1) is a simple model requiring IT capabilities only at the last point where information accumulated over several steps is pushed into an electronic system. Information contributors without direct access to the traceability system can deliver the information via other types of information exchanges, such as e-mail and CSV files, or can even deliver the information on paper (so- called mixed paper-electronic systems).

Figure A2. 1. The cumulative push model

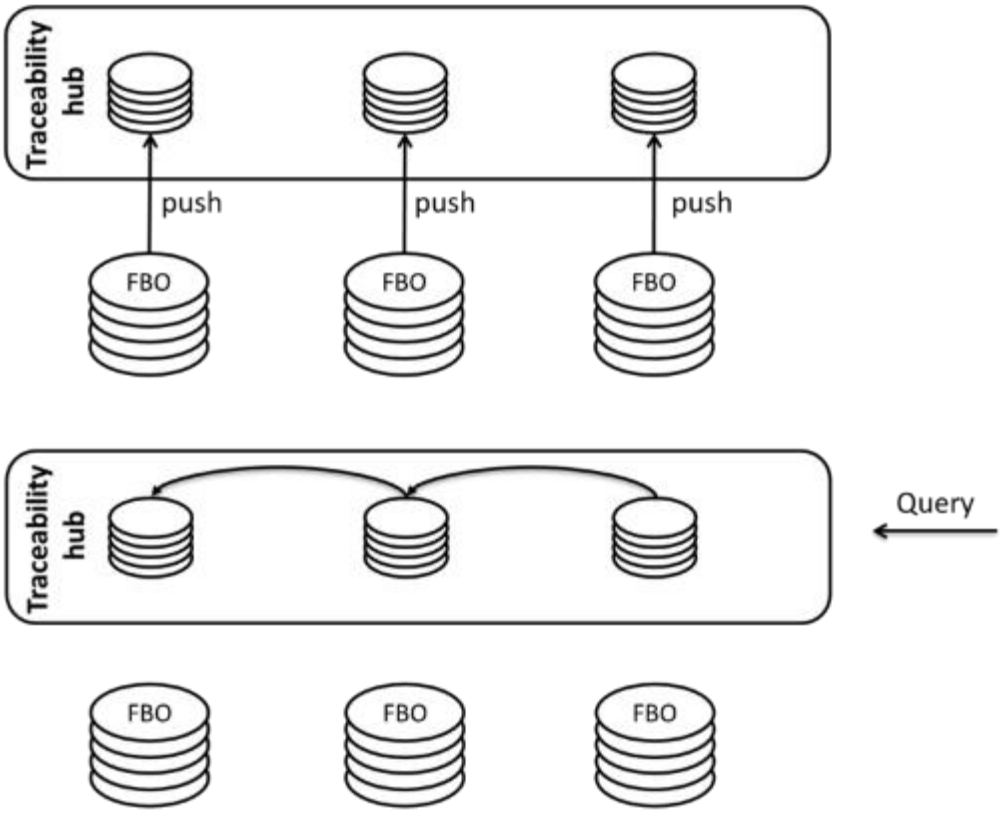


The ePermit systems are (often) of the cumulative push type. Exporters push information collected from the chain into a centralized database where it can then be accessed by officials dealing with the export permit process.

This model is very successful in the case where early-stage supply chain partners either have no knowledge or no interest in participating in the agrifood chain information effort. It is also a successful transitory model where the extension of the direct information suppliers is slowly pushed back into the chain, arriving finally at a full push model (see below).

However, the model has strong disadvantages – data should always be captured as near to the source as possible, as the number of errors in the data increases strongly with the distance from the source.

Figure A2. 2. The pure push model



The pure push model is a specialization of the cumulative push model where all parties directly push information into a traceability hub (which can be either centralized or decentralized).

Few pure push models have been implemented internationally; the UTZ Certified[55] system for coffee, cocoa and palm oil is one example where all the supply chain partners have to contribute information, in this case to a centralized database.

Typically, the description of a traceability unit is divided into master or static data, which describes such data that supposedly are "inherent" in the element, and "usage" data, which describes actions performed on or with the element.

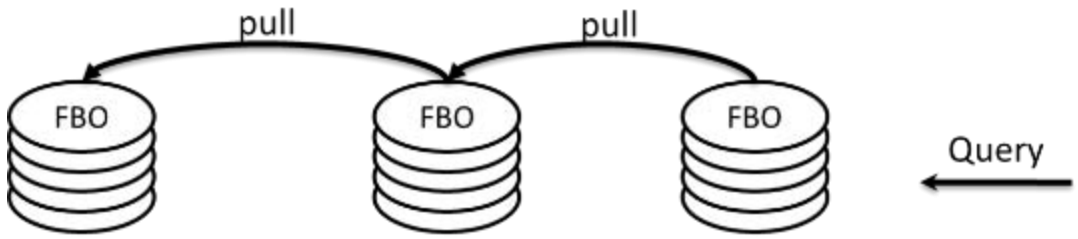
To access either master or transactional data, there are two basic models, the "hub" model and the "chain" model [(reference)].

In the hub model, data is copied to a "hub" and queries are then resolved solely on the hub. This model is similar to that of a centralized database. In the "chain" model, data is left at its origin and queries are resolved by hopping from one node to another (somewhat like DNS, the service that translates "web addresses" (i.e., URLs) into IPs (i.e., numbers required for the data transport).

[55] www.utzcertified.org.

Queries are resolved on the traceability hub level and do not require further data from FBOs. This is very effective for government control systems, but copying data instead of referencing it always creates problems with outdated and non-corrected data.

Figure A2. 3. The pull model or distributed model



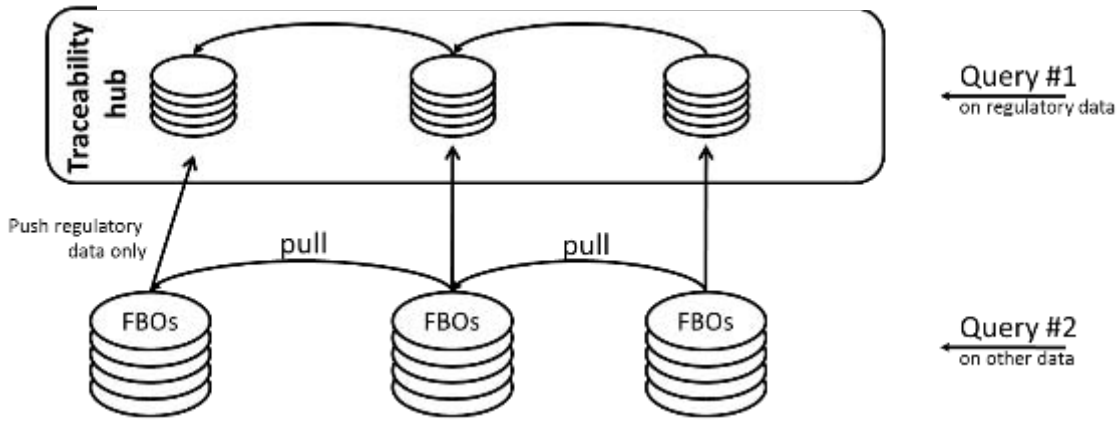
In the pull model, FBOs store and manage their own data without pushing it into a centralized system. Queries are resolved in hopping from one FBO to another following the queries trace.

This is the basic concept for "one up-one down" regulations that require the companies to store data about direct suppliers and demanders. The European Food Law 178/2002 established such a system – without a requirement for it being electronic.

Typically, a pull system is accompanied by some form of search service to obtain the initial entry point for a query. One obvious advantage is the scalability of the system; since there is no hub system, the load is completely distributed, thus nowhere creating a point of stress. Another advantage of this model is that there is no copying of data, so the quality of data should be the best available. A strong disadvantage is the dependency on each step doing the forwarding correctly. Also, FBOs have the ability to shut down access to their data more easily.

If a commonly accepted standard for electronic exchange of information exists, this could be a good, if fragile, model.

Figure A2. 4. Mixed push-pull or layered model



The last model effectively addresses the rather complicated question of privacy in food traceability by splitting information into two or three areas:

(a) Company-restricted information that is shared based only on private contracts between the FBO and its supply chain partners;
(b) Regulatory information that is provided to food authorities to enable them to deal effectively with incidences, statistics requirements and other issues. The information required by the authority is legally required. It may be company-specific, but can also be aggregated data only;
(c) Compliance-related information to which operators of a standard compliance scheme might require access. This is data that are required by standard scheme operators and governed by a private contract between the standard operator and FBO.

Although this model clearly restricts access to data and removes the fear of a privacy breach, the question still remains as to who operates the traceability system. Internationally, five approaches have been observed:

1. The top-down model, as seen in efforts by China, Indonesia, Malaysia, Thailand, Viet Nam, and other countries, where the Government basically provides a system and expects FBOs to use it. Compliance systems, such as the European TRACES, would also fall into this category;
2. The bottom-up approach, which is followed by Norway where industry associations run a traceability system and ask their members to use them;
3. Partial models such as those in the United States, where data are requested and then stored on a per case basis. This does not allow for general chain traceability, but does enable chain-connects particular batches in case of incidences;
4. Standard operators such as RSPO or ACC mandate the use of a chain traceability system (UTZ Certified and TraceRegister, respectively);
5. Private companies that offer their services based on a legally enforceable contract with privacy guarantees.

None of the above approaches have really convinced the general food industry worldwide. In addition, the absence of a universally accepted data exchange format isolates the different systems, making a worldwide approach additionally complicated.

The general loser is, of course, the consumer. Less available information means less (informed) choice, more insecurity (e.g., in the case of allergies) and more fraud. It also means not only great trade inefficiencies, such as trade barriers, but also errors in sourcing, superfluous stocking, shorter shelf-life and a general loss of market access.

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