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REPORT ON APEC REGIONAL STUDY

DEVELOPING AND APPLYING TRACEABILITY SYSTEM IN AGRICULTURE PRODUCTION AND TRADE

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Evaluation readiness of developing and applying traceability system in Agricultural trade and production.

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APEC Secretariat
35 Heng Mui Keng Terrace Singapore 119616
Tel: +65 68919600 Fax: +65 6891690
Email: info@apec.org Website: www.apec.org

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ATCWG Focal Point of Viet Nam
International Cooperation Department
Ministry of Agriculture and Rural Development
Tel: (84-4) 38437674
Fax: (84-4) 37330752
Email: dunght.htqt@mard.gov.vn; congt.htqt@mard.gov.vn
2 Ngoc Ha - Ha Noi - Viet Nam

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I. BACKGROUND

1. Project initiation

In recent years, concerns again food poisoning and outbreaks (such as "mad cow disease", avian influenza, FMD, microbial contamination, food addictives, etc) in both developed and developing countries, has emerged the demand for safety of food and food-related standards that protect public health and reduce negative social and economical impact of such crises. The accurate and timely traceability of products and activities become emerging factor in food industry and agro-business.

Since food safety hazards can enter the food chain at any stage, adequate control and communication throughout the process is very important. One weak link in the supply chain can result in unsafe food, and therefore can present a serious risk and danger to public health and has costly diverse effects again suppliers. For this reason, the safety of food is the join responsibility of all the stakeholders involved.

A effective traceability system shall allow an organization to document and locate a product through the stages and operations involved in the manufacture, processing, distribution and handling of feed and food, from primary production to end-user. It can therefore facilitate the identification and isolation of hazards and the causes for nonconformity with a product, and the ability to set forth corrective actions and to withdraw and recall these products if necessary.

In Vietnamese economy, Agriculture accounts for 20% of the total GDP and approximately 70% of the economy's population live on this sector. During past few decades, economic development in Viet Nam has gain some progress and the economy is recognized as one of leading exported economies for agricultural products. However, the system that support for the tracing back to source and tracking forward the movement of agricultural production in the APEC member economy is not usually possible.

Coping with the increase demand of traceability, recently, Vietnamese government has released several legal documents to address the issue. These legal documents are, however, not synchronic and lacking of guidelines on implementing procedures. Moreover, adding to this weakness, agriculture in Viet Nam base largely on household and small scale production. To meet new emerging requirements from markets, it is very useful to conduct a study to analyze current situation and opportunities to establish a traceability system in order to improve quality of agricultural

products for the cause of safety and well-being of people and to maintain the economy's competitiveness of agricultural products. Result from the study, in this context, may help to find out new experience and appropriate model to conduct the issue in APEC member, especially developing economies.

Viet Nam, at the 11th ATCWG meeting, has proposed the project on Evaluation *readiness of developing and applying traceability system in agricultural trade and production* in response to the Sydney's Joint Statement of the Nineteenth APEC Ministerial Meeting in Sydney in September 2007 on Food and other Product Safety and the establishment of the APEC Food Safety Cooperation Forum that aim at to deepen APEC cooperation, "improve on current standards and practices and strengthen scientific risk-based approaches to food safety and other products to facilitate trade and ensure the health and safety of our populations" and "to harmonize food safety regulations with international standards, to improve health and food safety outcomes and to establish more effective communication networks". The project is also supports initiatives state in Trade Facilitation Action Plan II on Food Safety and Standards Harmonisation. Through the project, it is expected that the improvement of awareness of traceability system and cooperation in issue of safety of food in the agriculture sector in Vietnam, developing APEC economies in particular and in APEC region in general.

2. Objectives of the project

The overall objective of the study is to evaluate the readiness of developing and applying traceability system in agricultural trade and production on agriculture production including agriculture, forestry, aquaculture from which lessons and experience will be withdrawn as well as solutions and policy options will be introduced to improve capacity of central and local administrative agencies. Guideline and training in APEC region will also be conducted to facilitate the cooperation and sharing information among the member economies.

Specific objectives of the project are as followings:

- Raising awareness and provide better understanding of traceability system in agriculture production in APEC region.
- Conducting survey and analysis of the readiness of developing and applying traceability system in agriculture production;
- Drawing lessons from APEC economies and broaden the types of traceability system in APEC. Providing strategies and policy options to agriculture production especially for APEC developing economies

in order to strengthen the capacity of administrative system dealing with the raising issue.

Given that exporting largely in agricultural products, there have not got any study on traceability of agricultural production. With the results find out from this research, it is expected that result will be benefited the scientists, policy makers, and especially the farmers in Viet Nam and APEC's members.

- Policy makers can have good information and analysis on the developing and applying traceability system agriculture production in the regions as well as the recommendations for developing their own policy on agriculture sector.

- Rural areas and farmers in Viet Nam and in other developing economies in APEC region can have more experience and thus improve agriculture productivity as well as cooperation in the region toward food safety and well-being of people in the region. Enterprise s working in agro-business sector should have an interest in the outcomes will be acquired more knowledge and recommendations as reference sources for developing traceability system of their own.

- Researchers in the region will have good chance to exchange information and view points on the experiences of developing and applying traceability on agriculture production.

3. Key concepts

Traceability is a widely used term. There are many definitions and application. The application of traceability in food will depend on the nature of production operation and product. Although traceability is legal requirements in many countries, including the EU, and a requirement of international standards, such as ISO22000, and private commercial standards, none is prescriptive in the way traceability is achieved. This is because many options are available. In general, traceability is the ability to trace the history, application or location of that which is under consideration. Traceability has two components: *tracking* and *tracing*.

- *Tracking***:** is the capability to follow the path of a specified unit and/or lot of trade items downstream through the supply chain as it moves between trading partners. Or in other words, it refers to the ability to follow the downstream path of a product along the supply

chain, possibly according to some specific criteria. This is crucial factor, e.g. for an efficient recall of faulty products.

- *Tracing:* is the capability to identify the origin of a particular unit located within the supply chain by reference to records held upstream in the supply chain. Or in other meaning, it refers to the ability to determine the origin and characteristics of a particular product. This is obtained by referencing to records held upstream in the supply chain. Tracing can help detect the cause of quality problems.

- *Supply Chain* is a set of approaches utilized to efficiently integrate suppliers and clients (comprised of stores, food service, retailers, wholesalers, warehouses, distributors, manufacturers and primary producers) so food and food products are produced and distributed in the correct quantities, to the correct locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements.

The Three Basic Elements of Traceability

- *Product, Party and Location Identification*: Fundamental to tracking and tracing a product for full chain traceability is that every food component harvested from farm or sea and through every stage of its transformation/packaging to a finished consumer product must be uniquely identified at each stage of transformation or possession – and that these identifiers be linked.

- *Recording of Information:* Effective traceability requires standardizing the information that needs to be recorded through each step of the food production and distribution chain.

- *Linking of Information:* To ensure the continuity of the flow of traceability information, each partner must pass on information about the identified lot or product group to the next partner in the production chain, or alternatively, to a central data base or registry where information can be retrieved when necessary.

On the other hand, traceability identifies the path from which a product has originated to the customers to whom it has been supplied, and consists of an interlinking chain of records. Therefore, with the supply chain approach, a traceability system should has three basic components: i) supplier traceability, which enables the sources of raw material to be identified; ii) process traceability, which enables the identify of raw material and process

records for a product, i.e. the process history; and iii) customer traceability, which enables to whom each product is supplied to be identified.

Linked to these basic components is effective record keeping. There are two categories of information relating to traceability: i) internal traceability, which relates to the processing history within an operation; and ii) external traceability which relates to information the operation either receives from suppliers or provides to customers.

Most of operations cannot create whole chain traceability, but each has a role to play in collecting and storing information about the process and products under their control. Traceability in the food chain relies on each operator establishing traceability, keeping associated records and being able to make information available, in the section of the food chain under their control.

It is the truth that traceability itself does not make food safe. It does, however, give the assurance of food safety and it enables necessary action to be taken if food is found to be potentially non-conforming. This is the basis of the legal provisions in countries such as EU and in other international standards.

In EU Food Law, food business operators must be able: a) to identify from whom and to whom a product has been supplied (external traceability); and b) To have systems and procedures in place that allow for this information to be made available to relevant authorities.

This requirement relies on the “one step back” and “one step forward” approach, i.e. external traceability, which implies food business operators must be able to:

- Identify suppliers of their raw materials (supplier traceability);
- Identify the businesses to whom products have been supplied (customer traceability); and
- Produce this information to relevant authorities in a timely manner.

In international standards, such as ISO22000, and private commercial standards, such as GlobalGAP and BRC Global Standard for Food Safety, internal traceability is also required, i.e. process traceability to link raw materials with finished product.

Taking all of the requirements as specified in legislation and international and commercial standards into account, then the basis of a traceability

system for food business operations in the food chain (e.g. farm, trader, and processor) is:

- Identify and trace what is received (external, one step down traceability);
- Identify and trace what is produced from what, when and how (internal traceability); and
- Identify and trace where finished product is sent (external, one step up traceability)

Agricultural traceability simply refers to the collection, documentation, maintenance and application of information related to all processes in the supply chain in a manner that provides guarantee to the consumer and other stakeholders on the origin, location and life history of a product as well as assisting in crises management in the event of a safety and quality breach. With respect to a food product, traceability represents the ability to identify the farm where it was grown and sources of input materials, as well as the ability to conduct full backward and forward tracking to determine the specific location and life history in the supply chain by means of records. It contributes to the demonstration of the transparency of the supply chain through the use of verifiable records and labeling. Traceability adds value to the overall quality management system by providing the communication linkage for identifying, verifying and isolating sources of noncompliance to agreed standards and customer expectations. There are six important elements of traceability which put together, constitute an integrated agricultural and food supply chain traceability system:

(a) Product traceability - which determines the physical location of a product at any stage in the supply chain to facilitate logistics and inventory management, product recall and dissemination of information to consumers and other stakeholders.

(b) Process traceability - which ascertains the type and sequence of activities that have affected the product during the growing and post-harvest operations (what happened, where, and when). These include interactions between the product and physical/mechanical, chemical, environmental & atmospheric factors which result in the transformation of the raw material into value-added products; and the absence or presence of contaminants.

(c) Genetic traceability - which determines the genetic constitution of the product. This includes information on the type and origin (source, supplier) of genetically modified organisms/materials or ingredients as well as

information on planting materials (such seeds, stem cuttings, tuber, sperm, embryo) used to create the raw product.

(d) Inputs traceability - which determines type and origin (source, supplier) of inputs such as fertilizer, chemical sprays, irrigation water, livestock, feed, and the presence of additives and chemicals used for the preservation and/or transformation of the basic raw food material into processed (reconstituted or new) food products.

(e) Disease and pest traceability - which traces the epidemiology of pests, and biotic hazards such as bacteria, viruses and other emerging pathogens that may contaminate food and other ingested biological products derived from agricultural raw materials.

(f) Measurement traceability - which relates individual measurement results through an unbroken chain of calibrations to accepted reference standards. To achieve this, measuring and test equipment and measurement standards are calibrated utilizing a reference standard whose calibration is certified as being traceable to a national or international standard. The other aspect of measurement traceability relates to the property of the measurements (data and calculations) generated throughout the supply chain and their relationship to the requirements for quality. By focusing on the quality of measurements (rather than on a property of an instrument, it is possible to assure that the measurements are indeed adequate for the intended use. To achieve this, each measured data must specify the environmental, perator, and geospatial and temporal factors, which are not related to the instrument but impact on the quality of the data.

II. STUDY METHODOLOGY

The project focuses on main activities to analyze the current situation of traceability in agricultural production including legal framework and application in Viet Nam. Data and experience of application was also collected from some APEC member, developed and developing economies, in order to have an overview of the situation of developing and applying traceability for agro-business in the region. Moreover, with recognition that traceability is gradually transferring from voluntarily basis to requirements from current major export markets, regulations and standards were also reviewed.

Literature review and field visit

The scientific literature concerning product traceability is gathered and reviewed with regarding all factors that would have impacts on the development and application of traceability.

Some findings and observation given in this report are based on the meetings and visit made, the information obtained during the mission and discussion with other project personnel that direct on indirect related to traceability application in Viet Nam.

National Workshop

National workshop was organized in order to involve stakeholders including representatives from government agencies, pilot projects, research institutions in Vietnam, enterprises. The workshop was intended to discuss on current situation of the development and application of traceability in agro-business and to recommend solutions for dealing with current challenges.

Regional Workshop

An APEC regional workshop was held in Viet Nam to gather inputs from APEC member economies for the study and to discuss on current challenges and suggest policy recommendations. Major stakeholders in Viet Nam , including representatives of state management agencies, research institute, consumer organizations, agro-business enterprises and associations was also invited to participate the workshop.

Preparation of report

The result from extensive literature review, case study in Viet Nam was outlined in a draft report. The draft report will be finalized with experience and lesson learnt in some APEC member economies that concluded from the regional workshop.

III. TRACEABILITY DEVELOPMENT AROUND THE WORLD

1. Traceability in agri-business as emerging issues

In 1985, a UN General Assembly resolution gave rise to the Guidelines for consumer protection, which were published in 1986. These guidelines identify food as one of three priority areas of essential concern to consumer health. The Codex Alimentarius (Food & agriculture organization of the United Nations, 1999) evolved from these UN guidelines as these were selected as the reference point for the FAO Codex Alimentarius guidelines

regarding food. While this codex also deals with quality issues, it reflects an emphasis on ensuring that consumers receive products that are safe and do not pose a threat to health.

The United States Department of Agriculture published ‘‘Traceability for Food Marketing and Food Safety: What’s the Next Step” (2002). The paper set out the case for voluntary traceability within the food industry, and then argues that government should ensure that the private sector meets performance targets for food safety, but there are no prescriptions and only suggestions on how this goal should be achieved.

EU is the early mover in transfer requirements for food traceability in legal documents. Since the beginning of 2005 a system has been required from food processors for identifying the origin of raw materials and the destination of final products i.e. one step forward and one step backward in the production chain. This was stated in EU regulation 178/2002, which includes the following clear requirements for traceability:

> 1. The traceability of food, feed, food-producing animals, and any other substance intended to be, or expected to be, incorporated into a food or feed shall be established at all stages of production, processing and distribution.
>
> 2. Food and feed business operators shall be able to identify any person from whom they have been supplied with a food, a feed, a food-producing animal, or any substance intended to be, or expected to be, incorporated into a food or feed. To this end, such operators shall have in place systems and procedures which allow for this information to be made available to the competent authorities on demand.
>
> 3. Food and feed business operators shall have in place systems and procedures to identify the other businesses to which their products have been supplied. This information shall be made available to the competent authorities on demand.
>
> 4. Food or feed which is placed on the market or is likely to be placed on the market in the Community shall be adequately labelled or identified to facilitate its traceability, through relevant documentation or information in accordance with the relevant requirements of more specific provisions.

In addition to the EU regulation, several countries have enacted specific legislative measures. The requirements for one step backward, one step

forward traceability are similar in the US. For food exported to the US, the requirements for documentation and traceability are even more detailed, due to The Bioterrorism Act of 2002 which came in force on August 12th 2004.

However, although the EU regulation has come in force, the regulatory situation is confusing. There are currently no general legal requirements for the establishment of traceability systems in food chains. The only mandatory traceability systems enforced throughout a complete food chain concerns beef on sale within EU, which must to be traced back to where it originated. Neither the EU regulation nor previously published documents give any precise requirements that would help in fulfilling the requirements.

Since 18 April 2004, the regulation 1829/2003/EU on genetically modified foods and feeds, the regulation 1830/2003/EU on the traceability and labeling of food products made from genetically modified organisms, and the directive 2001/18/EU on the deliberate release of genetically modified organisms into the environment and repealing Council Directive 90/220/EEC, have been applied in EU. Use of genetically modified material in foods and feeds is still subject to permission in EU and the permission is given by The Commission. This material must be able to be traced at its all production steps from the end products to the raw materials.

As the implementation of traceability systems is greatly voluntary, some pioneer companies have been developing their own traceability systems primarily to reduce business risk, but they have been lacking standards, which has resulted in much differentiated systems. As a consequence these systems have been producing different economical results.

International organization for standardization (ISO) introduced in the beginning of 2006 two new standards that define the requirements for a traceability system within a food safety management system and the data that needs to be retained (ISO 22000:2005. Food safety management systems: Requirements, and ISO 22519. Traceability system in the agriculture food chain: General principles for design and development. ISO's technical committee is also establishing a standard ISO/FDIS 22005:2007 .Traceability in the feed and food chain: General principles and basic requirements for system design and implementation.

International organization Codex Alimentarius has dealt with questions on traceability during the last years. It uses the definition of international standardization organization (ISO) for traceability: ISO 8402:1994 or ISO:2000 series of Quality Management Standards. Codex Alimentarius

and European committee for Standardization (CEN) have established the following standards:

- Alimentarius CAC/GL 60-2006 Principles for Traceability/Product Tracing as a Tool within a Food Inspection and Certification System.
- CWA 14659:2003 Traceability of fishery products. Specification of the information to be recorded in farmed fish distribution chains
- CWA 14660:2003 Traceability of fishery products. Specification on the information to be recorded in captured fish distribution chains
- CEN/SS C01. Food Products ISO 22005 Traceability in the feed and food chain. General principles and basic requirements for system design and implementation (ISO/FDIS 22005:2007).

GS1, a global not-for-profit organization, has recently published a global traceability standard, the GS1 Traceability standard. GS1 is dedicated to the design and implementation of global standards, technologies and solutions to improve efficiency and visibility in supply and demand chains and is formed as a result of the merger of EAN International and the Uniform Code Council. The standard defines the minimum requirements and business rules to be followed when designing and implementing a traceability system. It divides this process to five sub-processes:

- Plan and Organize: determines how to assign, collect, share and keep traceability data.
- Align Master Data: determines how to assign identifications to the parties, physical locations, trade items and assets as well as how to exchange master data with trading partners.
- Record Traceability Data: determines how to assign, apply and store data during the physical flow.
- Request Trace: sub-process determines how to initiate and respond to a traceability request and
- Use information: enables the use of the previous processes to take appropriate action to meet legal and business requirements.

GS1 Traceability Standard is based on existing business practices and there is no need to purchase, create or integrate new systems. It uses a common language, the GS1 System of identification and bar coding, GS1 EANCOM® and GS1 XML messaging.

GS1 Standard has a global approach as it is used in over 150 countries around the world. The standard is thorough, covering the fundamentals of traceability. It is also flexible, recognizing that circumstances vary within and between sectors and individual retailers and manufacturers.

2. Traceability in some APEC member economies

2.1. Traceability development in Japan

Inspired by increasing aware and concerned about food safety issues arising from the reported incidents of BSE, pesticide misapplication and presence of pesticide residue in the produce, in Japan, the establishment of food traceability systems prompted as a ways to disclose information about food production and distribution processes, to guarantee food safety and reliability.

The Japanese government, as well as local governments and JA (Japan Agricultural Cooperatives) have been actively promoting the development and practical application of food traceability systems as national projects since 2001. The Ministry of Agriculture, Forestry and Fisheries of Japan has announced "*Reproduction plan of food and agriculture*" in April, 2002, and "*Safety of food and policy outline for safety*" in June, 2003. By issuing those documents, MAFF indicated that the food safety is an important component of her policy in order to provide information that consumer requests, and to work on the risk management of food.

The Food Safety Commission was established as an organization that undertakes risk assessment. It works independently from risk management organizations such as the Ministry of Agriculture, Forestry and Fisheries, and the Ministry of Health, Labor and Welfare.

Currently, there are four type of traceability systems in Japan.

- *The beef traceability system:* the beef traceability is mandated since 2003 and chiefly targets domestic beef. In this system, information of cow's date of birth and sex, type, breeding location, and the breeding manager, etc. should be recorded and is made obligatory by law.

- *The food traceability system* targets foods other than domestic beef. This system doesn't allow the entrepreneur to owe a law obligation, and support their independent activities. The producer and the enterprise independently set recorded information.

- *The production history registration movement* targets the whole food. In this system, there is an effort obligation to record the item provided by Food Sanitation Law. The producer and the enterprise independently set other items.

- *The system of production information making* (JAS) targets beef (December, 2003, the imported beef is included), pork (July, 2004) and farm products (July, 2005), etc. In this system, the recorded item is provided by each commodity. In this system, in order to inform the consumer the production history, the JAS mark can be put to farm products that receive a third party certification. For instance, it is necessary to record fodder and the animal medicine in the beef production and the items provided by the beef traceability system. In farm products, it is necessary to record agricultural chemicals and the fertilizer used in production.

Name of system	Target	Record item
The beef traceability system	domestic beef	date of birth, sex, type, the breeding location, breeding manager,
The food traceability system	foods other than domestic beef.	The producer and the enterprise independently set recorded information.
The production history registration movement	whole food	An effort obligation to record the item provided by Food Sanitation Law.
The system of production information making (JAS)	beef, pork and farm products,	animal medicine, agricultural chemicals, the fertilizer

Table 1. Institutional Systems of Food Traceability in Japan

So far, MAFF is carrying various activities to support develop traceability such as writing guidelines, provide subsidy for development and testing of traceability system and technology, promoting traceability to public and companies. According to MAFF report in 2007, in Japan, 17.2% of food manufacturers in Japan had introduce traceability for all food and another 20.7% has applied traceability for some food. For the food retailers, 14.8% have traceability in place for all food and 21% for some foods.

2.2. Traceability development in US. Legislation framework.

The U.S. Government has a long history of mandating programs that contain traceability requirements. Government regulations have a diverse set of objectives. Often, they take into consideration ensuring a level of food safety, preventing and limiting animal diseases, or facilitating market transactions. Some of these regulations entail establishing traceability systems for select attributes in particular food sub-sectors, while other regulations have broader objectives but, in effect, require firms to develop tracing capacity. Whether the intent of the regulation is to address food safety or animal disease concerns or other issues, Government imposed demands for traceability usually requires information about the sellers and buyers (name, address, phone, etc.) and product-related information. The demands on recordkeeping are usually one-up, one-back traceability. Less frequently required are traceability systems for quality credence attributes that have become more prevalent in the private sector, although there are exceptions, such as the national organic food standard.

Below is the highlight of important regulations that require traceability systems. The relevant legislation, the objectives of the regulations, the product coverage and the recordkeeping are indicated.

Meat, Poultry, and Egg Inspection Acts was passed in 1906 for meats, 1957 for poultry, and 1970 for eggs. The Wholesome Meat and Poultry Acts of 1967 and 1968 substantially amended the initial legislation. The Acts have the primary goals of preventing adulterated or misbranded livestock and products from being sold as food and to ensure that meat and meat products are slaughtered and processed under sanitary conditions. The Food Safety and Inspection Service (FSIS), USDA, is responsible for ensuring that these products are safe and accurately labeled. The Acts call for complete and accurate recordkeeping and disclosure of all transactions in conducting commerce in livestock, meat, poultry, and eggs. For example, packers, renderers, animal food manufacturers, or other businesses slaughtering, preparing, freezing, packaging, or labeling any carcasses must keep records of their transactions. Businesses only need to maintain one-up, one-back records. For imported meat, poultry, and egg products, importers must satisfy requirements of two USDA agencies—FSIS and the Animal and Plant Health Inspection Service (APHIS)—and the U.S. Customs Service (USDA, FSIS, October 2003). Imported meat and poultry must be certified, not only by country but by individual establishment within a country. Certificates are issued by the government of the exporting economy and are required to accompany imported meat, poultry, and egg products to identify products by economy and plants of origin, destination, shipping marks, and amount. FSIS demands that the country of origin provide a health certificate indicating the product was inspected and passed by the economy's inspection service and is eligible for export to the United States.

To meet APHIS requirements, the product must not come from countries where certain animal diseases are present. USDA requirements are binding as the U.S. Customs Service demands that the importer post a bond, including the value of the product plus duties and fees, until FSIS notifies the Service of the results of its re-inspection. Failure to meet U.S. requirements may lead to forfeiture plus penalties.

Perishable Agricultural Commodities Act (PACA) was enacted in 1930 to promote fair trading practices in the fruit and vegetable industry. The objective of the recordkeeping is to help facilitate the marketing of fruit and vegetables, to verify claims, and to minimize any misrepresentation of the condition of the item,
particularly when long distances separate the traders. PACA calls for complete and accurate recordkeeping and disclosure for shippers, brokers, and other first handlers of produce selling on behalf of growers. PACA has extensive recordkeeping requirements on who buyers and sellers are, what quantities and kinds of produce is transacted, and when and how the transaction takes place. PACA regulations recognize that the varied fruit and vegetable industries will have different types of recordkeeping needs, and the regulations allow for this variance. Records need to be kept for 2 years from the closing date of the transaction.

National Shellfish Sanitation Program. Federal Food, Drug, and Cosmetic Act, portions revised or new as amended by the Food and Drug Administration (FDA) Modernization Act and various State health regulations. Shellfish must comply with the general requirements of the Federal Food, Drug, and Cosmetic Act and also with requirements of State health agencies cooperating in the National Shellfish Sanitation Program (NSSP) administered by the FDA in cooperation with the Interstate Shellfish Sanitation Conference (ISSC) (FDA, CFSAN, January 2003). A key objective is to mitigate the adverse effects of a disease outbreak. Regional FDA specialists with expert knowledge about shellfish assist State officials with trace back. When notified rapidly about cases, they are able to sample harvest waters to discover possible sources of infection and to close waters when problems are identified.

Shellfish plants certified by the State Shellfish Sanitation Control Authority are
required to place their certification number on each container or package of shellfish shipped. The number indicates that the shipper is under State inspection, and that it meets the applicable State requirements. It is central to tracing and identifying contaminated shipments. Shippers are also required to keep records showing the origin and disposition of all shellfish handled and to make these records available to the control authorities.

Organic Foods Production Act was enacted in 1990. Act was subsequently amended and rules went into effect October 2002. The objective of the Act is to establish national standards governing the marketing of certain agricultural products as organically produced products, to assure consumers that organically produced products meet national production, handling, and labeling standards, and to facilitate commerce in fresh and processed food that are organically produced.

Organic food certifiers work with growers and handlers to develop an individualized recordkeeping system to assure traceability of food products grown, marketed, and distributed in accordance with national organic standards (USDA, AMS, October 2002). Records can be adapted to the particular business
as long as they fully disclose all activities and transactions in sufficient detail to be readily understood, have an audit trail sufficient to prove that they are in compliance with the Act, and are maintained for at least 5 years. Many different types of records are acceptable. For example, documents supporting an organic system may include field, storage, breeding, animal purchase, and health records, sales invoices, general ledgers, and financial statements. In order for the attribute "organic" to be preserved, growers and handlers must maintain traceability from receiving point to point of sale and ensure that only organic or approved materials are used throughout the supply chain. Thus, for a traceability system for organic products to be viable it must confer depth.

Food Assistance Programs. The National School Lunch Act was enacted in 1946 after World War II. Objective of the program is to reduce malnutrition and improve poor eating habits, the U.S. Department of Agriculture provides food assistance to schools, Native American reservations, and needy families, the elderly, and the homeless through Federal Food Assistance Programs. In addition to financial subsidies for food purchases, the institutions receive entitlement and bonus commodities. The bonus commodities are procured to support the farm community in specific commodity markets that are experiencing weak market conditions. It coverage the series of products include flour, grains, oils and shortenings, dairy, red meat, fish, poultry, egg, fruit, vegetable, and peanut products.

To guarantee that foods are strictly American, producers who win U.S. Department of Agriculture contracts must provide documentation establishing the origin of each ingredient in a food product (USDA, AMS, 2003). The producer pays USDA inspectors to review the traceability documents and certify the origin of each food. Starting with the "code" or lot number on a processed product, inspectors use producer supplied

documentation to trace product origins all the way back to a grower's name and address.

Country of Origin Labeling. The legislation amends the Agricultural Marketing Act of 1946 by incorporating country of origin labeling (COOL) in the Farm Security and Rural Investment Act of 2002 (Public Law 107-171). Specific guidelines for voluntary labeling were issued in 2002 and are currently in effect (USDA, AMS, October 11, 2002). Mandatory labeling rules were proposed in October 2003. The Farm Act states that mandatory COOL is to be promulgated no later than September 30, 2004. However, the 2004 Omnibus Appropriations Act delays until September 20, 2006, implementation for all covered commodities, except wild and farm raised fish, which must be labeled beginning September 30, 2004. The objective is to provide consumers with more information regarding the economy where covered commodities originate. The legislation affects the labeling of beef, pork, lamb, fish, shellfish, fresh fruit, vegetables, and peanuts. COOL is not required if these foods are ingredients in processed food items or are a combination of substantive food components. Examples include bacon, orange juice, peanut butter, bagged salad, seafood medley, and mixed nuts.

Food service establishments such as restaurants, food stands, and similar facilities including those within retail stores (delicatessens and salad bars, for example) are exempt from the requirements. Moreover, grocery stores that have an annual invoice value of less than $230,000 of fruits and vegetables are exempt from COOL requirements. Consequently, retail food outlets, like butcher shops and fish markets that do not sell fruit and vegetables, are not included under COOL requirements.

Retailers may use a label, stamp, mark, placard, or other clear and visible sign on
the covered commodity, or on the package, display, holding unit, or bin containing the commodity at the final point of sale. The Act and the proposed rules have stringent requirements on the depth of recordkeeping. First, the supplier responsible for initiating the country-of-origin declaration must establish and maintain records that substantiate the claim. If a firm already possesses records, then it is not necessary to create and maintain additional information.

As a vertical supply chain, there must be a verifiable audit trail to ensure the integrity of the traceability system, that is, firms must assure the transfer of information of the country-of-origin claim. As a consequence, firms along the supply chain must maintain records to establish and identify the immediate previous source and the immediate subsequent recipient of

the transaction. For an imported product, the traceability system must extend back to at least the port of entry into the United States. Firms have flexibility in the types of records that need to be maintained and systems that transfer information. Records need to be kept for 2 years. The proposed rules provide flexibility in the type of recordkeeping. The Act states that the Secretary shall not use a mandatory identification system to verify country of origin. The U.S. Department of Agriculture provides examples of documents and records that may be useful to verify compliance with the Country of Origin Labeling provisions of the 2002 Farm Bill. (See http://www.ams.usda.gov/cool/records.htm.) These records vary depending on the business activities. As an example, a ship catching wild fish may keep records of site maps, and vessel, harvesting, and U.S. flagged vessel identification records. A distributor of wild fish may keep records of invoices, receiving and purchase records, sales receipts, inventories, labeling requirements, a segregation plan, and UPC codes.

Public Health Security and Bioterrorism Preparedness and Response Act of 2002 provides new authority to the Federal Drug Administration. The objective is to protect the Nation's food supply against the threat of serious adverse health consequences to human and animal health from intentional contamination. All foods are subject to the legislation except meat, poultry, and eggs (which are under U.S. Department of Agriculture's jurisdiction). The Act requires both domestic and foreign facilities to register with the FDA no later than December 12, 2003 (FDA, CFSAN, 2002). Facilities subject to these provisions are those that manufacture, process, pack, transport, distribute, receive, hold or import food. The Act exempts farms, restaurants, other retail food establishments, nonprofit food establishments in which food is prepared for or served directly to the consumer; and fishing vessels from the requirement to register. Also, foreign facilities subject to the registration requirement are limited to those that manufacture, process, pack, or hold food, only if food from such facility is exported to the United States without further processing or packaging outside the United States.

The Act requires the creation and maintenance of records needed to determine the immediate previous sources and the immediate subsequent recipients of food (i.e., one-up, one-down). For imported food the rules also require prior notice of shipment and a description of the article including code identifiers, the name, address, telephone, fax, and email of the manufacturer, shipper, and the grower (if known), the country of origin, the economy from which the article is shipped, and anticipated arrival information. Records are required to be retained for 2 years except for perishable products and animal foods (for example, pet foods) where 1 year of recordkeeping is allowed. Records may be stored offsite. Food Safety

and Inspection Service, USDA, has jurisdiction of meats, poultry, and eggs. FSIS has been issuing guidance to businesses engaged in production and distribution of these USDA-regulated foods. Among the guidance principles for slaughter and processing facilities, FSIS recommends validated procedures to ensure the trace-back and trace-forward of all raw materials and finished products.

Lesson learnt from US Traceability system is that the best role of Government policies is focus on strengthening firms' incentives to invest in traceability to ensure that unsafe food are quickly removed from the system, while allowing firms the flexibility to determine the manner.

2.3. Traceability development in Chinese Taipei

To improve safety, transparency and reliability of the value chain for agricultural products, central competent authority on agriculture in Chinese Taipei, the Council of Agriculture of the Executive Yuan, Chinese Taipei R.O.C. (COA), have constructed and promoted traceability certification system on certain domestic agricultural products.

In January 2007, "Agricultural Production and Certification Act" was enacted by the Legislation Yuan, Chinese Taipei R.O.C. and announced for execution by the President. This new Act adopted food traceability system and Good Agriculture Practice (GAP) certification as strategy for administration of agricultural products. In addition, this act has a great impact to the future agricultural production in Chinese Taipei and leads Chinese Taipei agriculture into the era of "certification" and "traceability" as well as provides a legal basis for the GAP and traceability system in Chinese Taipei.

Many appropriate information tools have been developed to support the traceability system and to ensure that agricultural products can be truly tracked and traced. In Chinese Taipei, important characteristics of traceability IT system are the domestic nation-wide standards of tracing code, communicative database and the utilization of international GS1/EAN-128 barcode standard. The COA has developed a Farmer's Management and Information System (FMIS) since 1987 initially for farm operators' management, accounting, production planning, and field records. This system has drawn much praise, but due to the averagely lower IT knowledge of farmers, and that Internet was not common as well as a higher cost of hardware, there were few farmers using this system.

In 2004, when COA decided to promote the traceability, the FMIS system was soon modified and upgraded for the traceability, in particular, the

functions for production planning and operation as well as distribution recording.

In 2005 and 2006, the MIS for traceability resume was modified to work on Internet for the upload of farmers' information into the nation-wide traceability database of the COA. At the same time, various daughter systems were developed for the adoption in different territory such as livestock, poultry and fishery. To further integrate and collect all the different type traceability information, COA set up a consistent tracing code encoding standard, and structured the nation-wide traceability database, TAFT, for consumers to search for the information of agricultural products.

2.4. Case of Animal Identification and Tracing in New Zealand

All cattle and deer must be uniquely identifiable with an individual official animal identification device approved under the Biosecurity Act 1993. Under the Biosecurity Act, the Animal Health Board (AHB), Livestock Improvement Corporation Ltd (LIC) and AsureQuality Ltd (AQ) have had their identification systems approved for the purposes of the Biosecurity (Animal Identification System) Regulations 1999 (Biosecurity Regulations). These regulations require that an approved identification system is used for cattle and deer for the purposes of controlling bovine tuberculosis

All three schemes use a primary and a secondary ear tag with a unique individual identifier. AHB has the responsibility of approving all official tag devices for the purpose of bovine tuberculosis. In accordance with approved scheme specifications, farmers must order these tags from a manufacturer that has been approved by AHB.

The primary tags must be yellow and printed with a barcode and visual identifier. The secondary tags also carry a visual identifier but may contain less information due to the fact that these may be button tags or brass tags and therefore too small to accommodate a lot of printed information.

There are also identification systems approved under the Animal Products Act 1999 (APA). The Animal Products (Approval of Animal Identification Systems and Manufacturers) Notice 2000 has approved the AHB and LIC identification systems for identifying and differentiating bovine animals treated with hormone growth promotants (all bovine animals treated with hormone growth promotants must be identified). AHB and LIC identification devices have also been approved under this notice for the differentiation and identification of animal materials.

Under the Biosecurity (Imported Animals, Embryos, and Semen Information) Regulations 1999 the owner or person in charge of specified imported animals (sheep, goat, cattle or deer) must notify the Director-General of MAF if tags issued in respect of importation of that animal are lost or become illegible, provide an annual status report confirming that such animal's ear-tags remain in place, and keep documentation identifying animals receiving imported animal genetic material (i.e. embryos, semen).

In addition to animal identification, movements of animals are required under the Animal Products Act (1999) to be accompanied by an Animal Status Declaration (ASD). The purpose of the ASD is to transfer key information about an animal, or group of animals, to the next person in charge, or the processor. For the processor, the information on the ASD is vital for guiding ante-mortem and post-mortem examination, and for determining export eligibility and certification.

The ASD also incorporates the Tb questions required by the Animal Health Board under the Biosecurity (National Bovine Tuberculosis Pest Management Strategy) Order 1998.

The National Animal Identification and Tracing (NAIT) project started in August 2004 when livestock industry parties approached the Government to work together to improve animal traceability in New Zealand. An Animal Identification and Tracing Working Group was then established to consider domestic and international trends in animal identification and traceability, and propose a way forward to enhance New Zealand's existing systems. While current systems are satisfactory, demands for traceability for animals will continue to increase for market access, and to meet biosecurity and other on- and off-farm needs. In July 2005, the Working Group distributed a report for industry consultation and from the submissions received, industry agreed in principle to the changes proposed.

In March 2006, an Animal Identification and Traceability Governance Group was established to oversee the development of the new system under the name "NAIT" (national animal identification and tracing). In the budget of the same year, the Government announced funding for the National Animal Identification and Tracing (NAIT) and project.

Following the completion and approval of a detailed business case, which has proceeded in parallel with system design and business process development (2008 – 2009), the Government will fully fund the capital cost and 35 percent of the operating cost of the NAIT system. The remaining 65 percent of operating expenditure will be funded by industry. A new

mandatory animal identification system for cattle and possibly deer is proposed to be in place by 2011. The inclusion of deer is dependent on confirmation of the in-field performance of radio frequency tags.

2.5. Case of castle, pig and poultry, and honey traceability in Mexico

In July 25, 2007 Mexico issued Federal Law of Animal Health, in which traceability is defined as technical and administrative systematized activities that allow register the process related to animal born, raised, feed, breeding, slaughter and processing of animal products or of chemical, pharmaceutical, biologic and feed to be used by animals until final consumptions. This document also indicates that SAGARPA to establish and coordinate the traceability system. It will be authorized to ask countries that export to Mexico the measures to guarantee the traceability of the products.

In Mexico domestic animal and animal products use Zoo-sanitary Certificate (CZM). This document includes information about identification of the animal and animal products, their origin and destination. It uses the press format. For imported one, at the entrance, a computer generates Import Zoo-sanitary Certificate (CIZ) with information like the domestic one. A system using chips had been developed by SAGARPA to trace the movement of documents while they are on transit or arrived to their destination. However, who is close the chip is still question to be determined.

Currently, there are some schemes of traceability apply in Mexico included:

- Cattle with National System of Individual Animal Identification (SINIIGA) with radiofrequency tag and a document that are registered all the animal movements.

- Pigs and Poultry: since it plays important role in exporting, traceability is a must for it is market requirements. However, he owners of the farm are responsible for their own system of traceability. SAGARPA is working on developing similar system with SINIIGA for pigs but with a modification of a group identification.

- Honey: to cope with the requirements of EU market, SENASICA had developed a system of traceability that requires all the units of production that are involving in producing and trading of honey should be registered.

The main constraint of traceability in Mexico is that the traceability is being implemented using difference programs. The participation on SINIIGA and GPP program will be requirements for enterprises that interest in participant the "Split System" to export to EU. SENASICA is to certify that all the requirements of EU rules are complied.

2.6. Fishery traceability in Thailand

In the past, Thai shrimp products have experienced the problem with some antibiotic residues due to the wrong application by the producers. This has made the volume of shrimp export reduce drastically. With the concern of Thai government, the Department of Fisheries has set up food safety projects for fish and shrimp production in order to improve the quality production including traceability system.

For traceability system development, the Department of Fisheries has put an effort to develop the concept as well as the documentation for fish and shrimp production. As for shrimp production, the concept of traceability has been developed with the assistance of French government by French experts under Thai-French cooperation program since 2002. The Thai-French cooperation program has been completed by mid 2004 leaving to be continued for further work. The concept developed includes the whole production line from farm to processing level including feed utilization, hatchery and farm operations, shrimp collectors/distributors and processors. Moreover, at the Departmental level, traceability system using documentation known as "Movement Document" or MD has been used among four steps, from hatchery to farm via shrimp distributors to processing level. Manual traceability in the form of MD has been occupied since 2002 up to present.

In 2005-2006, a pilot project was implemented to establish a computerized traceability system called "TraceShrimp" under Thai-EU cooperation.

Shrimp hatcheries, nurseries farms feed producers and food processors who want to use the TraceShrimp system have to apply for membership at the Department of Fisheries. After approval, users receive a login name and password. However, focal points must be assigned to manage the system within their organization. Each organization can allow their customers to trace back information.

- *Hatchery information:* Brood stock collected domestically or from abroad is recorded with a code. Information from each hatchery will be transferred to the nursery. Feeds used in rearing shrimp from zoea to post-larvae (PL) stages are recorded. PL are transferred to farms

with a fry movement document (FMD) which will be transferred to the TraceShrimp system.

- *Shrimp farm information:* After receiving PL from the nursery, farmers have to record data on type of feed (company name, batch) and CoC practice information. After harvesting, the movement document (MD) must be prepared. All data will be sent to the TraceShrimp system.

- *Processing plant information:* Data of raw materials (date receiving, MD) process (production data, size) and finished products transferred to domestic or export traders are collected and sent to TraceShrimp via direct electronic data interchange (EDI).

- *Feed production information*: Data on incoming and processing which has been examined and certified by the Department of Fisheries and transportation of the feeds to hatcheries and farms are recorded and sent to TraceShrimp via EDI.

The pilot project of TraceShrimp under Thai-EU cooperation has been finished. The Department of Fisheries is analyzing the program regarding objectives, results and budget management. By the way, FMD and MD are workable and may be fit for small scale farmers. These documents are provided by officers of Provincial Fisheries Offices, Coastal Fisheries Research and Development Centers, Shrimp Culture Associations/Clubs to hatchery operators or farmers who make a request. However, the manual traceability increases workload for the personnel.

2.7. Traceability development in Indonesia

In Indonesia traceability is considered as a way of responding to potential risks that can arise in food and it is needed to ensure that all food products are safe for Indonesian citizens to consume as well as to export. Past food crises, such as dioxin contamination and BSE, have illustrated the particular importance of being able to swiftly identify and isolate unsafe foodstuffs in order to prevent them from reaching the consumer.

It is vital that when national authorities or food businesses identify a risk they can trace it back to its source in order to swiftly isolate the problem and prevent contaminated products from reaching consumers. In addition, traceability allows targeted withdrawals and the provision of accurate information to the public, thereby minimizing disruption to trade.

Presently, technical regulation is being constructed by Ministry of Agriculture where traceability/product tracing is applied within an agro-food inspection and certification system to identify at any specified stage of the food chain (from production to distribution) from where the food came (one step back) and to where the food went (one step forward). It is requires that all food and feed operators implement traceability/product tracing into their quality management systems enable them to identify where their products have come from and where they are going and to rapidly provide this information to the competent authorities in Indonesia.

2.8. Traceability development in Philippines

Republic Act No 8550 (RA 8550) is also known as the Philippine Fisheries Code of 1998, provides for the development, management and conservation of the fisheries and aquatic resources. It reconstituted the Bureau of Fisheries and Aquatic Resources (BFAR) as a line Bureau under the Department of Agriculture. It is mandated to implement an inspection system for the import and export of fishery/aquatic products and fish processing establishments consistent with international and national standards to ensure product quality and safety.

The effective and efficient implementation of official control by the BFAR is supported with laboratory testing for verification of compliance to microbiological, chemical and sensory standards as required by the importing countries. The main laboratories are located in the BFAR Central Office which include: the Fishery Product Testing Laboratory (FPTL), the Marine Biotoxin Unit (MBTU), and the Marine Biotoxin Unit (MBTU). FPTL is responsible for microbiological and physico-chemical analysis of fish samples prior to export. The MBTU, on the other hand, monitors red tide toxin, ciguatoxin, cyanide and other substances. Finally, the FHL tests aquaculture products for chemical residue and contaminants and for disease surveillance.

Verification Sampling and Traceability Procedures: Fish inspector carryout the task of sampling fishery and aquaculture products for the following objectives:

- to verify the establishment's implementation and compliance to its own food control program;
- to check the safety of their product for export; and
- to check the Standard Operating Procedures (SOP) of in-house laboratory of some processing plants and to determine the reliability of tests results obtained.

The scope covers all stakeholders in the production chain (i.e. fishing/freezer vessel, fish port landing site, aquaculture farms, and auction markets, IPCS, pre-processing and processing facilities). These are targeted based on risk assessment studies.

A reference code is assigned for samples collected and submitted to BFAR laboratory and/or recognized laboratory by the inspectors and/or analyst to determine the appropriate analysis needed and for the purpose of verifying the products for shipment as requisite for the issuance of Health Certificate (HC). The code is a combination of letters and numerical numbers representing the following information:

- plant location
- establishment name
- product name
- production code

The code is consistently reflected on the sample collection form, laboratory analysis and on the HC issued to establish product traceability.

For traceability of raw materials, the inspector looks for the Auxiliary Invoice issued by the Local Government Units. This is a certificate given to suppliers prior to transport of raw materials from their point of origin to their point of destination within the Philippines. It bears information on the species of fish, weight, name of shipper/supplier, name of the fishing vessel and the catch area. However, there is difficulty in applying traceability for raw materials sourced from the auction markets. These include raw materials like tiny shrimps, crabs for crab meat, prawns and milkfish. Owners of auction markets get their supply from several suppliers and the Food Business Operators cannot identify the supplier and the catch area of the commodity. Moreover, some processors of aquaculture products get their supplies from unregistered farms even if BFAR have accredited farms and uses raw materials from unregistered/unlicensed vessels.

2.9. Traceability development in Malaysia

To support and modernize the agro-food industries in order to increase their economic output besides improving the quality and safety of food products, various initiatives were undertaken. In 2001, the National Food Safety and Nutrition Council under the Ministry of Health was established to advice the Cabinet on issues relating to food safety and nutrition. It sets clear policies and strategies for continuous improvement of food safety program.

Best practices certification to an extent feature traceability and it presently more a paper based record keeping scheme that included:

- The Farm Certification Scheme with 203 certified farms.
- The Organic Certification Scheme with 21 certified farms.
- The Livestock Farm Certification with 323 certified farms.
- The Aquaculture Farm Scheme with 34 certified farms.
- The Veterinary Health Mark logo with 125 certified operators.
- Animal Tagging
- HACCP
- *Halal* Certification
- Legal documents: Federal Agricultural Market Authority (FAMA) Act 1965. Food Act 1983 and Food Regulations 1985. Animal Act 1953 (Revised 2006), Pesticide Act 1974, Veterinary Surgeon Act 1974 and Fisheries Act 1985. Trade Description Act 1972.

In the presentations, issued and solutions is also shared and discussed included: a)many Government agencies involved in fragments of food traceability; b)confidentiality of data; c)limited adoption of best practices among food producers due to voluntary nature; d) comfortable entry to traceability system for big companies but not so for small companies due to cost and manpower limitation. Participants in the workshop agreed and reiterated that these issues are common in developing countries and discussed on suggested solution: a single authority as focal point on food traceability and a single authority which has a legal control of data entered by producers and data confidentiality should be established. Mechanism of collaboration between the network should be regulated. Awareness and information campaign by Government and time frame for food producer to comply with standards as well as support from Government is necessary to SMEs to encourage the application of traceability system.

4. CASE STUDY: DEVELOPMENT OF TRACEABILITY IN VIETNAM

1. Role of Viet Nam's agricultural sector

Viet Nam is basically an agricultural APEC member economy, though remarkable progress in economy and industry has been achieved recently. Economic growth in Viet Nam is still centred on the agricultural sector, which accounts for more than 25 percent of GDP. More than 45 percent of the APEC member economy’s foreign exchange earnings come from agricultural exports. Moreover, in the rural areas, which are home to close to 70 percent of the population, farming and fishing are the only forms of livelihood known to most. Agricultural statistics, therefore, play an important role for the agricultural sector of Viet Nam.

Small-scale or self-sufficient production is the mainstay of agriculture in Viet Nam. Households are usually scattered. Concentrated and large-scale production has not been much developed, especially in the North and along the Central Coast of the APEC member economy. Agricultural households practise mixed culture in general, including combination management of agriculture, forestry and fishery at household level. Other than agricultural households, state enterprises and cooperatives play an important role in agricultural production in Viet Nam.

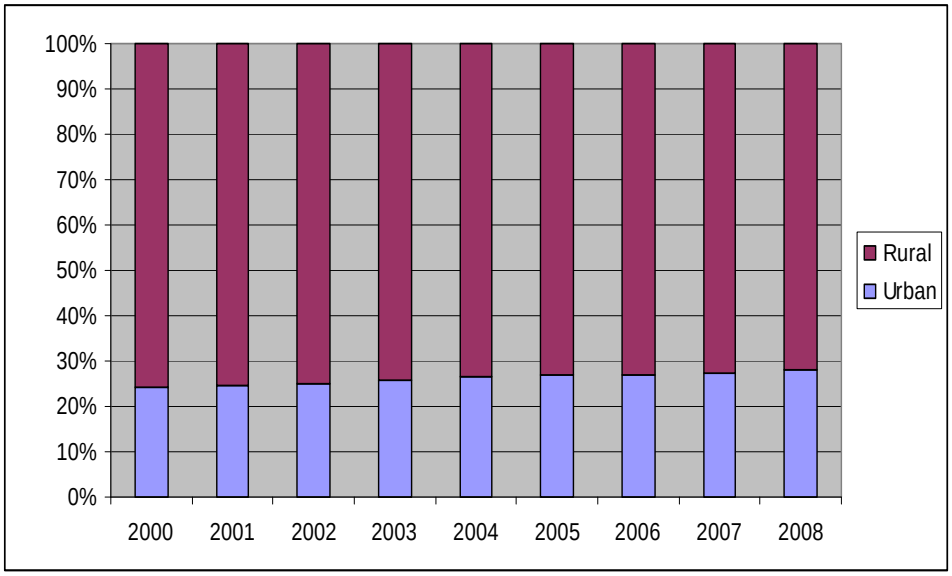

Figure1. Population in rural and urban area of Vietnam

Agriculture and agro-based products account for 23% of total export in 2006. The value of Vietnam's agro-based product export increased from $4 billion in 2001 to $9 billion in 2006. Fish and fishery product are major export category with $1.5 billion of shrimp is exported from 600,000 ha cultivated farm and $1.4 billion of Basa or Tra catfish from 6,000 ha cultivated farm. The main market for the fish and fishery products are Japan, the US and the EU. Russia also emerged as a new potential market for Vietnam's fresh and frozen fish in 2006.

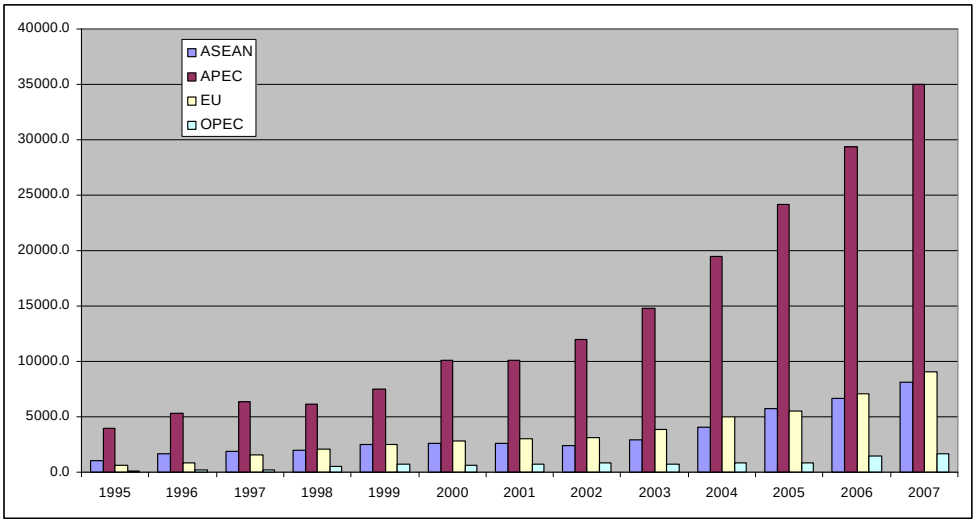

Figure 2. Export value to main markets

Rice features prominently in Vietnam's export with the value of rice export almost doubled between 2001 and 2006 reaching a value of $1.3 billion in 2006 and bring Viet Nam to among the top rice exporting countries. Coffee has traditionally been one of Vietnam's main export commodities and Vietnam's coffee export increased sharply to $1.2 billion in 2006. Vietnam's cashew nut exports account for half the world market's share with the total export value increased from $100 million in 2001 to $500 million in 2006. In 2006, Viet Nam export $190 million value of fresh and frozen vegetable with the man market for fresh and frozen vegetable including China, Japan, Korea and ASEAN countries.

Animal and product thereof export from Viet Nam is very limited. Frequent animal disease outbreaks (such and HPAI and FMD) in recent years have further hampered the development of this sector.

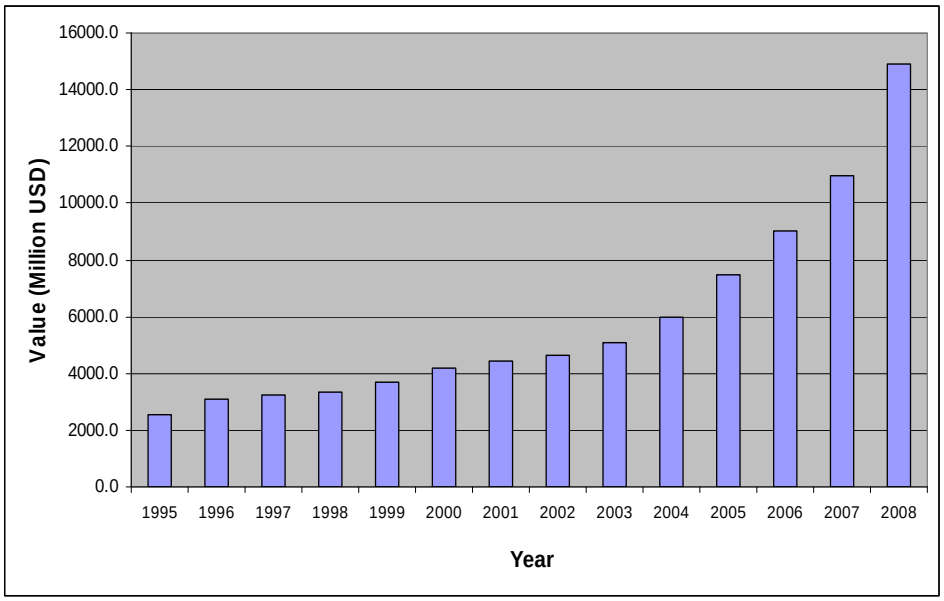

Figure 3. Export values in agricultural products.

Agricultural food and raw material import make up small part (around 7% on average) of Vietnam's total import value, with food product representing the largest share of 5%. About a third of agro-food imports is animal feed coming from diverse sources. Other important food products are cereals (21% on average), dairy product with mostly milk (15%) and vergetable and fruit (10%).

2. Drivers for change to traceability in agro-business

Limited efficiency and effectiveness of surveillance and response activities.
The outbreak of food and mouth disease, avian influenza, "blue-ear" as well as hoax of growing hormones, chemical using in vegetable plantation revealed the deficiencies with Viet Nam existing food safety and food quality management system. The traceability system at place will be the key issues to address this problem and strengthen the surveillance system and response activities in agro-business sector of the APEC member economy.

Customer Expectations

Consumers are beginning to expect identification and traceability as an indication of the quality and safety of agriculture products. In the dynamic, global marketplace the rate of innovation has increased to meet the growing influence of consumer purchasing power. There is considerable pressure on the food and agribusiness supply chain to meet this demand in mature and emerging market economies without increasing the percentage of disposable income consumers are spending on food. As food production, processing, and manufacture have evolved to efficiently meet this demand,

consumers have become sufficiently aware and knowledgeable to start questioning these processes and request more information about the food they are purchasing. In a old manner, information would be provided on a need-to-know basis. In a modern society, participants are provided with a different and potentially powerful set of expectations. The discord between the corporate need for rapid innovation, to sustain competitiveness in a global market, and the protection of consumer expectations is at the center of the debate of how to meet the needs of both. An inability to resolve this debate increases the probability of market failure in one or more sectors of the supply chain. Large food retail corporations, in the world, have started setting standards for accepting agricultural products and pushing towards setting up traceability for this production.

Vietnamese agricultural production is also affected by this trend. For those products that has export-orientation, attributes information should be provided by producers, traders to meet the growing demand of transparency of information from international customers. On the domestic market, food safety and quality is the current urgent issue. However, the pressure is not quite high on the market since the legal framework is still inadequate and completed, awareness of this right from domestic customer is not at high level, oversight voice of association and non-government organization is not strong enough.

Protection of current market position

Viet Nam needs to match the level of agricultural traceability provided by its key competitors in premium markets to avoid risking loss of access or market share. Markets that have high income such as EU, Japan, US are gradually made the traceability become mandatory. Moreover, internal expectations of key international trading partners are ever increasing. Following introduction of domestic standards, the EU, US, Japan and others have started to actively promote global movement towards improved product identification and traceability. Main competitors of Vietnamese in international markets are having introduce identification and tracing system for export agricultural markets. Therefore, the only way to maintain and expand the markets for Vietnamese agricultural production and trade is to following this emerging trend.

3. Traceability development in agribusiness in Vietnam

To find out the readiness of traceability system, the study team has decide to analysis current situation of development and application in Viet Nam on four main categories: i, legal framework; ii) economic factor; iii) technical issue; iv) operation management. For the study, literature review will be

conducted to illustrate the individual issue then find out the problem that is shed by the light of literature review.

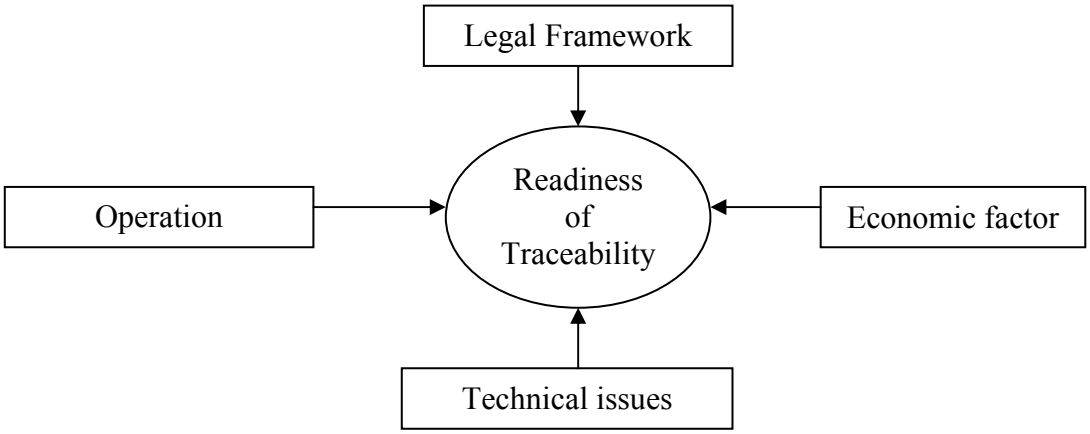

Figure 4. Main categories of studying

3.1. Legal framework

In spite of considering food safety is the importance issue in agriculture production in order to protect the consumers and to maintain the competitiveness of Viet Nam's agriculture products, the legal documents regarding traceability of agriculture production and trade in Viet Nam is not clearly defined and scattered in provisions. Responsibility to implement of those regulations, on the other hand, has been shared between different government departments for different product sectors. The related legal documents refer to traceability are includes:

- Ordinance on Food Safety 2003 that requires on labeling and origin of foodstuff, Decree 163/2004/ND-CP dated 7/9/2004 guiding the implementation of Ordinance on Food Safety

- Law of commodities quality 2007, Decree No.89/2006/NĐ-CP on the labeling of commodities, and Circular No. 09/2007/TT-BKHCN guiding the implementation of certain provisions of the Decree No.89/2006/NĐ-CP.

- Ordinance on Consumer's Rights Protection 1999 and Decree 55/2008/ND-CP dated 24/04/2008 guiding the implementation of Ordinance

Those documents provides that consumers have right to be informed in a promptly, accuracy and precisely manner of information of the products and the seller have obligations to guarantee that consumers are provided with safety food.

The traceability direct provisions are not available at present. It is possible, however, to assume that the requirements for traceability will meet accepted international practice, i.e. similar to that in the EU, USA, etc, as Viet Nam is a full member of the WTO. As mentioned before, food safety is a government priority. Traceability could not have directly result of safety for food but it is a appropriate tool for authority management and responsibility raising from producer. New food safety regulations are being drafted, which presumably will meet international accepted practice including the requirement for external traceability. Traceability regulation and official controls mainly focus on the fishery sector. In addition traceability has been introduced as part of VietGAP, although adoption is voluntary.

National Agriculture, Forestry and Fishery Quality Assurance Department (NAFIQAD) was established under MARD in 2008 and is responsible for the inspections and has an inspection checklist which includes traceability in relation to supply of raw material and procedures for traceability and recall. However, currently their focus is only in fishery sector.

In 2008, Ministry of Agriculture and Rural Development (MARD) issued Decision 117/2008/QD-BNN promulgating regulation on inspection and certification of food hygiene and safety conditions of fishery traders and producers. In the document, it regulates that: a) each fishery processing establishment shall establish their own procedure of traceability and product recall; b) fishery traders and producers (fish farms, middlemen, primary production units, processing establishments) must be inspected and approved (given a approval number).

And in National Technical Regulations:

- National technical regulation No. QCVN02-01:2009/BNNPTNT on Fisheries Food Business Operators (FBO) – General conditions for food safety, MARD also requires in Chapter 2, Item 2.2 on Fishery batch identification that: a the establishment shall have adequate records of each batch. Each batch of raw material must be given a code at the moment of entry. The code, or a record for each code, must indicate (supplier, date and time of receiving of raw material, species, quantity, quality/safety parameters-including temperature); b) the code shall follow the batch in all processing steps. All registrations about raw material and products on production line refer to this code. The code shall also be identified on the final package, to insure traceability from final product to batch of raw material.

- National technical regulation No. QCVN02-02:2009/BNNPTNT on Fisheries Food Business Operators – HACCP Based Program for Quality and Safety Assurance, regulates in Chapter 2, Item 2.3.9 on Traceability and recall defect products that a) the enterprise must elaborate regulations in writing for traceability and re-collecting of products in case food safety hazards are found in material or after the products has been shipped; b) the enterprise must carry out the traceability procedures, and when of necessary notify the concerned parties (competent authorities, customers) and recall defect products; c) when establishing the traceability procedures, the enterprise must elaborate very specific measures to ensure that they are able to recall and recall product defects both inside and outside the enterprise; d) documents relating procedures on traceability and collecting of defects must be kept in files in accordance with stipulations.

The drivers of these requirements are effort to keep and maintain with the market requirement from EU, USA, New Zealand and other main aquaculture market. These requirements as based on both local and/or EU legal requirements. In practice, this means that all fishery products for export has a lot number to identify the processor/exporter, and the processor and trade has systems in place to identify and approve their suppliers. This means that the processor has a list of approved suppliers (traders) and has established means of approval of these suppliers. Similarly, the traders has a list of suppliers (farms and/or other traders) and established the means of approval of these farms/traders. Therefore, there is a requirement for supplier traceability (one down) but what is not clear is whether there is also a requirement for customer traceability (one up). Records are also retained but there is a problem in retrieving the information, in general this is not possible in a timely manner. A project is in progress in collaboration with an aid organization (DANIDA) in relation to improve traceability in the Fishery sector.

In 2004, NAFIQAD carried out a pilot traceability system for 3 fishery producing chains: black tiger shrimp in Ben Tre province, tra catfish in An Giang province and tuna in Khanh Hoa province. Then, in 2008, the State Agency for Technology Innovation (SATI) under Ministry of Science and Technology, in collaboration with NECTEC of Thailand, carried-out the pilot application of Radio Frequency Identification (RFID) in frozen shrimp and it now plans for expand the result for nationwide in coming time.

There are approximately 320 fishery processing factories certified to export to EU. They are under inspection at least on a six month basis and shall be graded from A to D. Each grade has maximum number of permitted major, serious or critical non-compliances. Grade A and B are the top categories

and inspected every six month. Grade C shall be inspected on a monthly basis and has an agreed time for corrective actions. Grade D are not certified until corrective actions are undertaken satisfactorily. The inspection system is linked to a programme of surveillance testing of product.

The situation regarding implementation of traceability in other sectors in agro-business is not clear. In practice there is currently little or no official control, including for other export commodities such as coffee and pepper. NAFIQAD has also been given the responsibility for traceability in these other agricultural production since 2008. However, their capacibility and focus is still limited to the fishery sector. There are no official certification schemes similar to that for fishery product in place for other export commodities such as coffee and pepper. Some business involved in the export of these commodities may have voluntarily adopted international or commercial standards such as ISO9000 or ISO22000, or implemented the own food safety systems including traceability.

In conclusion, the legal framework in Viet Nam is still scattered and lacking of direct regulations that dealing with traceability. The current development of traceability in Vietnam, from the legal perspective, is focus only on high-profit-gain products from exportation such as fish, shrimp and other fisheries products, while other

3.2. Technical issues

A product traceability system requires the identification of all the physical entities (and locations) from which the product originates, that is to say, where it is processed, packaged, and stocked, and so this includes every agent in the supply chain. Nowadays technical and operative resources are available and the selection of appropriate technology in traceability plays an important role.

To implement traceability system in agriculture supply chains, technological innovations are needed for product identification, process, and environmental characterization, information capture, analysis, storage and transmission, as well as overall system integration. They include:

- Product identification technology
- Quality and safety measurement technology

- Genetic analysis technology
- Environmental monitoring technology
- Developments in geospatial science and technology
- Software technology for traceability system integration

However, since traceability is a new emerging issue in Viet Nam and in consideration of the current level of development in technology and human capacibility of Viet Nam, we have just focus the study on product identification technology that we feel most suitable for applying in traceability system in agro-business in the APEC member economy. They are fundamentally alphanumerical code, bar code, and radio-frequency identification (RFID).

Alphanumerical codes are a sequence of numbers and letters of various sizes placed on labels, which in turn are placed on product or on its packaging. The design phase of this system is very simple and economic, but its management requires significant human resources (and so costs) because code writing and code reading are not automatic. Furthermore, performance is not particularly good: there are many problem associated with the large amount of managed manually data. The risk of data integrity corruption is very high.

No standards are defined for alphanumerical codes, and they are generally "owners" codes, so there is a unique and not general tie between the different actors (raw material suppliers, manufacturers and distributors) in the supply chain analyzed. The European Article Numbering (EAN) association has made some effort towards standardization by introducing several codes: the best known is the EAN/UCC Global Location Numbers (GLN) in the EAN/UCC-13 version.

Today, alphanumerical codes are not frequently used because *bar codes* offer several significant advantages. In effect, the introduction of bar coding has modified handling of all materials along the supply chain and moreover particularly affects the traceability question. The automation, the high speed, the great precision (it is a practically error free system) guaranteed by a bar code structure permits simpler, more economical, and exact traceability systems. At the time of writing more and more industries, especially in the retail sector, use bar codes as a principal means of identifying items.

Various applications of industrial product traceability (non food) that still work well are based on this technology. With regard to food, traceability is less advanced and there are only a few spot applications. In a bar code system, each time items are moved from one point to another, their bar code labels must be so positioned that they can be detected and identified by the reader. This characteristic, often called line of sight positioning requirement requires human intervention (thus time and effort) for the scanning process and so there is room for error and inefficiency. Besides the physical support provided by a label, it usually has generous dimensions and is easily damaged (‘‘optical” damage is sufficient).

As a result, bar codes are less attractive to the food sector, and their application is consequently limited. In addition to bar code technology, there is *radio frequency identification – RFID system*. RFID is an identification tool using wireless microchips to create tags that do not need physical contact or particular alignment with the reader. The reading phase is very fast and fully automated.

RFID tags are very small (a few millimeters reading distance) and they have no compatibility problem with foods. The TAG is an isolated system, their materials are aseptic and food compatible. The link between TAG and product is very easy: for solid goods gluing system is very effective (glues are absolutely neutrals); for liquids TAG is usually connected to storage or package system. The radio wave used for communication between TAGs and traceability database use very little power, so electromagnetic interaction is practically non-existent. Latest technology at the time of writing has a good data transfer rate, even when a great deal of electromagnetic interference affects the ferromagnetic field.

In general an RFID system results in the following:

- A reduction in labor cost. RFID simplifies handling and storage processes, particularly as no manual scanning and checking operations are required.
- An acceleration of physical flows. As an RFID reader can scan numerous tags at the same time, identification is very simple and rapid.
- A reduction in profit losses. The University of Florida concluded that nearly 2% of total sales in United States is lost each year due to “shrinkage” – employee and customer theft, vendor fraud, and administrative.

- More efficient control of supply chain in terms of improving control of the stock situation, and production monitoring.
- Improved knowledge of customer behavior. This knowledge has great importance especially for new products or items in a promotion for which it is not only important to check whether or not they are selling, but also to know whether or not they are being taken away but not bought by consumers.

With specific reference to the food sector, RFID is a very promising system because it also results in:

- Improved management of perishable items. The continuous monitoring of item routing reduces waste and improves customer service levels.
- Improved tracking and tracing of quality problems. In using individual product codes, RFID systems are providing means to identify and find only defective product, and so help react to any quality problem.
- Improved management of product recalls. The ability to trace product routings can secure efficient recall procedures and help producers and distributors to minimize damage.

However, some RFID properties limit traceability systems. The main problem relates to tag cost. A tag costs between 0.5 € and 20 €, whereas the bar code is a low-cost system, so RFID is more expensive and can represent a significant handicap for product final price, particularly for low-price products (e.g. fruit, vegetables, pasta, milk, etc. In addition to this problem, there are some operational questions producing minor difficulties: lack of standardized RFID protocols (the best and most used are: ISO 13 MHz and EAN/UCC GTAG) and scanning problems due to interference under particular electromagnetic conditions.

	RFID	**Barcode**
Read Rate	High throughput. Multiple (>100) tags can be read simultaneously.	Very low throughput. Tags can only be read manually, one at a time
Line of Sight	Not required. Items can be oriented in any direction, as long as it is in the read range, and direct line of sight is never required.	Definitely required. Scanner must physically see each item directly to scan, and items must be oriented in a very specific manner.
Human Capital	Virtually none. Once up and running, the system is completely	Large requirements. Laborers must scan each

	automated.	tag.
Read/Write Capability	More than just reading. Ability to read, write, modify, and update.	Read only. Ability to read items and nothing else.
Durability	High. Much better protected, and can even be internally attached, so it can be read through very harsh environments.	Low. Easily damaged or removed; cannot be read if dirty or greasy.
Security	High. Difficult to replicate. Data can be encrypted, password protected, or include a "kill" feature to remove data permanently, so information stored is much more secure.	Low. Much easier to reproduce or counterfeit

Source: Atlas RFID Solutions

Table 2. Summary of advantage of RFID over Barcode

In conclusion, the current popular technical instruments to use for a product traceability system are bar codes and RFID systems. In particular, RFID presents very favorable properties for the food sector, but the tag cost remains a problem. With the above comparative between appropriate technologies for identifying, we recommended that Viet Nam traceability system should following the barcode technology at the mean times for enterprises in the APEC member economy in agri-business are SMEs and can not afford the cost of RFID. However, in the long run, with the advantage of RFID over barcode, big company should have strategy to swift to this technology for the effectiveness of traceability system.

3.3. Economic factors

It is the truth that for setting up a traceability system, internal or external, there is no expectation that the new information providing system will run automatically without cost. The fact that the system that provides information across the food chain from production, logistic, to end-consumer will be very difficult to calculate the costs. Also, it is the truth that there is also expectation that some benefits could be gained from for setting up a traceability system. Quantifying these benefits, however is difficult since they are “in the future” and reflective of likely future trends and so are somewhat less certain. The key challenge is therefore designing a tracing scheme that balances known and immediate costs versus future and less certain benefits. Due to unlimited resource and time, this study could not have done a comprehensive cost/benefit analysis of development of tracing system in Vietnam. The following is expected as guideline for the larger study in the future.

To define the cost and benefit of traceability, the major objectives of traceability should be taken into account first. Usually, the main objectives of establish traceability is for safety and quality of food.

- Safety of food: In the case of food contamination, separate batch management of traced system could allows an efficient organization of material flow and the manager agent , a firm or a authority, is able to withdraw specific batches, only the tainted bathes. Thus, the system can lead to a reduction in recall expenses and the attribution of specific liabilities of the agents of the traced supply chain.

- Quality of food: It refers mainly to the guaranteeing of quality standards of the firm products, thank to the fact that the firm adopted specific rules and implement specific control, reducing the cost of non compliance and making possible a differentiation of the product. It also determines the increase in competitiveness and in some cases facilitates the acceptance of the firms to comply with customer request of information.

Item	Cost (USD)
New equipment (Barcode Printer, Reader, computer, server etc.)	35,000
System software	4,000
Staff training	5,500
Consultant	6,000
Application for Barcode (13 digit) and annually maintenance	2,100
Labor per annual	24,000
Other	7,500
Total	**84,100**

Table 3. Investment for internal traceabilty in a fishery manufacture.

Cost

From information collected from and fish manufactory in Northern of Viet Nam and it show that the development and application of an internal traceability system do really cost in spite using moderate technology of bar-coding. For investment in internal traceability in fishery sector, USD 84,000 is not high (Table..). Nevertheless, not all of the agricultural production companies could afford this investment since Vietnamese enterprises is rather SMEs with low capital investment, especially in agricultural sectors. **Figure 7** shows that around 9% of Vietnamese enterprise in agricultural sectors that have total capital larger than USD 500,000. Therefore, it is a really financial burden to those enterprises in setting up an internal traceability even at moderate technology.

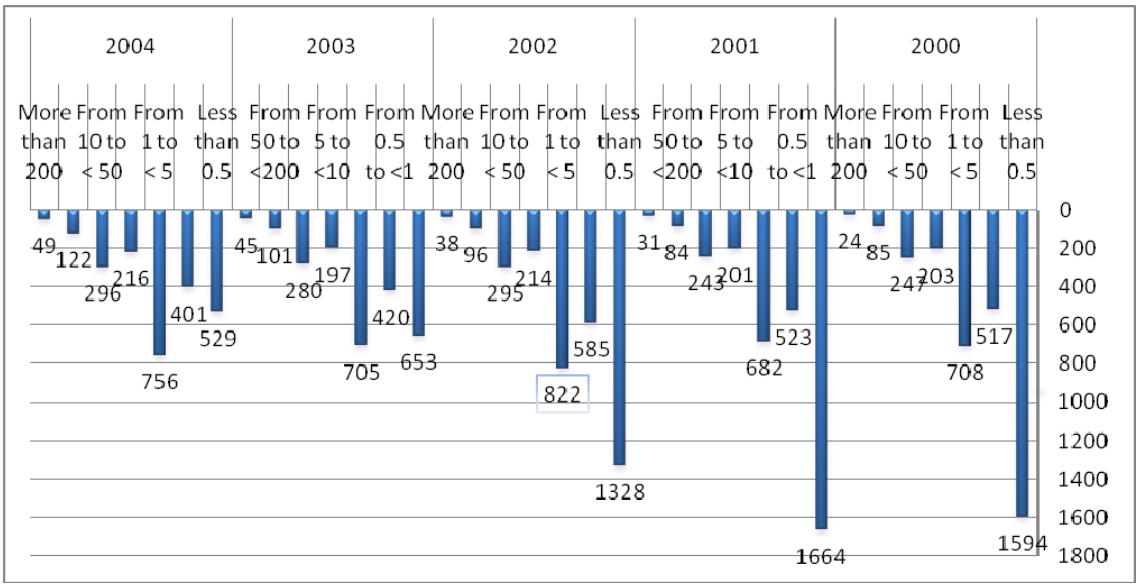

Figure 5. Categorizing Viet Nam Agri-enterpires by capital

Also, the information collecting from the other conversation with factories nationwide shows that the popular constraints is lacking of financial support, shortage of professional and technical expertise. The cost of management a traceability system is relatively high. Maintenance, operation and modification are usually more expensive than development a new system.

At the nation level, the calculation is more complicated, they should include the investment in infrastructure include database system, input devices, training and education, legal drafting, support schemes, etc. As in experience from Chinese Taipei, to manage national database only, it cost annually millions USD for the system.

Benefit

Once a tracing system for agricultural production had been setup, benefits are expected including:

- Enable agricultural product to be trace quicker and more accurately. Identification of product involved movement will be accurate. That will contribute to the management of food safety and facilitate the responsibility and reliability of the APEC member economy product. Cost of corrective actions to be taken, recall order whenever failure compliance happened will be reduced and manage in accurate manner.
- It can facilitate ability to communicate relevant threats, advice and progress during the action to be taken to the farming, processing

and retailing communities. This will fill the gap of information sharing between actors and stakeholders in Vietnam.

- Also, the traceability can enhance authorities to undertake better response planning in order to target of movement control and other interventions, allow setting up industry risk profiling and ability to "jump ahead" of tracing activities as well as potentially and significantly reduce the impacts of response controls and costs of compensation.
- A effective traceability system will enable authority to design and implement more effective surveillance activities quicker, and to collect surveillance information by increasing speed of surveillance design, enabling risk profiling, etc.
- For a firm, competitiveness will be enhanced since confidence from customer will be ensured by showing that the firm has implement specific control over the production. Added valued could be generated from this activities. Cost of non compliance product due to input materials will also be reduced since responsibility of actors in supply chain is clear and transparency.

3.4. Operation management

Development of traceability system for agri-business could be a complex task due to it characteristics. On the one hand, it requires the strong collaboration between stakeholders not only in the production chain, but also in governance perspectives. On the other hands, the traceability can become complex as they are designed to achieve a multi-purpose such as ensuring quality for food safety regulatory requirements, to gain added value and strengthen the competitiveness of products, providing enough information for stakeholders but maintaining privacy, etc. Study shows that there would be three layers of operation a traceability system at nationwide:

- Information operation layers: At this level the basic function of the system is to collect and store information. This information shall be keep to track the element activities and movements in the production chain.
- Governance operation layer. At this level the fundamental function is to monitoring safety information of products and support for the authorities in policy and decision making such as recall a products, require corrective action to be taken, etc.

- Strategic operation layer: At this level, the main function of the system is to improve competitiveness and image of product of the APEC member economy in the market as safety and healthy.

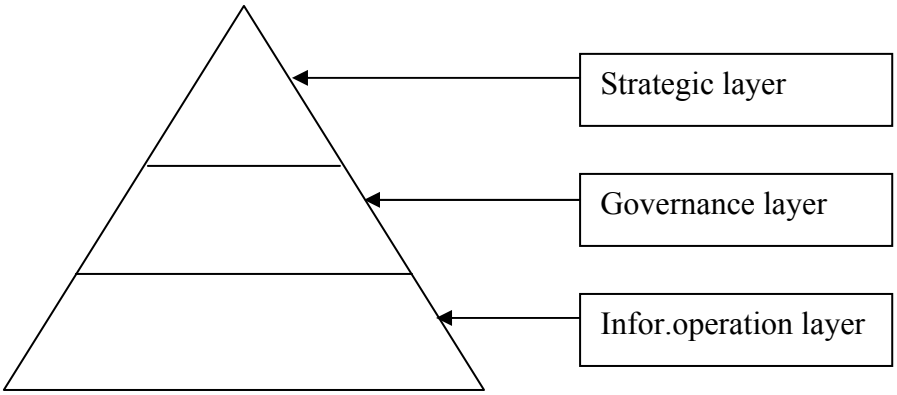

Figure 6. Layers of a national traceability system.

The three layers serve for difference purpose of a traceability system but they have strong relationship with each others. The strategic layer represents for political commitments and plays as overall objective to development and application of traceability system in a APEC member economy. Policy and legal requirements shall have theirs basic on this purpose. The governance layer serves as supplement for the strategic layer and shed the light on the information operation layer for monitoring and making prompt decision as needed. The information layer represents the supply of information that requires from drivers such as market requirements, customer rights, etc. It supports for the completion of the two others higher purposes.

Box 1. Steps recommendation for developing a Traceability system

- *Determine traceability plan*: The first step in developing an internal traceability system is the determination of the traceability plan industry standards, personnel and procedures. The personnel for the traceability team should be selected from a variety of different backgrounds and departments within the company. The traceability plan should be clearly defined in a consistent format and should include information such as what data needs to be recorded and shared with other actors in the supply chain. It should also define the measures of success and the precision required. The output of this process is a traceability system manual that defines the procedure for implementing the traceability plan. Economic factor and technical issue should also be address at this stage to find out what is the appropriate technology to apply with the

- *Implement traceability plan:* The output from process 1 is the input for this step. The traceability system manual is developed and be used to implement the plan. A relational database management system is used to implement the traceability plan. There is only one database for all the sources of related information. The users can enter the relevant kind of data in the database system. Both lot quality and lot activity data corresponding to a lot must be recorded. The relational database system connects the data about incoming lots, the internal lot activities and the outgoing lots. Traceability in terms of material movements within the production line and for customer shipments is more important than identification of lots. After this step is complete, an implementation report would be generated. This report would consist of a detailed description of the database system and its use.
- *Evaluate system performance:* The performance of the traceability system would be evaluated in this process. This would consist of evaluating the performance of the traceability database in terms of the efficiency of the system to react rapidly in a food safety crisis. The performance reports and audit reports are the output of this step.
- *System validation*. Validation is required to ensure that the system is performing as defined by the traceability plan. The performance reports and audit reports from step 3 are used to validate the traceability system using the same standard as the control and the same mechanisms that are used in the previous processes. The system validation would generate various documentations for this process. After the traceability system has been validated, the standard compliance can be achieved. Other documentations for production practices, Quality Management Systems and system validation certificates can be generated. Proof of customer satisfaction would also be a desired output of the traceability system development process.
- *System maintenance:* Maintenance of the traceability system is a crucial step in the whole process. Maintenance is required to keep the system functional and for continuous improvement. This is a continuous process and the traceability plan should be modified according to the changes in regulations, customer demands or any other factors that cause a change in the business process. The subsequent steps would need to be carried out again every time there is a change in the traceability plan. Developing such models can give the organization an overview of various steps that are

required to accomplish the task of developing and implementing a traceability system.

Basic behavioral patterns in a traceability system can be modeled by the following six activities, as shown in Figure 7.

- *Lot integration:* A number of lots are integrated into a unique lot. The responsible actor of the lot creates an association between the pre-integration lots and the post-integration lot, and vice versa. Real examples of lot integration are mixing and packing. Fig. 6a shows a scenario of integration with three pre-integration lots concurrently integrated into a unique post-integration lot.

- *Lot division* A lot is split into a number of lots. The responsible actor of the lot creates an association between the pre-division lot and the post-division lots, and vice versa. Thus, both tracing and tracking processes are possible. Real examples of lot division are cutting and splitting. Fig. 6b shows a scenario of the lot division pattern.

- *Lot alteration*: As shown in Fig. 6c, a new lot is generated from a lot by an alteration activity. The responsible actor of the lot creates an association between the prealteration lot and the post-alteration lot, and vice versa. Real examples of lot alteration are heating, freezing, and drying.

- *Lot movement:* A lot is moved from one storage site (source site in Fig. 6d) to another (destination site) under the same responsible actor. Since a lot can be associated with a unique site, the responsible actor has to create a new lot with a new identifier. Further, the responsible actor creates an association between the pre-movement lot and the post-movement lot, and vice versa.

- *Lot acquisition* An actor (buyer in Fig. 6e) of the supply chain acquires a lot from another actor (provider). Since a lot can have only one responsible actor, the buyer generates a new lot and creates an association between the pre-acquisition lot and the post-acquisition lot; this association allows implementing the tracing process and therefore determining the origin and characteristics of a particular product.

- *Lot providing*: An actor (provider) of the supply chain provides another actor (buyer) with a lot. The provider generates a new lot and creates an association between the pre-providing lot and the post-providing lot; this association allows implementing the tracking

process and therefore following the downstream path of a product along the supply chain. Fig. 7 shows the lot-providing pattern.

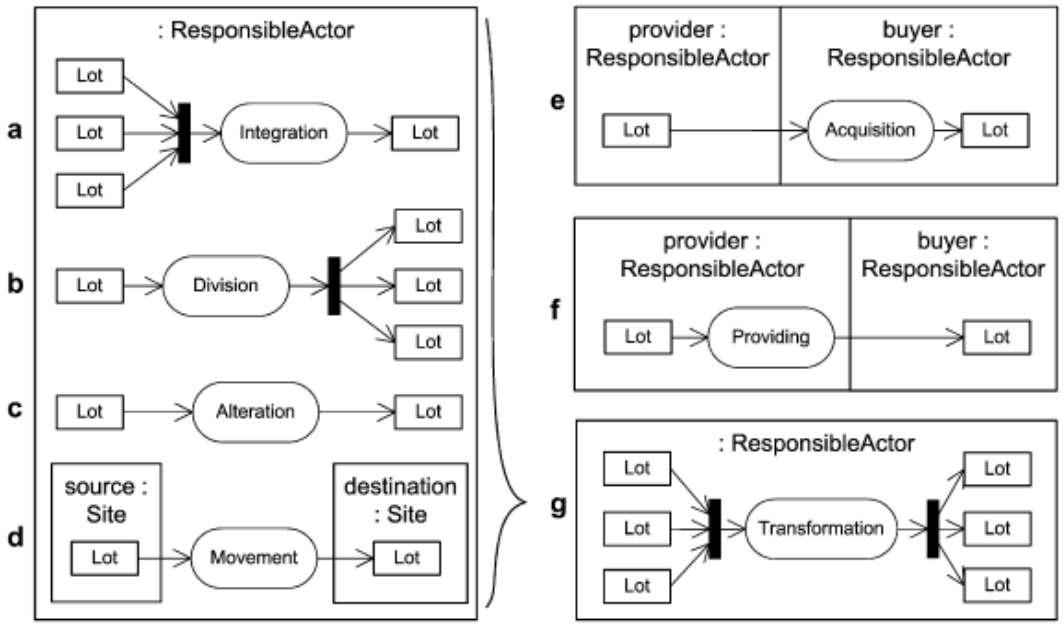

Figure 7. Lot-providing pattern.

Breadth, depth and precision of traceability systems should be considered. Nevertheless, there is a fact that no food traceability system is complete because food is a complex product and traceability is a tool for achieving a number of different objectives.

A system for tracking every input and process to satisfy every objective would be enormous and costly; consequently, enterprises across Vietnamese agriculture production have developed varying amounts and kinds of traceability. Therefore, the suggestion is that enterprises develop the necessary breadth, depth and precision of their traceability systems depending on characteristics of their industrial characteristics, production process and their traceability objectives.

- The breadth of a traceability system relates to the amount of information collected; attempting to keep records and to catalog every characteristic and/or event is not usually warranted and would be prohibitively expensive.
- Depth of a traceability system is defined as how far back and/or forward the relevant information is tracked; if, for example, food safety is at issue, depth would be determined by the number/location of Critical Control Points in the production/distribution chain.

- Precision reflects the degree of assurance with which the tracing system can pinpoint a particular food products movement or characteristics; in some cases, the objectives of the system will dictate a precise system while, for other objectives, a less-precise system will suffice.

In the context of Vietnamese agricultural production, experience show that the ability to extract the accurate information is improved largely in the close-to-end output production: The close to the field or at farm level, the more difficult to collect the information. The reason of this is that, awareness of farmer in Viet Nam is not high on recording. In addition, farm size in Viet Nam is generally small and there is a broken chain in the system: farmers and processor are separated from the final market by brokers and intermediate traders.

From information management perspective, to implement a tracing system within a supply chain, it is requires all the involved parties to systematically obey the physical flow of materials to the corresponding information flow. This could be enhance by developing disciplinary, or "rules of play" to material and document flow, production and process management and execution, business process collaboration through partners agreement, and responsibility placements. In the disciplinary, traceability requirements must be stated, as well as quality and safety goals. A tracing system, therefore, is a massive, central database, storing and capturing all the information about each lot along each stage of the supply chain.

In case of Vietnam, we suggest that there should be a government authority should manage the database. This authority will have full right to access information whenever it is requires for investigation related to a failure of compliance or product recall. Others stakeholder only can access the general information. Firstly, the most benefit from traceability is government since it can improve the management over food safety; secondly, in context of Vietnam, government is the only organization that can mobilize resources to manage this massive database; thirdly, to protect the privacy and fair competition between domestic enterprise, a government authority will play as neutral role for access information that sensitive to the operation of some enterprise.

IV. CONCLUSIONS AND RECOMENDATIONS

1. Conclusion

The study gives an overview of traceability development in the global scale and some APEC member economies. General literature review show that a traceability system is a tool for manage safety on food for public health. It allows documenting, locating a product from primary production to consumption. In case of nonconformity of a product, it is easy to identify its cause. It also provides security from a social and economic point of view by offering a unique solution for good practice on a worldwide basis. As a consequence, it contributes to lowering trade barriers. However, to development and application such system requires involvement of all stakeholders that participate in supply chain of food including agro-business enterprise and governance authorities.

Simply knowing where a product is in the supply chain does not improve supply management unless the traceability system is accompanied with a real-time delivery system or some other inventory-control system. Or in another way, tracking food by lot in the production process does not improve safety unless the tracking system is linked to an effective safety control system. Moreover, traceability systems do not create credence attributes, they simply verify their existence. Traceability systems should be considered as an element of an enterprise's supply side management system, safety system, and production strategy. Traceability systems are built to complement the other elements in each system.

The best role of government policies is to focus on strengthening enterprise incentives to invest in traceability to ensure that unsafe food are quickly removed from the system, while allowing firms the flexibility to determine the manners.

In case of Vietnam, traceability development is at the beginning stage. The study shows that there are still need improvements of legal framework, awareness of stakeholders, selection of adequate and appropriate technology. The current establishing traceability is in supply chains for export. To expand this to domestic market, it would be a gradual process and was best led from the top.

Where the most benefit from implementation tracing system can be gained in the short term to medium term, the processor could play an important role of initiator. Enterprises with high-value-income from exportation are likely have the management system, technical knowledge and resource to implement and maintain traceability. Farmers and collectors do not, and would not be motivated to do so without a market demand. If the processor had traceability system in place, they then would be more interested in controlling the supply chain, including

traceability. This is what happened in the fishery sector of Viet Nam. The manufacturer has been market led from the exporter down to the farmer. This has been recognize by the government as well as the industry.

2. Recommendation

For APEC

Since tracing in agricultural production is an emerging issue as mandatory from premium market, APEC member economies should develop a network to sharing experience of developing and applying traceability system in their own economy. Best practice in traceability in agricultural sector should be compiled to help others

Since there is different understanding, standards and guideline to develop a traceability system, in order to facilitate the harmonization standard, and to enhance the trade volume between APEC region, strategies for application traceability, uniform standard of a traceability system in APEC should be build, led by developed economies such as US, Japan, Australia.

There should be policies within APEC region to facilitate research and development to reduce cost of technology application that developing member could afford in developing and applying traceability.

Programme and campaigns to address awareness of people, enterprise in APEC region should also be paid attention. Activities may vary from dissemination, publication, workshop, seminar that led and sponsor by developed member economy like US, Japan, Australia.

For Viet Nam

As a developing member of APEC, Vietnamese Government should set up strategies with step by step introduce obligatory traceability in agricultural production. Pioneer sector could begin with those are working involved with export-oriented production with high value. Experience from this application should be concluded in wider scope of application nationwide. Legal framework should also be completed to facilitate the emerging trend.

Government should composing guidelines, publication related to good practices to support for the application of traceability in agricultural

production and trade. An comprehensive cost and benefit analysis of applying traceability and technology alternatives should be carry out in order to provide clearly pictures and encourage the application of traceability system.

V. FOLLOW-UP ACTIVITIES

For APEC

Given the trend that traceability is gradually became obligatory requirements in doing agro-business, for APEC member economies, especially developing countries such as Viet Nam, Government should develop a strategy to synchronized standards, national technical regulations and legal requirement in conformity with international standard and requirements from importing countries in order to encourage the application of traceability in agro-business and trade.

A forum with thin APEC economies should be set up in the framework of ATCWG or as part of APEC Food Safety Cooperation Forum to exchange information and experience in between developed economies leading by US, Japan, and Australia with developing member in applying traceability system.

Raising awareness on traceability for stakeholder related to agro-business such as entrepreneur, government officials, NGOs acting in protecting consumer rights by means of organizing workshop and training course on standards, certification, technology guideline for development and application traceability system.

For Viet Nam

Development and implementation of traceability should be undertaken in two stages. Firstly, an analysis of characteristics of the existing process should be done to examine traceability objective and design. This will involve all the steps in the operation and examine each step for identifying what information is needed, the records taken and the traceability applied. The analysis will provide a gap of traceability in the process operation. The second stage, if the business is willing and resources are available traceability will be applied. In practice, this will involve working with the business to specify the traceability system. The

recommended traceability system should be based on good practice and which is acceptable by the export market. It is recommended that the analysis should include both external and internal traceability to meet both accepted regulatory requirements as well as industry expectation in export market.

One of the major weaknesses of the agricultural industry is the information gap among entities in the supply chains originated either by unwillingness to share information or by inability to do so due to lack of sufficient means and sophisticated technologies that allow efficient and transparent information flow. An integrated traceability system must be able to file and communicate information regarding product quality and origin and consumer safety. An infrastructure to accommodate central database should be developed with harmonization with international standards and good practices of traceability application. Cooperation with other APEC's developed member economies should also strengthen for searching appropriate low cost technology that suitable for condition of Vietnam.

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Annex 1

Traceability in agricultural trade and production. Lessons from developing a new traceability system for cattle and deer in New Zealand

Douglas Birnie.
Director Policy and Risk, MAF Biosecurity New Zealand

Summary

To improve capability in responding effectively to a biosecurity or food safety emergency and to ensure on-going consumer confidence in New Zealand's livestock produce, Government and industry organisations have come together to develop a new integrated system for the identification and tracing of livestock - the National Animal Identification and Tracing (NAIT) project. The scope of the proposed scheme is initially limited to cattle and deer .Regulations requiring compliance with new procedures to support NAIT are expected to be in place by 2011. This paper describes progress in developing the NAIT system together with discussion of some of the main lessons that have been learned along the way - these are summarised below:

- Working in partnership to develop a traceability system is advantageous but can be challenging
- Reaching consensus and defining project scope can be time consuming
- Cost benefit analysis has a high profile but is inherently difficult for this type of project
- Data access and privacy issues will require careful handling
- Careful selection of animal identification technology is required
- Change management is crucial in a complex and fragmented livestock health landscape
- Learning from international guidelines and traceability systems in other countries has been very helpful
- Managing stakeholder concerns can be very resource intensive
- Communicating the need for a new and mandatory system has been challenging

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1. Agricultural Production in New Zealand

New Zealand's temperate climate and fertile soil make the APEC member economy ideal for almost every kind of land-based production - from sheep and cattle, to cropping, horticulture and forestry. The agriculture and forestry sector is one of the largest sectors in the New Zealand economy. Together with its support and processing components it regularly contributes more than $21 billion per year, or about 20 percent of Gross Domestic Product.

The sector's major exports include meat, wool, dairy products, wood products, horticultural products, and many specialised products supplying niche markets around the world. The nation's meat processors annually produce 660 000 tonnes of beef and veal, 430 000 tonnes of lamb and 110 000 tonnes of mutton. The dairy sector exports over 370 000 tonnes of butter, 290 000 tonnes of cheese and 140 000 tonnes of casein products. The horticulture industry produces and exports about 65 million trays of kiwifruit and 17 million cartons of apples each year.

Agricultural exports accounted for about 47 percent of export receipts in 2002, reaching almost $14.5 billion, while horticulture exports accounted for over 7 percent of export receipts, or $2.1 billion. Together, agriculture, horticulture and forestry accounted for over 65 percent of the export receipts.

2. Animal Identification & Tracing in New Zealand

All cattle and deer must be uniquely identifiable with an individual official animal identification device approved under the Biosecurity Act 1993. Under the Biosecurity Act, the Animal Health Board (AHB), Livestock Improvement Corporation Ltd (LIC) and AsureQuality Ltd (AQ) have had their identification systems approved for the purposes of the Biosecurity (Animal Identification System) Regulations 1999 (Biosecurity Regulations). These regulations require that an approved identification system is used for cattle and deer for the purposes of controlling bovine tuberculosis

All three schemes use a primary and a secondary ear tag with a unique individual identifier. AHB has the responsibility of approving all official tag devices for the purpose of bovine tuberculosis. In accordance with approved scheme specifications, farmers must order these tags from a manufacturer that has been approved by AHB.

The primary tags must be yellow and printed with a barcode and visual identifier. The secondary tags also carry a visual identifier but may contain less information due to the fact that these may be button tags or brass tags and therefore too small to accommodate a lot of printed information.

There are also identification systems approved under the Animal Products Act 1999 (APA). The Animal Products (Approval of Animal Identification Systems and Manufacturers) Notice 2000 has approved the AHB and LIC identification systems for identifying and differentiating bovine animals treated with hormone growth promotants (all bovine animals treated with hormone growth promotants must be identified). AHB and LIC identification devices have also been approved under this notice for the differentiation and identification of animal materials.

Under the Biosecurity (Imported Animals, Embryos, and Semen Information) Regulations 1999 the owner or person in charge of specified imported animals (sheep, goat, cattle or deer) must notify the Director-General of MAF if tags issued in respect of importation of that animal are lost or become illegible,

provide an annual status report confirming that such animal's eartags remain in place, and keep documentation identifying animals receiving imported animal genetic material (ie embryos, semen).

In addition to animal identification, movements of animals are required under the Animal Products Act (1999) to be accompanied by an Animal Status Declaration (ASD). The purpose of the ASD is to transfer key information about an animal, or group of animals, to the next person in charge, or the processor. For the processor, the information on the ASD is vital for guiding ante-mortem and post-mortem examination, and for determining export eligibility and certification.

The ASD also incorporates the Tb questions required by the Animal Health Board under the Biosecurity (National Bovine Tuberculosis Pest Management Strategy) Order 1998.

3. Summary of the National Animal Identification & Tracing (NAIT) project

The National Animal Identification and Tracing (NAIT) project started in August 2004 when livestock industry parties approached the Government to work together to improve animal traceability in New Zealand. An Animal Identification and Tracing Working Group was then established to consider domestic and international trends in animal identification and traceability, and propose a way forward to enhance New Zealand's existing systems. While current systems are satisfactory, demands for traceability for animals will continue to increase for market access, and to meet biosecurity and other on- and off-farm needs. In July 2005, the Working Group distributed a report for industry consultation and from the submissions received, industry agreed in principle to the changes proposed.

In March 2006, an Animal Identification and Traceability Governance Group was established to oversee the development of the new system under the name "NAIT" (national animal identification and tracing). In the budget of the same year, the Government announced funding for the National Animal Identification and Tracing (NAIT) and project.

Following the completion and approval of a detailed business case, which has proceeded in parallel with system design and business process development (2008 – 2009), the Government will fully fund the capital cost and 35 percent of the operating cost of the NAIT system. The remaining 65 percent of operating expenditure will be funded by industry.
A new mandatory animal identification system for cattle and possibly deer is proposed to be in place by 2011. The inclusion of deer is dependent on confirmation of the in-field performance of radio frequency tags.

4. Lessons from NAIT

4.1 Working in partnership to develop a traceability system is advantageous but can be challenging

The OIE guidelines on the development and implementation of traceability systems for livestock place emphasis on the need for an approach focused on outcomes and strong collaboration between public and private sectors in developing and operating these systems.

The NZ experience to date indicates that the partnership approach adopted by NAIT will ultimately lead to a more useful and farmer-focussed system. NAIT is likely to achieve more comprehensive user buy-in than would otherwise have been the case with a solely industry or government led project. Specifically, the joint industry-Government model:

+ Has led to increased ownership of project issues, increasing the resources available for problem solving. Having a number of different organisations involved has extended the breadth and depth of perspectives and technical expertise that is directly available to the project team to ensure that realistic solutions are developed.

+ The involvement of industry representative groups has been instrumental in achieving overwhelming user support for the project and in allaying potential concerns about government over-regulation of industry activities. This support will be crucial during the implementation and operation of the system.

+ Similarly, direct government involvement is required for a mandatory scheme, and has brought additional regulatory, policy, legislative and technical experience to the table, which is required for establishing the credibility of NAIT with trading partners internationally.

+ The shared funding of NAIT, determined according to the level of benefit that it is anticipated partner organisations will realise, can be seen as more equitable than alternative approaches that, for example, rely solely upon producer or tax-payer resourcing.

+ The value proposition that developing the NAIT traceability system is an appropriate and worthwhile endeavour, rigorous cost-benefit analysis notwithstanding, is supported by the active involvement of a wide range of organisations.

However, working in partnership has presented the NAIT parties, both individually and collectively, with a number of challenges that might not otherwise have been apparent:

– Shared funding models are difficult and time consuming to negotiate owing to the fact that each of the parties involved has a different perspective on the relative magnitude of the contributions that they should contribute.

- Approval of significant decisions by the NAIT parties has been affected by the differing governance arrangements and requirements within each of the different organisations and the lack of synchronisation of boards meetings where approval of NAIT decisions is sought.

- In particular, some difficulties have been encountered owing to the increased time and cost associated with the provision of the level of quality assurance that is legally or otherwise required before Government departments can contribute public resources into projects such as NAIT. Partner organisations from the private sector often operate with less stringent requirements in this area and have found the requirements necessarily imposed on the NAIT project through government participation challenging.

- In addition, true public-private partnership arrangements are not ubiquitous in New Zealand and the NAIT project has to a large extent not been able to utilise any pre-existing precedents for governance and decision making in this area.

- The core NAIT project team has not, until recently received a continuity of funding but has instead relied upon the re-negotiation and allocation of resources following completion of project phases or where shortfalls become apparent. Accordingly, the administration and uncertainty associated with this has not helped with the progress of the project.

It is reasonable to suggest that obtaining unanimous agreement on issues surrounding project and ongoing governance has been the most difficult aspect of the NAIT project to date. Maintaining mutual trust and good communication between partner organisations is essential to minimising the impact of these difficulties on NAIT.

4.2 Reaching consensus and defining project scope can be time consuming

Any new traceability system needs to be developed with a scope defined by the needs of the parties participating, i.e. it must be fit for purpose yet cost effective. Scope issues include:

- species of livestock covered
- mob / individual animal versus premises level recording
- data elements to be captured, e.g. date of birth, production purpose, vaccination status etc.

It was decided quite early that NAIT should focus, at least initially, on individual identification and movement recording for cattle and deer, as these species are already required to be individually identified for the purposes of TB control (see above). Market based drivers for enhanced traceability are also particularly strong for beef.

Initially, the data needs among the different partner organisations were not aligned, with some wishing to see a comprehensive data set collected for individual animals and properties whereas other parties advocated a minimalist approach. After prolonged discussion it was agreed that only those data elements that were considered strictly necessary to meet the purposes of NAIT (biosecurity surveillance and response, market access) were to become mandatory system requirements but that some provision for optional, non-mandatory data fields would also be included.

NAIT has been designed to include an element of flexibility in order to allow other data items to be included at minimal incremental cost in future, if required. It was further agreed that such decisions would be subject to business casing, with the beneficiaries of the capture of additional data likely to be expected to fund any such development.

4.3 Data access and privacy issues will require careful handling

NAIT, like other analogous systems will collect many different data from a range of sources, collate it and make it available to multiple recipients for varied but defined purposes. In particular, management practices in livestock farming mean that multiple individuals may be required to interact with NAIT in relation to the same animals or property (e.g. keeper, owner, buyer, seller, resident, stock agent etc). Determining who is responsible for, and can access, particular data items and at what point in the process, is complicated. For this reason, the technical and legal issues concerning data sharing and access will require a good deal of further work as NAIT progresses.

Some system participants have indicated that they are not content for government to use NAIT data for activities unrelated to biosecurity. Other groups have expressed concern about conflicts of interest arising from NAIT service delivery being performed by vendors who may be in a position to use NAIT data for competitive advantage. Managing these concerns has and will continue to require active communication and consultation with system participants and reference to existing privacy and data management legislation.

4.4 Cost benefit analysis has a high profile but is inherently difficult for this type of project

NAIT will not receive financial or other support to proceed to implementation unless it is supported by a favourable cost benefit analysis. The CBA has been a point of intense stakeholder interest.

The nature of the NAIT project has presented some unique challenges to the project team when conducting the CBA. For example:

- Quantifying benefits to biosecurity (a key driver for NAIT) is often difficult given that the probability and magnitude of impacts of future incursions of

exotic disease cannot be known and estimates cannot be supported with the most robust evidence. This situation is exacerbated by the fact that New Zealand, fortunately, has had no significant outbreaks of exotic diseases in livestock in recent times from which to draw comparisons. It is also the case that biosecurity benefits arising from systems like NAIT largely sit in the area of improved business intelligence and serve to limit potential impacts rather than prevent them – determining the magnitude of mitigation is itself fraught with uncertainty.

- NAIT is an enabling system – costs to set up the infrastructure are high but marginal costs to derive additional benefits are relatively small. The realisation of benefits is with a wide community, but if individuals or groups do not make that additional investment the community as a whole does not get the synergies from the investment. There is no single owner of the benefits who can make the associated investment with a clear link between the cost incurred and the benefits derived.
- The other main driver for the NAIT project is maintaining access to premium livestock product markets. To some extent NAIT can be seen as insurance against loss of current access, as opposed to demonstrably contributing to an increase in product unit value. As with biosecurity benefits, quantifying the value of this is challenging, particularly as global food commodity markets are increasingly volatile making predictions especially difficult.

- Other issues that have been encountered during the NAIT CBA have included difficulty in accessing what is commercially sensitive data about industry business practices and some disagreement between partner organisations about which benefits should and should not be included, for example on-farm benefits from utilising RFID technology that would require additional user investment. In addition, many of the input variables about business practices, for example time required to apply an eartag to a cow, have necessarily been derived from Delphi conferencing, as they are unavailable in peer-reviewed and other literature.

Despite these challenges, the NAIT CBA is in the final stages of completion and the approaches adopted have been subject to favourable stakeholder review and external quality assurance.

4.5 Careful selection of animal identification technology is required

There is a wide variety of technologies that can be used for individual animal identification, including rumen boluses, eartags, tattoos, brands, retinal scanning, microchips and DNA fingerprinting. The OIE guidelines are not proscriptive but a review of other systems worldwide and reference to FAO advice indicated that Low Frequency (LF) RFID eartags were the best option for NAIT in the initial rollout for cattle and deer.

However the approach does not confine other animal species to use the same technology, or even to individual animal identification. There was a challenge in

communicating this message of one-size does not fit all. A lot of discussion was on the individual tagging for sheep, currently outside of scope for the initial rollout of NAIT.

During the planning and design phase of the NAIT project, some stakeholders questioned whether it might be more appropriate for NAIT to embrace promising emerging technologies, specifically ultra-high frequency (UHF) as opposed to LF RFID eartags that are currently available and proven to be fit for purpose in New Zealand and abroad.

NAIT from an early stage has articulated its decision to be a technology adopter, rather than a developer, and has produced a technical standard with which manufacturers of eartags must demonstrate compliance before their products are approved by NAIT. However, NAIT has also made provision for the development of a formal process that can be used to review the potential utility of new and emerging technologies with a view to potential NAIT approval.

4.6 Change management is crucial in a complex and fragmented livestock health landscape

For historical reasons, New Zealand has a large number of public and private organisations that provide services or manage risks associated with animal health and livestock production. Numerous databases are maintained to support these activities, many of which are also undertaken as required by multiple different pieces of legislation and regulations. As a result, the planning and implementation of NAIT has required careful consideration of how these activities and those who undertake them will be affected by the introduction of NAIT, involving a lot of consultation.

Inevitably, NAIT will present opportunities for some parties and business risks for others. However, the tight focus of NAIT upon the inclusion only of data that is absolutely required should reduce the possibility of negative impacts upon businesses that provide value-added services to the livestock industry.

In addition, it is recognised that this complex environment means that NAIT must place particular emphasis on ensuring that clear and consistent information about requirements and obligations is provided to farmers and others involved in animal production, movement and processing.

4.7 Learning from international guidelines and traceability systems in other countries has been very helpful

The design of NAIT has been informed by observations and lessons that have been taken from the implementation of similar systems overseas and with reference to guidelines provided by the OIE and the FAO.

NAIT has benefited from the experience of members of technical advisory group who have first hand knowledge of the operation of several national systems from the EU and elsewhere. In addition, staff from animal identification and tracing

agencies in other countries, particularly Australia, have been tremendously helpful in providing information and advice on an ongoing basis.

In 2009, MAF conducted a formal review of selected cattle identification and tracing systems worldwide, which identified nine key lessons that have / will inform the technical design and implementation of the NAIT system.

4.8 Managing stakeholder concerns can be very resource intensive

The NAIT proposal has been the subject of two rounds of formal government consultation and feedback received from these and ongoing farmer workshops and road shows has contributed to significantly raising public awareness of NAIT and has also improved the design of the proposed system.

Unfortunately, one of the NAIT partner organisations withdrew its support for the project at a relatively late stage of the planning phase, citing concern with various aspects of the proposal.

Managing issues, including public confusion, associated with this required the diversion of considerable resources that might have been better directed towards achieving progress with system design. However, the media interest generated in response to these difficulties has ultimately provided NAIT with a windfall of publicity and an unprecedented opportunity to raise profile of the project among farmers. It has also highlighted the value of adopting a partnership approach and in having an independent spokesman and chairman, Mr Ian Corney, who has refused to be diverted from addressing the issues of real importance and has maintained the trust of the farming public.

Support for and awareness of NAIT was assessed through the commissioning of an independent survey of approximately 700 farmers. This revealed that a significant majority were in favour and has provided the NAIT partner organisations with assurance that public approval for the scheme continues to exist.

4.9 Communicating the need for a new and mandatory system has been challenging

As described above, New Zealand has animal and product traceability systems that are currently satisfactory. The message that they may not be considered adequate in future and that improvements will be beneficial in other ways has not been easy to get across to stakeholders understandably resistant to ‘fixing something that isn’t broken’.

Substantial effort has also been required to convince some industry participants that the data quality, and hence the biosecurity utility and international credibility of any new system requires that Government is an active partner and that the system should be mandatory. This is, in part, due to the prevailing political ethos

in New Zealand, where commercial activity is kept as free as possible from official regulation.

Annex 2

An Outlook of New GAP and Traceability Certification System in Chinese Taipei

Fuu Sheu
Associate Professor
Department and Institution of Horticulture,
National Taiwan University

Summary

To improve safety, transparency and reliability of the value chain for agricultural products, central competent authority on agriculture in Chinese Taipei, the Council of Agriculture of the Executive Yuan, Chinese Taipei R. O. C. (COA), have constructed and promoted traceability certification system on certain domestic agricultural products. In January 2007, "Agricultural Production and Certification Act" was enacted by the Legislation Yuan, Chinese Taipei R.O.C. and announced for execution by the President. This new Act adopted food traceability system and Good Agriculture Practice (GAP) certification as strategy for administration of agricultural products. In addition, this act has a great impact to the future agricultural production in Chinese Taipei and leads Chinese Taipei agriculture into the era of "certification" and "traceability" as well as provides a legal basis for the GAP and traceability system in Chinese Taipei. This article briefly introduces the process of developing traceability system in Chinese Taipei in past few years and also the recently enacted regulations of certification and authentication as well as the information technology (IT) systems and procedures for routine traceability works.

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1. Introduction

Food traceability system, constructed and promoted by many countries in the early 21st century, was developed to improve the security and safety of food chain. Similar to some other countries, food safety problems occasionally happen in Chinese Taipei such as pork from dead or sick pigs ending up on markets, excess residual pesticide in vegetables, and presence of antibiotics in fish. All these events have caused food scare, which lowers people's reliance in the APEC member economy and society. Since 2003, Chinese Taipei government has started to promote traceability system in the hope to effectively increase the quality and safety of agricultural and food products.

As defined by the European Union, traceability means "the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution." Agricultural products, except those being served

raw, could be raw ingredients of many processed food products. Hence, a complete traceability system should start with a well managed source. In Chinese Taipei, COA is in charge of establishing a traceability environment for agricultural products. Producers are expected to record the operational procedures and resumes, including the production of raw materials, processing and manufacturing, and product distribution, thus to enable consumers to trace back the sources of raw materials and also to track forward the whereabouts of products.

Transparency and trace/track capability of the entire food chain is the principle of food traceability. It is expected to provide consumers the related information about food production, processing and distribution, and at the same time to allow a fast trace back the causes of food poisoning accidents, and to recall flaw products. In such a way, food safety can be increased by reducing food accidents. In Chinese Taipei, food traceability is established on Good Manufacturing Practice of Foods (GMP), Hazard Analysis Critical Control Point (HACCP), ISO-9000 manufacturing certification and so on. It systematically elevates the reliability of the whole food chain, which enhances not only food sanitation but also the safety and security of the food chain. Therefore, on one hand, food traceability system can ensure food safety and public health as well as people's belief to the food chain and the government. On the other hand, an integrated information system has firmly developed to integrate with the traceability works, allowing a fast and correct trace back of agricultural products, and most importantly, reducing the risk and impact of food accidents.

Public awareness on food safety and environmental sustainability has also apparently increased along with the rapid social economic growth in Chinese Taipei. The public expect more transparency on food production processes. The central competent authorities require a more precise and efficient solution to reduce food safety risks and to maintain environmental sustainability. Therefore, COA have constructed and promoted traceability certification system on certain domestic agricultural products and adopted GAP certification as strategy for administration of agricultural products.

2. Trail and Pilot Plans for Traceability Development

The reason to promote the traceability system of agriculture products in Chinese Taipei is to ensure food safety and in the hope to establish a safe agricultural production value chain. After becoming a member of WTO in 2002, the agricultural products and agricultural production in Chinese Taipei have encountered an enormous impact. In the meantime, the worker population in Chinese Taipei agriculture is ageing, and the increase of production costs leads to a decline of competitiveness. Agriculture in Chinese Taipei is in need of innovation and advancement. To effectively increase Chinese Taipei agricultural safety and competitiveness, Chinese Taipei government and farmers highly value the establishment of traceability system.

In 2004, COA initialed several trial plans for promotion traceability system on agricultural products, which conducted step by step upon several periods. First, the harmony among production and dispatch stages was tested to estimate the feasibility on comprehensive implementation of traceability system. Second, the cultivation and operation, guided under the conventional GAP documents, were conducted in the field. The farmers were requested to record their daily operations in paper and further input this information into computer. Third, the information system for traceability and management purposes has been developed. Information systems were developed for farmers to input the information about their crops and operation procedures into computers to help manage their crop production. Labeling with barcode was stuck onto different batches of products for consumers' enquiries. In addition, COA also established the Good Aquaculture Practice (also called GAP) system and computer tools for fishery. Fortunately, all these pilot works performed very successful, drawing people's much attention as well as strengthening COA's confidence on building traceability system. It provided the basis for the expanded promotion of the system in the subsequent years.

COA then quickly faced the insufficiency of conventional GAP protocols, which were roughly developed and applied in 1980s. In 2005 and 2006, the governmental institutions in charge of research were invited to review the operational procedures of each agricultural product and the measures of microbe and insect prevention. Taiwan Good Agricultural Practice (TGAP), as revised and updated GAP protocols for a total of 80 products, was then drawn up. Many pilot farms were selected for each products allowing the evaluation and revision of every TGAP operational procedure to meet the new traceability requirements. The revision works on TGAP were believed as a huge load and TGAP was further used as the principle for certification. On the other hand, COA also established an integrated database, "Taiwan Agriculture and Food Traceability System" (TAFT). This web-based database is provided to farmers of each field and consumers to upload and search for the information of traceability, respectively. The COA also subsidized supermarkets to set up traceability information enquiry machines (Kiosk systems) to introduce traceability to consumers and allow traceability information to easily become available. Furthermore, COA further expanded the scale of the traceability system by incorporating the production of livestock and poultry and by constructing more pilot farms. (Figure 1)

3. Agricultural Production and Certification Act

In January 2007, "Agricultural Production and Certification Act" was enacted by the Legislation Yuan, Chinese Taipei R.O.C. and announced for execution by the President. The definition of the term "traceability" in that Act is "the ability to trace the information of an agricultural product through specified stages of cultivation, processing, packaging, distribution and marketing, which can be demonstrated by keeping complete records that could be made known to the pubic". This Act has a great impact to the future agricultural production in Chinese Taipei and provides a legal basis for the promotion of traceability

system in Chinese Taipei. The aspects that traceability stated in this Act are as the follows:

1. Traceability was officially taken as a legal term, and traceability products were given a legal status.

2. Traceability in Chinese Taipei is voluntary, however, this Act clearly stipulates that the government can enforce the execution of traceability system by announcement regarding certain agricultural products, and also applies to the imported agricultural products.

3. This Act stipulates the business holders of agricultural products who shall implement the traceability system to be responsible for providing and maintaining the traceability information.

4. This Act incorporates the traceability system into the certification and accreditation of agricultural products, clearly stipulating that traceability shall undergo certification.

5. Related punishment is stipulated in this Act.

After the official implement of this Act, agricultural products intended to post or claim to be the products of traceability shall undergo the process of certification. Chinese Taipei agricultural products thus enter the "age of certification and traceability". The certification system helps improve producers' management and product quality.

As one of the daughter measures related to Agricultural Production and Certification Act as announced by the Council of Agriculture in June 2007, "Regulations Governing the Certification of Traceable Agricultural Products" stipulates that traceability system should be based on TGAP, and the guideline and measures for the traceability certification of agricultural products. Others also stipulated in this Act about traceability agricultural products include batch work, raw materials, producing procedures, product labeling, the information that should be addressed to the public, etc. For instance, traceability agricultural products when sold on shelves should have the labels clearly showing the product name, tracing code and the instruction about how to obtain the open information, including product name, name of business holders, place of production, tracing code, major operations, package date, name of certification body and expiry date of certification license.

In terms of information system integration, "Agricultural Product Traceability Management Act" stipulates that the information about agricultural products of traceability certification should be opened to the public by the information system of traceability management as approved by the central competent authority such as internet, communication and other electronic means. Moreover, COA has integrated the information of TAFT agricultural products in different

fields in 2007, allowing consumers to search for the traceability information of different products through a single counter.

4. Operation Standards and TGAPs for Certification

Different strategies was adopted on concluding operation standards at cultivation, processing, packaging, distribution and marketing stages for the differences in operational characteristics and requirements of various agricultural items. TGAP protocols for diverse agricultural products, including rice and grains, fruits and vegetables, livestock, poultry and fishery products, are the main principle and operation standards to achieve the requirements of traceability, certification procedure and accreditation scheme in Chinese Taipei traceability system.

TGAP was established mainly based on or by referring to the latest international standard ISO-9001:2000, JAS, HACCP and GlobalGAP after an extremely progress of investigation on the cultivation methods, fertilization, pest/weed prevention, harvesting, packaging and so on. In "Regulations Governing the Certification of Traceable Agricultural Products", the definition of TGAP is "the standardized operation procedures and patterns for production (include the primary process and slaughter) concluded by central competent authority proceeded along through the production process that effectively exclude risk factors, eliminate the loads of environment, to ensure the safety and quality of products". The protocols are made not only easily understanding but also suitable for compliance practice and clear direction on evidence keeping and recording. The typical TGAP book contains the following items, (1) the flow chart about operational procedures of production and distribution, (2) tables for risk management about production and distribution, (3) a check list of production and distribution work, (4) a recording notebook for production and distribution, (5) a calendar of cultivation management, (6) the operational standard of fertilization, and (7) a table for pest and blight prevention. The recording notebook for production and distribution is compulsory for farmers to fill in those including personal basic information, tables of examination and analyses, planting and breeding area graphs, the recording tables for material procurement, and the recording of cultivation, fertilization, pests and blight prevention, harvesting and post-harvesting processing and distribution, etc. The recording contents are believed very detailed. The subsequent execution of traceability certification and the design of information systems on the basis of TGAP are therefore very important for the promotion of agricultural traceability.

In another side, while certification system including the GMP, premium agricultural product certification system (CAS) and ISO 22000 had well developed in Chinese Taipei for food manufacture, their operation standards was directly adopted as Chinese Taipei traceability system's at processing stages. Among the transportation, distribution and marketing stages, more provisions promulgated by respective government department are still required to lower the safety risk within the whole food chain.

5. Accreditation and Certification

In accordance with the "Regulations Governing the Certification of Traceable Agricultural Products", agricultural product operators can not apply for certification until at least 3-month records for operation following TGAP were made and uploaded to information system authorized by COA. The certification bodies have to be accredited sequentially by TAF and COA according to their conformity to ISO/IEC Guide 65 and other requirement issued by COA. After receiving the application, certification bodies should appoint auditors to audit according to arranged auditing plan including document examination, farm inspection, products survey on safety risk, and so on. All result of those evaluation activities above should be took into account before the certification decision was made by deliberation team composed by staffs or experts other than auditors of respective case appointed by certification bodies, and only applicants who meet criteria below should be certified:

1. All operations comply with respective operation standards.
2. Methods for traceability requirements adopted according with relative provisions.
3. The relative records are correct and completed.
4. The result of products survey on safety risk meet respective standards of Chinese Taipei.

Beside of individual agricultural product operator, group composed by multiple operator members who satisfies essential requirements below also allowed to apply for certification:

1. All the members should have legal or contracted relationship that restrict them to follow the unitary quality management system laid down and implement by group, and to obey all surveillance inspection conducted by group and derived corrective requirement.
2. Operations of all members should comply with operation standard.

For group certification, certification bodies should conduct additional audits on the QMS the groups adopted before individual members inspect. Only group that comply with essential requirements above should be inspected in the sampling pattern, namely, selection of producers is made by taking a random sample that, as a minimum, is the square root (or next whole number rounded upwards if there are any decimals) of the total number of group members.

The purpose of group certification is to partly substitute the function of external certifications by QMS that ensure the unity of operator members, so as to not only decrease the certification cost, but also increase the efficiency of resources and the consistence in products' quality and quantity. As for the whole system, group certification provides good gateway to let the price of traceable agricultural products easier by reasonable allocation on certification resources.

6. Development of IT Systems for Traceability

Many appropriate information tools have been developed to support the traceability system and to ensure that agricultural products can be truly tracked and traced. In Chinese Taipei, important characteristics of traceability IT system are the domestic nation-wide standards of tracing code, communicative database and the utilization of international GS1/EAN-128 barcode standard. The IT system for traceability, which is highly integrated to daily recording cultivation and distribution information, is not merely used in a small scale of trials, research or academic investigation, but it is a nation-wide and large scale application in different fields. This system operates online every day and COA, certification bodies and farmers highly demand the database stability, system efficiency, authority control, and emergency case processing.

The COA has developed a Farmer's Management and Information System (FMIS) since 1987 initially for farm operators' management, accounting, production planning, and field records. This system has drawn much praise, but due to the averagely lower IT knowledge of farmers, and that Internet was not common as well as a higher cost of hardware, there were few farmers using this system. In 2004, when COA decided to promote the traceability, the FMIS system was soon modified and upgraded for the traceability, in particular, the functions for production planning and operation as well as distribution recording. In 2005 and 2006, the MIS for traceability resume was modified to work on Internet for the upload of farmers' information into the nation-wide traceability database of the COA. At the same time, various daughter systems were developed for the adoption in different territory such as livestock, poultry and fishery. To further integrate and collect all the different type traceability information, COA set up a consistent tracing code encoding standard, and structured the nation-wide traceability database, TAFT, for consumers to search for the information of agricultural products.

The "Regulations Governing the Certification of Traceable Agricultural Products" stipulates that certified agricultural product operator should make their production and marketing record public by the service what authorized system provides. In 2007, COA completed the integration works to harmonize all the IT systems for crops, livestock, poultry, and fishery production. All traceability resumes and information can be searched and displayed in TAFT, which collects the data of all agricultural products for consumers' search and trace as well as for supermarkets to import related information. All the systems are asked to be user-friendly and easy to use. The farmers are trained to operate computer and upload all the resumes and records themselves. The authorities and certification bodies are educated to monitor the compliance of relative operation through the internet. Therefore, TAFT is also used by the certification and accreditation institutions for certification approval, product certification approval, and expiry date management.

Under TAFT, there are several sub-databases for crops, livestock, poultry and fishery, each collecting its related information to be uploaded into TAFT. Under these sub-databases, there are various different MIS systems for different production units to set up and upload their product information into the database

of individual field. To allow the information exchange within this large IT system, open XML standard was employed. So as long as following this standard, traceability data can be successfully uploaded into TAFT (Figures 2 and 3).

The most difficult part is to set up the standard of XML and WebService resumes between the IT systems. In past few years, we have built a correlation table for commonly used agricultural products, and the encoding for operation procedures, fertilizers, pesticides, and drugs. The COA pesticide system, farmland system, farmer organization management system, and knowledge management system were also integrated together. Through the application of traceability, the information from different databases can be connected and exchanged. Therefore, we strongly believe that the successful integration is highly contributive to the further utilization of agricultural information.

7. Identity and Labeling

The key to the success of traceability is the identity of different product batches. In Chinese Taipei, we legally stipulate that the products should be taken as different batches in accordance with the difference of producers, product items, cultivation time, location, operational methods, and harvesting time. Indeed, all the works for batch operation should be supervised by the certification body. In the IT system, the product batches can therefore be easily distinguished and traced. During the process of distribution, a product after undergoing a different stage should be given a new tracing code, and operators should clearly record the relevant data to ensure that the product can be traced back to the origin of raw materials in the IT system.

The GS1/EAN-128 barcode system is used for the labeling and tracing of traceability agricultural products, which is aimed to connect the traceability information and product distribution. As shown in Figure 4, the label on a container box includes GTIN product code (AI 01), tracing code for each lot (AI 10), producer's location (AI 251), grading and number (AI 240), packaging date (AI 13), certification code (AI 99), etc. As for the label for small package, in addition to the GTIN code for accounting, there is a two-dimensional QR code, provided for consumers to search for the product traceability information through mobile phones, PDA, or Kiosk machines.

It is convenient for users to print out labels from the traceability information system. After farmers have harvested their crops, they can input the command of harvest into a computer. They can further enter the post-harvesting treatments, mixing, and hereditary information for making the label print-out. The system then automatically gives a new tracing code to the labels. After confirming that the information is correctly uploaded to TAFT through internet, TAFT converts the information into WML and HTM files for browsing. The information will be presented to the Chinese Taipei QR certification system for further confirmation. A 255 bytes encrypted password will be given back to users who should decode the encrypted password on the terminal of client before they can print out the QR

symbol. This entire process is named as IT self-security process, which ensures the completeness and accuracy of information for future tracing and searching.

Once certified, agricultural product operators have to use Traceable Agricultural Product Mark (thereafter TAP mark, see Figure 5 below) on their products, under management by their certification bodies in according to ”Agricultural Production and Certification Act” and relative sub-regulations, as well as relative requirement about information reveal and products labeling mentioned above. Agricultural products shall be certified before using the TAP mark.

8. Current Status, Challenges and Prospects

After two years of the enforcement of traceability act since Jul 2007, there were fourteen certification bodies being accredited, 1,536 operators and groups being certified and 122 agricultural items covered, according to the data from COA (8/13/2009). In addition, more than one thousand of tracing codes were produced and more than twenty thousands of traceability labels were printed every day. These results suggest that the GAP and traceability certification system works smooth and its IT system firmly operates well. However, in the market, only 2 % of the total agricultural production was certified and traceable, which was still very limited and below the desire of the people.

As my understanding, most of the operators/groups, who have obtained their certifications, have comprehensive enterprise characteristics. Too small management scales of the farming household, increasing cost and aged as well as poor educated producers have limited the implement of GAP and traceability certification for common farmers. In Chinese Taipei, the average cultivated area of each farmer household was only 1.1 hectares, farmer’s average age was above 58 years old, and most of them graduated from elementary school. On the other hand, the conventional distribution channels, especially the auctions and tradition markets that share more than 80 % of the products, are still the leaks for traceability chain in Chinese Taipei. Therefore, these factors were the most difficult challenges throughout the Traceability system.

The GAP and traceability certification, which only covers partial agricultural products, is not really effective to protect the whole food chain. Fortunately, the public awareness on food traceability has been waken up and much more people pay attention on their right to know the source and safety of the food that they eat every day in Chinese Taipei. In 2009, Department of Health (DOH) will be reorganized and Chinese Taipei Food and Drug Administration (TFDA) will be established to enhance the food safety management. In addition, DOH has raised and added the traceability issue to the amendment of “ACT GOVERNING FOOD SANITATION”. After the completion of this legislation procedure, food safety and traceability could be effectively strengthened. Furthermore, COA will try to revise TGAP again for obtaining the benchmarking of GlobalGAP in the coming years. Chinese Taipei government believes that international standard such as GlobalGAP, ISO 22000 and others will help the quality and safety of agricultural products.

In conclusion, traceability system is an integrating work process from the field production to supermarkets, through the whole food chain. In Chinese Taipei, we have established a certification system and TGAP standard operational procedures, and employed advanced IT systems to integrate the entire procedures from production to distribution. During the development of nation-wide traceability IT system, we have also integrated several agricultural databases for providing users more information, knowledge, and convenient operations. This traceability work has been started recently in Chinese Taipei. We hope that every step can be extensively implemented, and more farmers can join and obtain their issued certification licenses.

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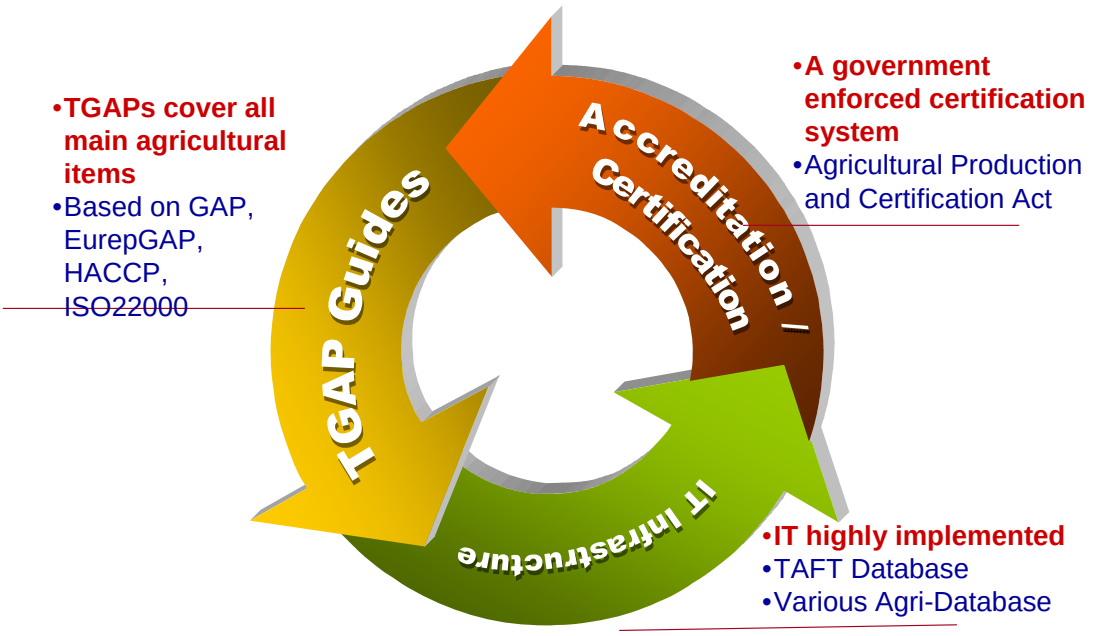

Figure 1. Main foundations for traceability implementation in Chinese Taipei.

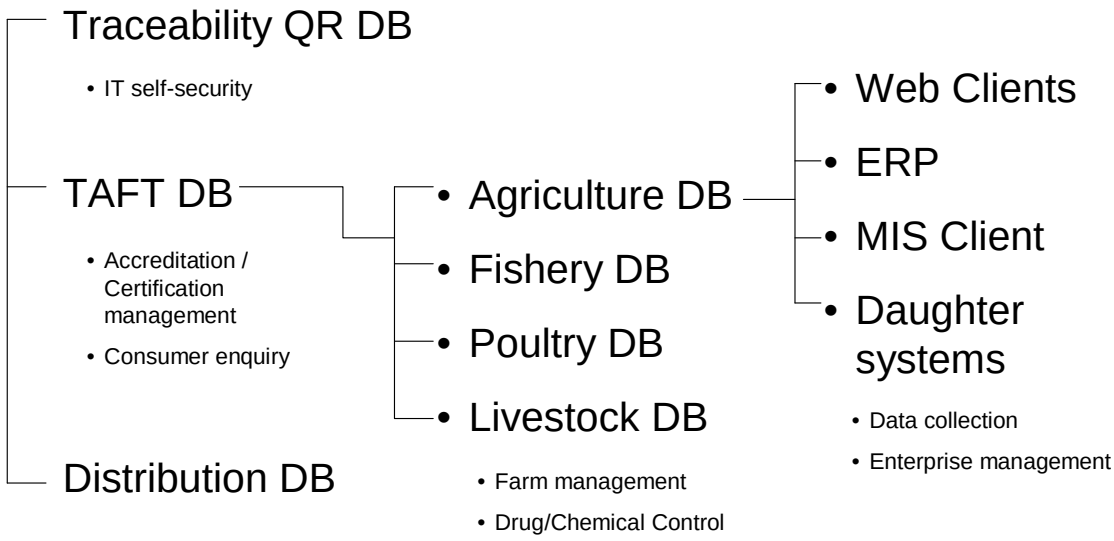

Figure 2. A three-level IT infrastructure supports the traceability system in Chinese Taipei.

(A)

(B)

(D)

(C)

(E)

Figure 3. Illustrations of some IT systems used for traceability works. (A) and (B) homepages of TAFT database, (C) consumer-querying page, (D) client software for data collection, (E) Kiosk displaying page.

Figure 4. Barcode layout, certification logos and stickers used for traceability in Chinese Taipei. (A) standard GS1/EAN128 barcode, (B) sticker samples for small-packaging products and (C) label form of Traceability Agricultural Product. The TAP mark on the upper-left corner of the label is used specifically on certified traceable agricultural products. Using this mark without certification will be fined NTD $200,000 to $1,000,000..

Figure 5. The TAP mark and some agricultural products. (A) TAP mark, (B) rice products, (C) tea products, (D) potato chip and (E) fishery products.

Annex 3.

Traceability in Agricultural production and Trade. Challenges for economic developing and implementation the system

Nguyen Huu Hoang
Southern Horticultural Research Institute (SOFRI)
Box: 203 - My Tho, Tien Giang, Viet Nam

1. The Overview

The December 2003 discovery of a cow with Bovine Spongiform Encephalopathy (BSE or mad-cow disease) in the state of Washington has prioritized traceability and assurance issues in the United States (US) food policy debate.

Nowadays, traceability has become an important issue in the international food sector as a result of the higher profile of food safety problems and consumer concerns, especially in developed countries (Liu Xue *et al*., 2007; Smith and Furness, 2008). On the international agenda related food safety, particularly for global organizations such as the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO), it's gradually emerging as a hot topic. With considerable outbreaks of food born diseases and public trust in food quality fundamentally undermined, the ability to trace food produce back to its source or origin rapidly, accurately, and credibly has become a significant issue for governments. Furthermore, consumers worldwide are increasingly demanding food products that are produced within a system capable of correctly identifying the source of potential food safety risks. Meanwhile suppliers such as farms, firms and marketers also have a number of motives for establishing traceability systems (Golan *et al*., 2004; Nanseki and Yokoyama, 2008). Overall speaking, each stakeholder concerns about food safety, potential health hazards, and transparent information, consumers' demand for credence attributes, and improving supply chain management etc. have pushed food traceability turn popular. Accordingly food traceability has first received growing recognition by policy makers and firms in the food industry.

"Traceability" is a common term in any food supply chain or value chain. However, there was a debate in using 'term' of how to trace food. U.S. regulators preferred the term "trace back," which has a history of use in illness outbreak investigations and food product recalls for public health purposes. The Codex Alimentarius has defined traceability as the "ability to trace the history, application or location of an entity by means of recorded identifications." Traceability is closely linked to product identity, but it can also relate to the origin of materials and parts, product processing history, and the distribution and location of the product after delivery. The European Union has fastened on traceability and labeling as solutions to consumer concerns about mad cow disease, dioxin in chicken feed, and bioengineered food products. In the EU view,

consumer confidence will be restored if food products are clearly labeled and ingredients can be traced backward to the source and forward to the customer. Traceability became a political football last summer when the European Commission approved proposals requiring traceability and labeling for biotech foods, including highly refined starches and oils where no altered DNA or proteins can be detected. Meanwhile, the Codex Committee on General Principles has been asked to examine the role of traceability as a potential risk management tool for public health purposes. Other Codex committees will seek to determine how traceability might be used in their standards and guidelines.

In the context of the European food policy, traceability systems have been introduced to improve the degree of food safety in supply chains and to provide more information to consumers. A "comprehensive and integrated approach" to food safety policy, provided by the European Commission (2000) in the White Paper (COM (1999) 719), has led to mandatory traceability for all other agri-food products (Reg. 178/2002).

What is TRACEABILITY? *Traceability is a verifiable method of conducting product identification from the growers through all the steps in the supply chain, to the retailer and customer. Traceability comprises two components, tracking and tracing. Tracking involves monitoring a product and all its inputs through all steps and agents along the supply chain. Tracing is the reverse and involves following a product from any point in the supply chain back to its origin. The E.C. General Food Law defines traceability as "the ability to trace and follow a food, feed, food-producing animal or substance through all stages of production, processing, and distribution."*

2. The Implementation of Traceability

Increasingly, market participants, rather than government agencies, are influencing the determination of acceptable levels of health and food safety. The leading global food retail chains establish acceptable thresholds based on their home nation's legal standards and cultural experience, as well as those pertaining to the APEC member economy within which they are operating. For example, Tesco responds to the consumer market of the United Kingdom (UK), Ahold to the Netherlands, and Carrefour to France, and to some extent transfer the associated strategies to the international markets within which they operate. Processors and manufacturers supplying these retail chains must meet the public and private standards established for procurement, even though they may differ significantly from those prevailing in the country of origin. A significant question is whether US multinational food corporations are adopting this model, and if such action diminishes or retains the public's role as a third-party certifier.

In addition to mandatory traceability, it is possible, in the EU, to outline a second traceability system level which is voluntary, and which provides a higher degree of information associated with a single product. This voluntary traceability system is regulated by a number of European organizations accredited to deliver food safety standards, like AFNOR (Association Française de Normalization) in

France, BSI (British Standard Institute) in the United Kingdom, UNI (National Standards Organization) in Italy. Recently, within the framework of ISO 22000:2005, a specific voluntary traceability standard was designed also at the international level (ISO, 2005).

According to the ISO 9001:2000 standard, chain traceability is the ability to trace the history, application or location of an entity by means of recorded identifications throughout the entire supply chain. In practice, chain traceability is achieved if businesses keep records of suppliers and customers and exchange this information along the entire supply chain. In particular, each unit/batch (called lot in the following) of a component or a product must be both traceable and trackable. To trace an entity means to identify its origin by tracing back in the supply chain, whereas to track an entity means to follow the path of the entity through the supply chain from supplier(s) to consumers. Traceability is a needed strategic service in any production context. It can be used to improve security, control quality, combat fraud or manage complex chains. In particular, traceability in food supply chain has attracted considerable attention in the last few years for a variety of reasons. First of all, it has become a legal obligation within the EU since 1st January 2005; similar requirements for traceability systems are present in the United States and Japan too. Then, food companies tend to consider the significant expenditure required to build a traceability system as a long-term strategic investment to create consumer confidence both in the company image and in the specific product. Consequently, other requirements for traceability exist besides the legal ones.

In fact, in addition to systematically storing information that must be made available to inspection authorities on demand, a traceability system should also take food safety and quality improvement into account. This means, for example, enabling the system to trace back so as to discover the cause of a problem and to prevent it from happening again, or to trigger a proper recall of potentially unsafe products, thus protecting public health. Of course, the implementation of a complete and efficient traceability system has to cope with several problems, such as the lack of alignment of the possibly different systems adopted in the various segments of the supply chain, or the non-homogeneous information kept at the various supply chain units. Building a traceability system is therefore a complex task that involves all stages of production, processing, and distribution: traceability records should be kept for both products and processes (such as movement, transformation or combination) that operate on products. To this aim, traceability needs to be supported by appropriate architectural and technical implementation solutions, as well as suitable operational services, in order to provide its expected value for business partners.

Traceability from farm: Traceability systems have become an essential tool with regard to food safety in the global marketplace. Traceability and quality control begins on the farm level. Further incentive to control liability exposure was provided by EU General Food Law Reg. EC No. 178/2002, in which the extent of the traceable system comprised the food chain from retail to farm. Article 18 of this regulation specifies: “Food and feed business operators shall be

able to identify any person from whom they have been supplied with a food, a feed, a food-producing animal, or any substance intended to be, or expected to be, incorporated into a food or feed. To this end, such operators shall have in place systems and procedures which allow for this information to be made available to the competent authorities on demand."

Traceability and assurance protocols that incorporate existing food safety and assurance elements, such as HACCP and ISO 9000, have the potential to provide an umbrella framework for the diversity of public and private market facilitation needs in the food system. They may address such issues as:

- food safety contaminations,
- intentional biosecurity contamination,
- requirements established for market entry by APEC member economy or firm,
- opportunities to address inefficiencies in the supply chain, such as non-safety contaminations that violate contractual specifications,
- opportunities to identify extrinsic characteristics such as animal welfare, environmental and social responsibility, and
- opportunities for gaining consumer, and internal supply chain customer, brand or private label equity through implied system integrity.

Asian countries must also use as basis existing international standards, guidelines and codes of practice (such as CODEX, HACCP, GAP/GMP/GHP, ISO 9000/01) to meet food quality and safety standards and hence facilitate trading among exporting and importing countries. Among Asian countries, the level of safety management systems in agriculture/aquaculture production and distribution, wherein traceability system is an integral component, varies considerably due to differences in socioeconomic conditions. Some countries are more advanced than the others in terms of implementing Good Agriculture/Aquaculture Practice (GAP) protocols and traceability systems, while some are still in the level of consolidating a mix of best practices in agriculture/aquaculture production and distribution. In more advanced countries in the region, GAP protocols and quality management systems are in place, as well as guidelines and implementing mechanisms on food traceability. These include safety policies and guidelines, and risk assessment regulations and certification for agri-produces

3. The Concept of Traceability in Food and Agribusiness

In the dynamic, global marketplace the rate of innovation has increased to meet the growing influence of consumer purchasing power. There is considerable pressure on the food and agribusiness supply chain to meet this demand in mature and emerging market economies without increasing the percentage of disposable income consumers are spending on food.

As food production, processing, and manufacture have evolved to efficiently meet this demand, consumers have become sufficiently aware and knowledgeable to start questioning these processes and request more information

about the food they are purchasing. In a totalitarian culture, information would be provided on a need-to-know basis. In a free society, participants are provided with a different and potentially powerful set of expectations. The discord between the corporate need for rapid innovation, to sustain competitiveness in a global market, and the protection of consumer expectations is at the center of the debate of how to meet the needs of both. An inability to resolve this debate increases the probability of market failure in one or more sectors of the supply chain (Armbruster, 2004).

The term 'traceability' has become so widely used in recent times in various industries that it is timely to examine the concept, particularly in relation to agriculture and food. Agricultural traceability simply refers to the collection, documentation, maintenance, and application of information related to all processes in the supply chain in a manner that provides guarantee to the consumer and other stakeholders on the origin, location and life history of a product as well as assisting in crises management in the event of a safety and quality breach. With respect to a food product, traceability represents the ability to identify the farm where it was grown and sources of input materials, as well as the ability to conduct full backward and forward tracking to determine the specific location and life history in the supply chain by means of records. It contributes to the demonstration of the transparency of the supply chain through the use of verifiable records and labeling. Traceability adds value to the overall quality management system by providing the communication linkage for identifying, verifying and isolating sources of noncompliance to agreed standards and customer expectations. There are six important elements of traceability which put together, constitute an integrated agricultural and food supply chain traceability system:

(a) Product traceability - which determines the physical location of a product at any stage in the supply chain to facilitate logistics and inventory management, product recall and dissemination of information to consumers and other stakeholders.

(b) Process traceability - which ascertains the type and sequence of activities that have affected the product during the growing and post-harvest operations (what happened, where, and when). These include interactions between the product and physical/mechanical, chemical, environmental & atmospheric factors which result in the transformation of the raw material into value-added products; and the absence or presence of contaminants.

(c) Genetic traceability - which determines the genetic constitution of the product. This includes information on the type and origin (source, supplier) of genetically modified organisms/materials or ingredients as well as information on planting materials (such seeds, stem cuttings, tuber, sperm, embryo) used to create the raw product.

(d) Inputs traceability - which determines type and origin (source, supplier) of inputs such as fertilizer, chemical sprays, irrigation water, livestock, feed, and the

presence of additives and chemicals used for the preservation and/or transformation of the basic raw food material into processed (reconstituted or new) food products.

(e) Disease and pest traceability - which traces the epidemiology of pests, and biotic hazards such as bacteria, viruses and other emerging pathogens that may contaminate food and other ingested biological products derived from agricultural raw materials.

(f) Measurement traceability - which relates individual measurement results through an unbroken chain of calibrations to accepted reference standards. To achieve this, measuring and test equipment and measurement standards are calibrated utilizing a reference standard whose calibration is certified as being traceable to a national or international standard. The other aspect of measurement traceability relates to the property of the measurements (data and calculations) generated throughout the supply chain and their relationship to the requirements for quality. By focusing on the quality of measurements (rather than on a property of an instrument, it is possible to assure that the measurements are indeed adequate for the intended use. To achieve this, each measured data must specify the environmental, perator, and geospatial and temporal factors, which are not related to the instrument but impact on the quality of the data.

In implementing a new traceability system or studying an existing one as part of routine quality management system or in the event of food safety and quality alert, these basic aspects must be addressed in order generate sufficient data to adequately evaluate the type, origin and location of the source of safety concern to enable corrective actions to be taken. Traceability is an information-based proactive strategy to food quality and safety management. It is a complimentary tool to other quality management programmes such as Hazard Analysis and Critical Control Points (HACCP) systems. A key strength of traceability chain management is that it facilitates the identification and isolation of hazards and implementation of effective corrective actions in the event of an incident. Thus, like point inspection and product testing, traceability by itself cannot introduce safety into the food process or handling process. When considered in isolation of other quality management systems, its traceability is not a sufficient condition to satisfy the safety requirements of the food chain. However, its strength lies in preventing the incidence of food safety hazards, and reducing the enormity and impact of such incidents when they occur by facilitating the identification of product(s) and/or batches affected, specifying what occurred, when and where it occurred in the supply chain, and identifying who is responsible.

The major driver for food traceability is still the need for large retailers and trading companies to obtain the assurance that their products are safe. This need is being reinforced by a strong regulatory climate throughout the world. These standards are now being expanded from legislation governing food production and importation to include domestic standards for food traceability. Not only are the major markets in the industrialized regions of North America, Europe, and

Japan introducing stricter laws on food safety and proof of origin, but many smaller countries are also following this trend.

4. Benefit and Prospects

a. Benefit

International food safety and food hygiene regulations and trade standards require that all food is traceable to source, and that movements of food products through supply chains can be traced "from farm to fork" and traced "from folk to farm". Traceability is also a key element of phytosanitary requirements of importing countries, which are designed to prvent the spread of pests and diseases. In the prevent of a problem, authorities and business must quickly acess and report on information relating to whatever conditions are relevant to the specific situation. The improvement in food safety due to the traceability system is connected to the growth of information throughout the food supply chain, and to the attribution of specific responsibilities to agents of the supply chain. In an increasingly competitive food system, traceability has become a major tool in dealing with concerns of food safety, quality assurance, risk prevention, and gaining consumer trust.

The benefits of integrating traceability into the overall quality agricultural management system are numerous, ranging from improvements in product quality and safety management, crises management in the event of a safety alert, and strengthening overall agribusiness coordination. With heightening public scrutiny of the food supply chain and agriculture, many national and regional new food quality regulatory directives and laws have been enacted, leaving agriculture and food industries with little option but to implement traceability systems as part of the overall food safety and quality management programme. As agriculture continues to experience declining terms of trade and competition by other more financially lucrative industries, there are good reasons to believe that the concern about traceability will continue in global food trade. The search for cost-effective technological innovations for implementing accurate and reliable traceability systems is therefore an important challenge facing agriculture in the new globalized economy.

Golan *et al.* (2005) said: (1) No food traceability system is complete because food is a complex product and traceability is a tool for achieving a number of different objectives. (2) A system for tracking every input and process to satisfy every objective would be enormous and costly; consequently, food supply system have developed varying amounts and kinds of traceability. (3) Firms develop the necessary breadth, depth and precision of their traceability systems depending on characteristics of their production process and their traceability objectives. (4) The breadth of a traceability system relates to the amount of information collected; attempting to keep records and to catalog every characteristic and/or event is not usually warranted and would be prohibitively expensive. (5) Depth of a traceability system is defined as how far back and/or forward the relevant information is tracked; if, for example, food safety is at

issue, depth would be determined by the number/location of Critical Control Points in the production/distribution chain. (6) Precision reflects the degree of assurance with which the tracing system can pinpoint a particular food product_s movement or characteristics; in some cases, the objectives of the system will dictate a precise system while, for other objectives, a less-precise system will suffice.

The evolving trend toward implementing traceability and assurance protocols is motivated by the need for greater transparency throughout the food supply chain—from retail and restaurant to the producer—in response to consumer demands. The extent of traceability required depends on the level of assurance needed to ensure market facilitation, sustainability and possibly competitiveness. Moreover, the need to use process verification, rather than inspection, to certify some food product attributes may be motivated by the lack of technology to test for an attribute, or the lack of a testable indicator to ensure required management practices occurred.

Increased movement of food ingredients and products in global supply chains increases corporate exposure to different interpretations of due diligence and accountability. The need to track accountability and recall contaminated products provides strong financial motivation to incorporate information needed for traceability with the supply chain management processes implemented to discover efficiencies. Consequently, the greatest concern and recent focus of debate is associated with the handling and production levels of the supply chain where the economic signals to implement traceability and assurance protocols have been the weakest.

The appearance of genetically modified organisms (GMOs) and the need for identity preservation of GMO and non- GMO agricultural chains has further exacerbated declining consumer confidence on food safety and the increasing concern over potential negative impacts of agriculture on the environment and ecological diversity. Closely related to these factors is the introduction of new food safety legislations that have placed responsibilities on producers, processors, caterers and other handlers in the supply chain to ensure food safety. The main tool that these operators will use to defend any subsequent liability will be the demonstration of “due diligence”, which must demonstrate that every precaution has been taken to prevent contamination and subsequent food safety hazards. More than before, an essential feature of food quality management system is that finished products can be traced back to their raw material and thus to their original producer and previous handlers in the chain. In the same way, forward traceability is also essential to guarantee the location of products and facilitate their recall when safety and quality standards have been breached.

b. Challenges

In the context of a globalizing economy, there should be domestic policy support in favor of small and medium-scale fish farmers. In some developing countries, one way to successfully introduce GAP protocols is to encourage, promote and

support group fish farming or production and marketing units. Enabling policies (e.g. government subsidy) must also be made available to small-scale fish farmers, and they must be provided with training and support services to improve their capacity to adopt safety management systems and traceability. Cost is a major issue in the development and adoption of traceability system for fish and fish products. Hence, the success of a system (such as bar code, RFID, etc.) is not so much an issue of technology, but of cost-effectiveness. Consumers must also be willing to pay for better access to information on product history, from production to distribution, and attain product trust and satisfaction. Finally, small producers must be provided with incentives such as a better opportunity not only in terms of trading, but also in improving overall fish industry management, market position, and competitive edge. With the goal of harmonizing standards and regulations among countries in the Asian region, resource sharing and technical collaboration is important in the development of fish and fish products traceability system.

Firms build traceability systems to improve supply-side management and construct lower-cost distribution systems, but simply knowing where a product is in the supply chain does not improve supply management unless the traceability system is paired with a real-time delivery system or some inventory-control system (Golan *et al.*, 2004).

The traceability system is becoming of increasing importance at the international level, though there are different application formats depending on the APEC member economy. In some countries the adoption of traceability systems is regulated only by private standards, and the incentives for their adoption are market-based (for example in the USA), whereas in others a mandatory regulation has been introduced, especially for the beef supply chain. The EU, in addition to obligatory traceability for the beef sector, has adopted a 'mixed' system that foresees a public regulation concerning a basic level of traceability for all agri-food products (Reg. 178/2002), and voluntary systems that refer to national and international private standards. Focusing on the effects of traceability in terms of vertical coordination in the EU, mandatory traceability has only a limited effect on the vertical relationships of the supply chains, whereas a second level of traceability referred to private standards involves a reorganization of vertical relationships due to a system that permits the association of product batches with information flow. Following the new institutional approach, particularly transaction cost economics, we considered traceability as an institution affecting supply chain organization. In the empirical analysis we evaluated the changes in terms of transaction characteristics, costs and governance within the food supply chains. The results confirm the hypothesis of a growth in transaction asset specificity, a decrease in the uncertainty level throughout supply chains and an augmentation of monitoring costs due to the specific investment necessary to implement traceability. These changes lead to new forms of governance revealing an increase in liability among the agents of the supply chain, and an enforcement of production rules, leading in general to an increase in vertical coordination. Factorial and cluster analysis revealed different effects of voluntary traceability on supply chain organization

in four groups of firms depending on the level of transaction characteristics and cost variations, and on the governance surrounding the exchange among the economic agents of the food chain before the introduction of the voluntary system. Firms revealing increased informative transparency (like firms in the third cluster) had no reorganization of vertical relations, although it can be observed that there was an increase in bilateral dependency between economic agents. In accordance with Williamson's theory, the reduction in the transaction uncertainty degree reduces the risk of contractual infringement. In such a situation subjects do not increase the level of vertical coordination in order to ensure the correct execution of agreement conditions. On the other hand, if the level of uncertainty remains more or less the same, and the level of asset specificity or monitoring costs increase (like in the fourth and first clusters) variations in the organization of transactions are observed. According to Williamson's contracting scheme, economic incentives (cluster 4) or more stringent contractual safeguards (cluster 1) are established for traced suppliers. In the vertically integrated firms (cluster 3) no significant variations in asset specificity and uncertainty are observed whereas monitoring costs increase. However, this does not lead to a governance variation as transactions are already internally organized.

Companies that produce, process and handle food products that are destined for export to the European Union and other major Northern Hemisphere markets are required to keep and retain more detailed records than was previously the case, supported by appropriate operational systems. There are obvious benefits when supply chain and trading partners adopt a common, practical chain-wide product identification and information communication standards. Agricultural industries and companies in many developing courtiers that supply products to sotiphicated markets and customers lack information and communications technology (ICT) infrastructure and the associated skills and capacity. Traceability of agricultural products is a new requirement, and there is a global shortage of experienced agricultural supply chain traceability analysts and system implementers. This situation is compounded by the fact that standards are still evolving and hence there is a lack of accredited supply chain traceability qualifications.

It is thus important that countries and industries evaluate the implications of the techno-trading climate that is developing on the back of food safety and traceability, and strategies to meet and beat the challenges. Individual producers, food processors and supply companies must similarly understand how and when their businesses might be affected, and prepare for traceability in good time. To often, smaller supply chain companies get caught up in last minute must-do-must-have dictates from a valued customer or influential trading partner. Such implementations are likely to be resented, costly and inefficient, with the supplier doing the bare minimum that is needed to retain a business relationship. Companies that are unable to meet the requirements and standards within the time allowed run the risk of being cut out of the supply chain.

Referring to the transaction governance changes we can outline three different situations. Firms that used oral agreements before the introduction of voluntary

traceability show an increase in vertical coordination due to the introduction of formal agreements with specific safeguard conditions. Firms that use contracts for exchanges can undergo variation in conditions established in agreements (price incentives). Moreover, vertically integrated firms do not show any variation in the governance of transactions as they are already internally safeguarded. These changes in vertical relations reinforce the ties created within the supply chain, facilitating the creation of transactions characterized by strong bilateral dependency among the economic subjects; in many cases, such dependency also concerns a closer geographical neighborhood among the traced firms. This aspect is very relevant in the situation of both market globalization and the possibility of outsourcing some phases of the production process. Adopting traceability based on private standards can lead to benefits for both the producer and the consumer. Indeed, firms can enjoy benefits from the strategic choice of differentiating their products in terms of specific food quality and safety standards, achieving through a centralized mode of organization, a reduction in product recalls, precise identification of the responsibility of the agents involved in the network, and a more efficient management of the supply chains. For the consumer the advantages concern an increase in controls, more information and, above all, better food.

Staff labor costs are a huge factor in production of fresh fruit and vegetables regardless of the environment or region. Using the ProducePak V5.0 Timesheets Module, staff labor is accurately tracked, easily and rapidly recorded, and is attributed to the relevant crop/block cost centre for later profit and staff performance analysis.

Traceability presents both challenges and opportunities for educators, research and development practitioners and agribusinesses. Students in agricultural related disciplines need exposure to the concepts and principles of supply chain management and traceability to prepare them for the practical and management challenges that these present in industry. The trend to implementing traceability systems based on providing detailed documentation on the history of a product may enlarge to create a demand for traceability professionals in agribusiness and other life science industries. Developing cost-effective traceability technologies for both large and small scale farmers and post harvest enterprises should receive priority attention by engineers and other science and technology experts working in agriculture and other biological industries. Farmers and food product handlers need training on the principles and procedures of traceability. With increasing concentration of global supply chains and enactment of new regulations on traceability in agriculture, technology transfer and rural development projects designed to improve the market orientation and quality of products from small-scale farmers in developing countries must include appropriate tools to facilitate the traceability of their products and processes.

5. Remarks and Conclusions

One size does not fit all. The greatest challenge to implementing traceability and assurance systems may be adjusting a century-old public-private partnership that has been extremely successful using a “one size fits all” paradigm.

The emergence of traceable agricultural supply chains is the outgrowth of a long line of developments in improving food quality and safety management. In industries such as telecommunications, software development and airlines, security is the principal driver for traceability. In recent times, traceability has emerged as a new index of quality and basis for trade in agricultural products. This development has been catalyzed by rising incidence of food-related health hazards and high-profiled scares such as BSE, FMD, dioxin in poultry products, and microbial contamination of fresh produce. The decline in consumer confidence has been exacerbated by the introduction of genetically modified organisms, plants and animals into the human food chain. The purpose of agricultural traceability is to permit the full backward and forward tracking of a product and its life history (activities) in the supply chain, from farm to fork. It is therefore a preventative quality and safety management tool. A good traceability management systems allows for trace-back to the original producer as well trace-forward to individual consumers and indeed any step in the supply chain, for effective identification of products and management of recall when quality and safety standards are breached. From a consumer perspective, traceability helps to build trust, peace of mind, and increase confidence in the food system. For the grower and post harvest operators, traceability is part of an overall cost-effective quality management system that can also assist in continuous improvement and minimization of the impact of safety hazards through rapid determination and isolation of sources of hazards. It also facilitates rapid and effective recall of products, and the determination and settlement of liabilities. Modern technological innovations already exist which can be applied to develop and implement an integrated agricultural traceability system. Advances in information and computer technology for information systems management; scanning and other digital technology for product identification, image capture, storage and display; nondestructive testing and biosensors for quality and safety assessment; and geospatial technology (GIS, GPS, RS) for mobile assets tracking and site-specific operations, are technological innovations that can be applied in a traceability system. Initial cost may be limiting, but several commercial products and software already exist, which can meet the needs of most medium farms and other agribusiness. Developing appropriate traceability technology for small-scale farmers, particularly in the least developed countries, offers considerable challenges and opportunities for researchers and development practitioners in this food and agribusiness. Traceability is an interdisciplinary concept that promotes documented transparency in the way we practice sustainable agriculture. It applies technological innovations to sound agribusiness practices in order to meet consumer demands for reliable and accessible information about the source and life history of products in the human food chain. Farmers, processors and handlers, and food policy experts need to be aware of future developments in this area to assist them in implementing appropriate traceability systems for their enterprises.

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Annex 4

Traceability in Fishery Trade and Production in Thailand

Varin Tanasomwang
Samutsakhon Coastal Fisheries Research and Development Center. Department of Fisheries
Thailand

Introduction

Fishery is an important sector on the economy of Thailand for decades. A total production of the fishery was 3,625,930 tons in 1999 accounting for US$ 3,560.64 million. Major contribution of 2,725,200 tons came from marine capture with a value of US$ 1,382.31 million. Aquaculture industry contributed 693,830 tons accounting for US$ 1,958.69 million by which 441,220 tons derived from coastal aquaculture valued at US$ 1,760.07 million.

In 2008, the total fishery production and value were estimated at 3,802,740 tons and US$ 4,016.41 million, respectively. The production from marine capture decreased to 2,196,040 tons accounting for US$ 1,696.02 million. Alternately, the aquaculture production increased to 1,382,340 tons contributing US$ 2,063.94 million. The production of 519,070 tons valued at US$ 549.40 million was from freshwater culture while 863,270 tons with a value of US$ 1,514.54 million from coastal farming. The shift of fishery production in quantity and value by sub-sector during 1999-2008 are shown in Table 1 and 2. At present both fresh and coastal aquaculture contribute important portion to the fishery production in Thailand.

Table 1. Fishery production in quantity by sub-sector in 1999-2008

(unit: 1,000 tons)

Year	Total	Capture		Culture	
		Marine	Inland	Coastal	Freshwater
1999	3,625.93	2,725.20	206.90	441.22	252.61
2000	3,713.27	2,773.68	201.50	467.07	271.02
2001	3,648.42	2,631.70	202.50	534.53	279.69
2002	3,797.03	2,643.73	198.70	660.10	294.50
2003	3,914.02	2,651.22	198.40	703.28	361.12
2004	4,099.65	2,635.97	203.70	736.27	523.71
2005	4,106.35	2,603.37	198.77	764.74	539.47
2006	4,030.23	2,461.95	214.00	826.87	527.41
2007*	3,835.40	2,234.58	223.83	869.71	507.28
2008*	3,802.74	2,196.04	224.36	863.27	519.07

* Estimated value

Source: http://www.fisheries.go.th/it-stat/top.html

Table 2. Fishery production in value by sub-sector in 1999-2008

(unit: million US$, US$ 1 = approx. 35 bahts)

Year	Total	Capture		Culture	
		Marine	Inland	Coastal	Freshwater
1999	3,560.64	1,382.31	219.64	1,760.07	198.62
2000	3,832.92	1,384.14	206.32	2,015.24	227.23
2001	4,506.47	1,411.48	200.71	2,653.34	204.95
2002	3,960.56	1,534.81	201.41	1,959.20	265.14
2003	3,779.75	1,667.84	179.72	1,618.25	313.94
2004	3,769.78	1,833.41	202.00	1,357.64	376.73
2005	3,937.14	1,765.73	212.46	1,407.15	551.80
2006	4,016.75	1,793.80	224.37	1,422.51	576.07
2007	4,172.71	1,779.67	241.21	1,575.02	576.81
2008	4,016.41	1,696.02	256.45	1,514.54	549.40

Source: http://www.fisheries.go.th/it-stat/top.html

Current Situation of Aquaculture Industry

Aquaculture in Thailand was gradually developed after establishment of the Department of Fisheries, Ministry of Agriculture and Cooperatives in 1933 and the Faculty of Fisheries, Kasetsart Unversity in 1943 by the Thai government. Fish culture has expanded rapidly since 1970s to meet the demand for fish-protein by rapidly growing population. Freshwater aquaculture are commercially operated due to the success in artificial breeding of a number of fish species such as hybrid clarias catfish, striped catfish Chinese carp etc. In 2008 the production from freshwater culture was 519,070 tons contributing US$ 549.40 million (Table 1 and 2). More than 15 species are reared. The highest quantity produced is Nile tilapia followed by hybrid clarias catfish and silver barbs. However, seafood is more favorable for consumption and gains higher price than those derived from freshwater. Much more efforts have been put on high value of marine species. Marine shrimp culture has grown steadily since 1985 due to the success in mass seed production of black tiger shrimp (***Penaeus monodon***) and the advance in culture technology. This has changed the culture method from natural or extensive to semi-intensive and intensive system.

Thailand has long coastline that are suitable for developing into shrimp farms. Climate condition is also favorable. In addition, overseas demand has, for the most part, strongly acted as an incentive for production. Shrimp production tremendously increased since 1988. The production was 118,600 tons in 1990 and reached 280,000 tons in 2001. More than 90% of cultured shrimp has been exported. However, the rapid expansion of intensive shrimp farms without good management and practice has caused serious problem of environmental deterioration. A characteristic phenomenon affecting shrimp ponds is decline in production and increase in disease outbreaks. Due to the problem of disease outbreaks and slow growth, the cultured species has shifted from black tiger

shrimp to Pacific white shrimp (***Penaeus vannamei***) from 2002 onwards. Thailand has become world leader in shrimp production and exportation since 1991 although in 2002 production was less than that of China. In 2006 shrimp production was peak at 507,184 tons comprising 503,207 tons of Pacific white shrimp and 3,977 tons of black tiger shrimp (Table 3). Most of the shrimp products have been exported to U.S.A., Japan, Canada, South Korea, EU and Australia with 27% of world market share in 2006. (Figure 1). In 2008, the production slightly declined to 466,329 tons by which 99.6% was Pacific white shrimp and 0.04% black tiger shrimp. The rank and market share of Thai shrimp in the world main markets is shown in Table 4.

Table 3. Production of cultured marine shrimp in 1990-2008

Year	Production (MT)			Growth (%)
	P. monodon	*P. vannamei*	Total	
1990	118,600	0	118,600	+26.17
1991	162,100	0	162,100	+36.68
1992	185,200	0	185,200	+14.25
1993	225,700	0	225,700	+21.87
1994	264,100	0	264,100	+17.01
1995	255,890	3,650	259,540	-1.73
1996	235,035	4,465	239,500	-7.72
1997	223,551	4,009	227,560	-4.99
1998	247,458	5,273	252,731	+11.06
1999	271,019	4,525	275,554	+9.03
2000	304,594	5,200	309,794	+12.43
2001	275,000	5,000	280,000	-9.62
2002	245,000	56,000	301,000	+7.50
2003	194,909	135,816	330,725	+9.88
2004	142,600	249,400	392,000	+18.53
2005	14,550	408,235	422,785	+7.85
2006	3,977	503,207	507,184	+19.96
2007	3,300	441,451	444,751	-12.30
2008	1,909	464,420	466,329	+10.30

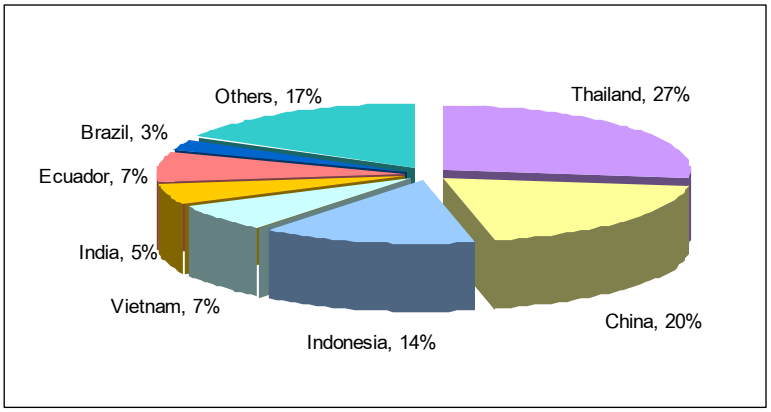

Figure 1. World market share of cultured shrimp production in 2006

Table 4. Rank and market share of exporters in USA, Japan and EU in 2008

Market/ Exported APEC member economy	USA Rank (%)	Japan Rank (%)	EU Rank (%)
Thailand	1(31)	2(20)	1(13)
Indonesia	2(15)	3(18)	4(9)
Vietnam	3(12)	1(21)	5(8)
China	5(6)	4(9)	6(5)
Ecuador	4(8)	21(0.3)	2(12)
India	6(4)	5(9)	3(10)

Source: World Trade Atlas, 2009

Food Safety and Quality Certification

The fishery industry has produced safe and premium quality products for decades. However, the rapid growth of aquaculture especially intensive culture has induced various disease outbreaks resulting in extensive use of drugs and chemicals. This has led concerns over food safety issues worldwide. In response to these concerns, the Thai government has assigned food safety issue as national policy. Thailand also declared the year of 2004 as the "Food Safety Year" in order to standardize the quality of food products for both domestic consumption and exportation.

However, Thailand is the world leader of shrimp producer and exporter. At the same time, shrimp importing countries has required much more on the food safety and quality assurance. In order to maintain Thailand's exporting potential, the Department of Fisheries has put a lot of efforts by introducing several program started with shrimp industry. Food safety control should cover the whole supply chain from farms to tables. The food safety control system is focused on good practices in each production chain.

At farm level which consists of hatchery, nursery and grow-out farm (Figure 2). There are two standards for quality control. The first standard is GAP (Good Aquaculture Practice) which is minimum requirement of aquaculture farm management for small scale. The practice is emphasized on producing good quality and safe shrimp for consumers. Shrimp farms must be clean, sanitary and generate no environmental impacts. Furthermore, therapeutic and chemical agents leading to residues must be avoided in shrimp health management. The second is CoC (Code of Conduct for responsible aquaculture). This standard s full requirement of aquaculture management and harvest as premium grade product. Awareness is in all items of concern with preventive measure according to the farm operational manual. Aquaculture farms comply with these standards though certification scheme.

Figure 2. Shrimp farm and its production

At processing level, shrimp processors and exporters have to comply with GMP (Good Manufacturing Practice), HACCP (Hazard Analysis and Critical Control Point) for their manufacturing. In addition, a number of processing plants are certified with ISO 9000 and ISO 14001 which are internationally recognized standards. Thai shrimp has been well recognized by the world importers and consumers as high quality products (Figure 3).

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Figure 3 Processed shrimp

Food Supply Chain and Traceability

Shrimp industry is not bring in revenues to the APEC member economy but also provides career opportunities for the whole supply chain for more than one million people in Thailand. Years ago, Thai shrimp products has faced the problem with some antibiotic residues due to the wrong application by the producers. This has made the volume of shrimp export reduce drastically.

With the concern of Thai government, the Department of Fisheries has set up food safety projects for fish and shrimp production in order to improve the quality production including traceability system.

For traceability system development, the Department of Fisheries has put an effort to develop the concept as well as the documentation for fish and shrimp

production. As for shrimp production, the concept of traceability has been developed with the assistance of French government by French experts under Thai-French cooperation program since 2002. The Thai-French cooperation program has been completed by mid 2004 leaving to be continued for further work. The concept developed includes the whole production line from farm to processing level including feed utilization, hatchery and farm operations, shrimp collectors/distributors and processors. Moreover, at the Departmental level, traceability system using documentation known as "Movement Document" or MD has been used among four steps, from hatchery to farm via shrimp distributors to processing level. Manual traceability in the form of MD has been occupied since 2002 up to present. In 2005-2006, a pilot project was implemented to establish a computerized traceability system called "TraceShrimp" under Thai-EU cooperation. The application of traceability system for shrimp supply chain is shown in Figure 4.

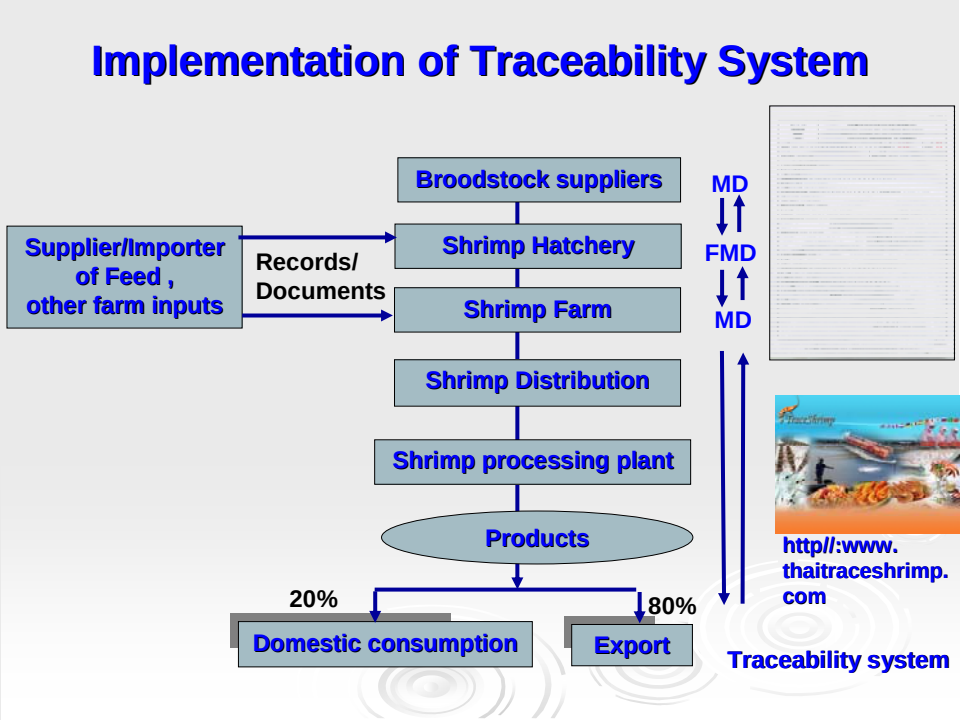

Figure 4. Application of traceability system in the shrimp supply chain

Shrimp hatcheries, nurseries farms feed producers and food processors who wants to use the TraceShrimp system have to apply for membership at the Department of Fisheries. After approval, users receive a login name and password. However, focal points must be assigned to manage the system within their organization. Each organization can allow their customers to trace back information.

Hatchery information: Broodstock collected domestically or from abroad is recorded with a code. Information from each hatchery will be transferred to the nursery. Feeds used in rearing shrimp from zoea to post-larvae (PL) stages are recorded. PL are transferred to farms with a fry movement document (FMD) which will be transferred to the TraceShrimp system.

Shrimp farm information: After receiving PL from the nursery, farmers have to record data on type of feed (company name, batch) and CoC practice information. After harvesting, the movement document (MD) must be prepared. All data will be sent to the TraceShrimp system.

Processing plant information: Data of raw materials (date receiving, MD) process (production data, size) and finished products transferred to domestic or export traders are collected and sent to TraceShrimp via direct electronic data interchange (EDI).

Feed production information: Data on incoming and processing which has been examined and certified by the Department of Fisheries and transportation of the feeds to hatcheries and farms are recorded and sent to TraceShrimp via EDI.

The pilot project of TraceShrimp under Thai-EU cooperation has been finished. The Department of Fisheries is analyzing the program regarding objectives, results and budget management. By the way, FMD and MD are workable and may be fit for small scale farmers. These documents are provided by officers of Provincial Fisheries Offices, Coastal Fisheries Research and Development Centers, Shrimp Culture Associations/Clubs to hatchery operators or farmers who make a request. However, the manual traceability increases task for the personnel.

The better and more efficient of computerized traceability system is still in an urgent need for Thailand whom known as one of the top shrimp exporter of the world. The Department of Fisheries is considering to use technology to increase the competitiveness of the shrimp industry and also to increase cooperation between the government and private sector. The use of a computerized system may increase data accuracy and availability; consequently it will increase confidence of the buyers in the quality and safety of Thai food products.

READINESS OF DEVELOPING AND APPLYING TRACEABILITY SYSTEM IN AGRICULTURAL TRADE AND PRODUCTION IN INDONESIA: CURRENT SITUATION AND SOLUTIONS

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Introduction

With the openness of the world economy, global trade including trade in food has increased faster. The food is move faster from one location to another location. At the same time, food safety problems occasionally happen such as presence of forbidden chemical food additive, excess residual pesticide in vegetables, and presence of antibiotics in food of animal origin. Back to some years ago, international food trade was disturbed by BSE and dioxin cases and only recent days food safety cases due to melamine.. All these events have caused food scare, which lowers people's reliance in the APEC member economy and society. In order to protect their community and ensure that the food supply is safe, every importing economy should put more intensive attention on the transparent food trade and set a series of rules and requirements which is very strict and tough. Constructed and promoted by many countries in the early 21st century, food traceability system was developed to improve the security and safety of food chain. This system is aimed at preventing food chain crises (such as those evidenced in recent years), and therefore will allow the consumers to make more informed choices regarding the producers of the goods on their supermarket shelves. This, in turn, can significantly hinder the flow of inferior food and encourage quality and competitiveness throughout the world.

As defined by the European Union, traceability means "the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution." Traceability is the ability to accurate record and report on what ingredients, processes, machines, operators, recipes etc. were used in the production of consumer goods. Food processing facilities need to be able to assure consumers, shareholders and government agencies that quality ingredients are used in the production of the consumer goods. Agricultural products, except those being served raw, could be raw ingredients of many processed food

products. Hence, a complete traceability system should start with a well managed source. The Ministry of Agriculture is in charge of promoting the establishment of a traceability environment for agro-food products. Producers are expected to record the operational procedures and resumes, including the production of raw materials, processing and manufacturing, and product distribution, hence to enable consumers to trace back the sources of raw materials and also to track forward the whereabouts of products.

Transparency and traceability of the entire food chain is the principle of promoting food traceability. It is expected to provide consumers the related information about food production, processing and distribution, and at the same time to allow a fast trace back the causes of food poisoning accidents, and to recall flaw products. In such a way, food safety can be increased by reducing food accidents. In Indonesia, agro-food traceability is utilized within the implementation of food safety and quality system as food inspection and certification system. It systematically elevates the reliability of the whole food chain, which enhances not only food sanitation but also the safety and security of the food chain. Therefore, on one hand, food traceability system can ensure food safety and public health as well as people's belief to the food chain and the government. On the other hand, an information system is developed to integrate with the traceability works, allowing a fast and correct trace back of agricultural products, and most importantly, reducing the risk and impact of food accidents.

This article briefly describes the current position and solution of developing agro-food traceability system in Indonesia, in past few years and also the recently enacted regulations of certification and authentication, thus to give an introduction of information systems.

Agricultural Sector Performances

a. GDP Growth

During 2000-2003 periods, average growth rate of agricultural sector GDP was 1.83 per annum, higher than during crisis (1998-1999) of only 0.88 percent per annum, even compared to the 1983-1997 (before crisis) of 1.57 percent per annum. Up to the third quarter of 2004, the growth of agricultural sector GDP was 3.23 percent as compared to third quarter of 2003. For 2006, Indonesia's economic outlook was more positive. Economic growth accelerated to 5.1% in 2004 reached 5.6% in 2005 and 6.1% in 2008. Contribution of sectors to GDP is agriculture (14.4%), industry (48.1%), services (37.5%). Within the agriculture sector, food

crops and estate sub sectors grew higher than that of before crisis, while livestock sub sector has not fully recovered yet. After passing low growth phase, agricultural sector is now in the phase of accelerating growth, entering towards sustainable growth.

b. Agricultural Production

Statistics Indonesia provisionally valued *food crop* yields at 213,529,700 million rupiahs in 2006 thus registering over 35% growth since 2003. Central Bureau Statistics (CBS) provisionally valued *estate crop* yields at 62,690,900 million rupiahs in 2006 thus registering over 34% growth since 2003. Central Bureau Statistics (CBS) provisionally valued *livestock* and its derivative products at 51,276,400 million rupiahs in 2006 thus registering over 37% growth since 2003. Central Bureau Statistics (CBS) provisionally valued forestry at 30,017,000 million rupiahs in 2006 thus registering over 63% growth since 2003. Central Bureau Statistics (CBS) provisionally valued *fishery* at 72,979,900 million rupiahs in 2006 thus registering over 60% growth since 2003.

c. Export and Import

During the 2000-2008 periods, balance of payment of food crops, horticulture, estate crops and livestock (excluding fishery and forestry) for fresh and processed products had been consistently increased. In 2008, the average export value was US $ 5.1 billion, while average import value was US $ 4.6 billion, so that average balance of payment surplus of US $ 0.5 billion. During the 1998-1999 periods, import had been drastically declined, in such the average balance of payment surplus of US $ 1.4 billion. During the 2000-2004 period (after crisis), export has been increasing so that balance of payment surplus has reached US $ 2.2 billion.

As of June 2004, export value of agriculture commodities for both fresh and processed product was US $ 8.6 billion, while import value was US $ 4.7 billion, so that balance of payment surplus was US $ 3.9 billion. This surplus was mostly due to better paddy production in 2004 which reach 54.06 million tons, over targeted production of 53 million tons, so that import had been decreasing from 1.4 million tons (US $ 291 million) to only 0.17 million tons (US $ 0.4 million). Import value of corn had been decreasing from US $ 160 million to only US $ 80 million. However, import value of soybean has been increasing from US $ 370 million in 2003 to be US $ 383 million in 2004. The primary source of agriculture export remains estate crops subs sector, palm oil and natural rubber in particular.

d. Farmers Welfare

In the end of 1998, multi dimensional crisis caused the increased of number of poverty to 26 percent or 32 million persons of rural population and 22 percent or 18 million persons of urban population. In 2004, number of poverty has drastically decreased to 19.5 percent or 25 million persons of rural population and 12.6 percent or 13 million persons of urban population. While in 2006, the number of poverty was 17.8 percent.

Absolute number of poor farm household had been decreasing from 26 million persons in 1999 to 20.6 million persons in 2002. Significant increase of agriculture sector growth is expected to reduce number of poor farm household member by the end 2004. Based on CBS data, in the 1998-1999 period income from agriculture (1993 constant price) had been decreased, but during the 2000-2003 period it has been consistently increased.

The principles for traceability

As defined by Codex, the principles of traceability cover the context, rationale, design and application of traceability/product tracing as a tool for use by a competent authority within a food inspection and certification system. The traceability/product tracing tool should be able to identify at any specified stage of the food chain (from production to distribution) from where the food came (one step back) and to where the food went (one step forward), as appropriate to the objectives of the food inspection and certification system. When an importing economy use a traceability/product tracing tool, it should not be mandatory for an exporting economy to replicate (i.e. establish the same) the traceability/product tracing tool as used by the importing economy. A food inspection and certification system within which a traceability/product tracing tool is applied should not be more trade restrictive than necessary. And the application of the traceability/product tracing tool within a food inspection and certification system should be practical, technically feasible and economically viable.

Traceability system

Totality of data and operations that is capable of maintaining desired information about a product and its components through all or part of its production and utilization chain.

Current situation of traceability implementation in Indonesia

a. Regulation on traceability/product tracing

As in many other countries, Indonesia in the view of traceability as a way of responding to potential risks that can arise in food and it is needed to ensure that all food products in Indonesia are safe for Indonesian citizens to eat as well as to export. It is vital that when national authorities or food businesses identify a risk they can trace it back to its source in order to swiftly isolate the problem and prevent contaminated products from reaching consumers. In addition, traceability allows targeted withdrawals and the provision of accurate information to the public, thereby minimizing disruption to trade. Past food crises, such as dioxin contamination and BSE, have illustrated the particular importance of being able to swiftly identify and isolate unsafe foodstuffs in order to prevent them from reaching the consumer.

At this moment a technical regulation is being constructed by Ministry of Agriculture where traceability/product tracing is applied within an agro-food inspection and certification system to identify at any specified stage of the food chain (from production to distribution) from where the food came (one step back) and to where the food went (one step forward). It is requires that all food and feed operators implement traceability/product tracing into their quality management systems enable them to identify where their products have come from and where they are going and to rapidly provide this information to the competent authorities In Indonesia.

b. Quality Management System for Agro-food products

The reason to promote the quality management system of agriculture products in Indonesia is to ensure food safety and in the hope to establish a safe agricultural production value chain. As a member of WTO, the agricultural products and agricultural production in Indonesia have encountered an enormous impact. In the meantime, the worker population in Indonesian agriculture is ageing, and the increase of production costs leads to a decline of competitiveness. Agriculture in Indonesia is in need of innovation and advancement. To effectively increase Indonesia agricultural safety and competitiveness, Indonesian government, farmers and agribusiness highly value the implementation of food safety and quality management system.

The Ministry of agriculture regulation number 61/Permentan/OT.160/11/2006 on GAP certification requires cultivation and operation of Good Agricultural Practice (GAP) are conducted in the field by agriculture farmers and Ministry of Agriculture regulation number

35/Permentan/ OT.140/7/2008 on GMP certification requires handling and processing together of Good Management Practice (GMP) are conducted by operator in agro food industry. In Ministry of agriculture regulation number 58/Kpts/OT.140/8/2007 on Standardization system in agriculture sector allow the implementation of HACCP system, ISO 22000, organic food system and other food safety and quality management system to ensure the safety of agro-food and enable them to be traced back and forward at the same time.

Documentation system of GAP is applied for farmers and to develop and maintain related information about their cultivation activity to help them manage their crop production Documents may include information on supplier, type and volume of inputs, planting, crops and operation procedures, harvesting time and volume as well as customer or destination of harvested produce. While documentation system of GMP is applied for agribusiness operators to develop and maintain related information of their product handling and processing activity including the names and addresses of the supplier and customer in each case, as well as the nature of the product and date of delivery. Operators are also encouraged to keep information on the volume or quantity of a product, the batch number if there is one, and a more detailed description of the product, such as whether it is raw or processed. Recording is applied during production, processing and handling.

c. Problems and solutions

Promoting the implementation of food safety control system with traceability/product tracing within the inspection and certification system of it is not without any constraints.

a Processors, packers, and manufacturers not always maintaining lot-specific information, as required;
b Other types of facilities not maintaining lot-specific information because it is not required;
c Retailers receiving products not labeled with lot-specific information; and
d The mixing of products from a large number of farms.

These factors also affect the speed of tracing specific food products through the food supply chain.

The poor awareness and knowledge on food safety and quality, low level of education, poor access to information and lack of infrastructure are among the main constraints in implementation of food safety control system and product tracing system. Weak farmer institution and tradition to some

extent adds the weakness in implementation of food safety control and product tracing system.

To promote implementation of the traceability system in the agro-food industry in Indonesia not only aimed at competitive products through the improvement of safety and quality as well as the availability of desired information throughout the food chain of agro-food, such actions should be taken:

Promote the development of statutory regulation, to strengthen existing records requirements regarding lot-specific information

Ministry of Agriculture should seek statutory authority, to require all processors, packers, and manufacturers to create and maintain lot-specific information for food products. Ministry of Agriculture should also extend the requirements regarding lot-specific information to other types of facilities, such as distributors, storage facilities, and retailers, in order to further strengthen the traceability of food products.

Enhance the competent authority in central and regional government to facilitate the improvement of traceability in agro-food industry

Ministry of Agriculture should consider seeking additional statutory authority (OKKP) requiring food facilities to further strengthen the traceability of food products. Ministry of Agriculture should consider a variety of different approaches, such as expanding current requirements stipulating that facilities maintain information only for their immediate sources, recipients, and transporters. Ministry of Agriculture may instead require each facility that handles a food product to maintain records about every facility or farm that handled the product, along with the relevant lot-specific information. This may allow Ministry of Agriculture to more quickly and accurately trace food products during a food emergency. In addition, Ministry of Agriculture should consider requiring facilities to use certain information technologies to help facilitate recordkeeping, such as interoperable recordkeeping systems. These interoperable systems, which would allow for information to be exchanged among all facilities in the food supply chain, may also allow Ministry of Agriculture to more quickly and accurately trace food products during a food emergency.

Work with related regional governments and the agro-food industry to develop additional guidance to strengthen traceability

Ministry of Agriculture should work with related regional governments (agriculture services office, Food Security Agency) the food industry (farmer group, agro-food handlers and processors) to develop additional guidance on traceability. Among other things, this guidance could

encourage facilities to assign a point person to be responsible for responding to food emergencies, conduct mock recalls, and contract with independent third-party auditors to monitor recordkeeping systems.

Address issues related to mixing raw food products from a large number of farms.

Ministry of Agriculture should work with related regional governments (agriculture services office, Food Security Agency) and the food industry (farmer group, agro-food handlers and processors) to develop standards for mixing raw food products from a large number of farms. This would address a serious vulnerability in the traceability of the food supply chain.

Intensify activity of competent authority to conduct activities to ensure that facilities are complying with its records requirements

Ministry of Agriculture should seek statutory authority (for example OKKP) to request facilities' records at any time, as opposed to its current authority to request records only when Ministry of Agriculture has a reasonable belief that an article of food presents a serious health threat. Ministry of Agriculture should use this authority to conduct traceability exercises or other checks on facilities to ensure that they are complying with its records requirements. With this added authority, Ministry of Agriculture would be able to include a component in its food facility inspections to verify as a matter of course whether facilities are complying with its records requirements.

Conduct education and outreach activities to inform the food industry about its records requirements.

Ministry of Agriculture should develop education activities that focus on appropriate and reliable record keeping systems in the agro-food production. These activities could include informational meetings, workshops, trainings and other initiatives. Ministry of Agriculture should use these efforts to clearly explain the specific types of information that must be maintained, such as transporter contact information. Ministry of Agriculture should also target outreach efforts to facilities that have less familiarity with the records requirements, namely retailers, distributors, wholesalers, and storage facilities.

APPROVED SUPPLIER LIST

Company Name	***Goods Supplied***	***Address***	***Telephone***	***Fax***	***Mobile***

CROP RECORDS

SPRAY RECORDS (HERBICIDES, FUNGICIDES, INSECTICIDES) CALIBRATION DATE: ……

Date	Crop Stage	Target pest / disease	Spray material	Batch number	Rate: L or gm per Ha	Water used: L / ha	WHP	Comments (rain, wind, temp etc)	Harv -est Date	Signed

GENERAL OPERATIONS

Operation	***Date***	***Initial***
Deep Rip/rotary Hoe Beds		
Fumigation		
Final Rotary Hoe/Bed Preparation		
Sow		
Minimum Germination Rate		
Predicted Harvest Date		
Actual Harvest Date		
Tonnage/Bin Quantity Lifted		

FAULTS / PEST & DISEASE MONITORING

Fault(s) ***(Give brief Description of fault/pest or disease)***	***Date***	***Initial***

WEED CONTROL

Operation	**Detail Rates &/or Methods**	**Date**	**Comments**	**Initial**
Pre-emergent Treatment				
Cover Spray				
Spot Spray				
Other Weed control				

IRRIGATION RECORDS

Crop Stage	Hours/Day	Hours/Day	Hours/Day	Hours/Day	Comments	Initial
Pre-emergence						
Emergence						
Emergence to Harvest						

APEC MEMBER ECONOMY REPORT: PHILIPPINES

ESCOLASTICA G.DINAPO
BFAR REGION IV-A

INTRODUCTION:

In CY 2006, the Philippines ranked 8th among the top fish producing countries in the world with a total production of 4.41 million metric tons of fish, crustaceans, mollusks, and aquatic plants including seaweeds. This further increased to 4.71 million metric tons in 2007, and to 4.96 million metric tons last year.

Commercial fisheries production in 2008 contributed 1,225 million metric tons or 24.7% of the national production. Municipal fisheries was 1,332 million metric tons (26.8%). While aquaculture production contributed the remaining 2,408 million metric tons (48.5%).

LEGAL FRAMEWORK:

Republic Act No. 8550 (RA 8550), also known as the Philippine Fisheries Code of 1998 provides for the development, management and conservation of the fisheries and aquatic resources. It reconstituted the Bureau of Fisheries and Aquatic Resources (BFAR) as a line Bureau under the Department of Agriculture. It is mandated to implement an inspection system for the import and export of fishery/aquatic products and fish processing establishments consistent with international and national standards to ensure product quality and safety.

For purposes of monitoring and regulating the importation and exportation of fish and fishery aquatic resources, the inspection and quarantine service of the BFAR is strengthened. Among its function is to examine fish and fishery products coming into and out of the country which may be a source or medium of fish pests or diseases and/or regulated by existing fishery regulations. This is being done to ensure that the quality of imported and exported fish meet international standards. It likewise mandated to establish and maintain laboratories for disease diagnosis during handling and surveillance, as well as inspection during transport, manufacturing and storage in processing facilities, ports, landing areas and markets.

BFARs inspection services are anchored on the applicable national and international food standards and regulations. These regulations have detailed requirements of importing countries on traceability, food hygiene and product safety, respecting the principles of ethical and fair trade and conditions relevant to GMP, personnel hygiene, plant sanitation

and product safety assurance which are provided for in the national regulations and international food standards.
To further strengthen implementation of these regulations, Fisheries Administrative Orders (FAOs) applicable to harvesting, production, preparation and processing of fisheries/aquatic products for export were promulgated, among which are:

a) FAO 117, series of 1975 amended by FAO 117-1 series of 1994: Rules and regulations governing and the operation of processing plants for fish and fishery/aquatic products and prescribing/requiring standards, quality control and inspection of processed fish and fishery aquatic products.
b) FAO 209 series of 2009 series of 2001: Guidelines on the Production, Harvesting, Handling and Transport of shellfish for Implementation of the Local Government.
c) FAO 210 series of 2001: Rules and Regulations on the Exportation of Fresh, Chilled and Frozen Fish and Fishery Aquatic Products.
d) FAO 211 series of 2001: Requirements for Pre-processing and Processing Plants, the SSOP thereof and the Processing and Quality Requirements for Shellfish.
e) FAO 212 series of 2001: Guidelines on the implementation of the HACCP System.
f) FAO 214 series of 2001: Code of Practice for Aquaculture.
g) FAO 247 series of 2006: Powers and Functions of Regulatory Officers (Fish inspectors, FHO, Quarantine Officers and Certifying Officers) for the safety and Quality Assurance of Fisheries and Aquaculture Products intended for Human Consumption.

Other relevant laws include:

a) Presidential Decree 856 Sanitation Code of the Philippines, and
b) Republic Act 7394 (Consumer Act of the Philippines) An Act that protects the interest of the consumers, promote their general welfare and establish standards of conduct for business and industry against hazards, deception, unfair and unconscionable sales acts and practices.

These regulations establish the requirement for implementation of food safety standards as described in the CODEX.

INSPECTION MANDATE:

Pursuant to RA 8550, DA-BFAR is mandated to perform regulatory functions to include among others, the inspection of all fishery establishments involved in the production chain for fishery and aquaculture products to provide guarantee for the protection of public health, consumer welfare and product safety. It includes fishing vessels and boats, carrier vessels, fish ports and landing areas, auction markets, pre-processing and processing plants, ice plants and cold storage facilities.

The national and regional Fish Inspection Units (FIUs) are responsible for the implementation of HACCP-based inspection program as the mechanism of carrying out the official control system of BFAR as the recognized competent authority (CA) for the purpose.

LABORATORY SUPPORT ACTIVITIES:

The effective and efficient implementation of official control by the BFAR is supported with laboratory testing for verification of compliance to microbiological, chemical and sensory standards as required by the importing countries.

The main laboratories are located in the BFAR Central Office which include: the Fishery Product Testing Laboratory (FPTL), the Marine Biotoxin Unit (MBTU), and the Marine Biotoxin Unit (MBTU). FPTL is responsible for microbiological and physico-chemical analysis of fish samples prior to export. The MBTU, on the other hand, monitors red tide toxin, ciguatoxin, cyanide and other substances. Finally, the FHL tests aquaculture products for chemical residue and contaminants and for disease surveillance.

In addition, BFAR has five (5) regional laboratories which are responsible for monitoring microbiological and physico-chemical testing of fish samples. These laboratories are conducting analyses of raw materials as well as finished products that are collected by designated fish inspectors.

OFFICIAL CONTROL SYSTEM:

Verification Sampling and Traceability Procedures: Fish inspectors carryout the task of sampling fishery and aquaculture products for the following objectives:

- to verify the establishment's implementation and compliance to its own food control program;
- to check the safety of their product for export; and
- to check the Standard Operating Procedures (SOP) of in-house laboratory of some processing plants and to determine the reliability of tests results obtained.

The scope covers all stakeholders in the production chain (i.e. fishing/freezer vessel, fish port landing site, aquaculture farms, auction markets, IPCS, pre-processing and processing facilities). These are targeted based on risk assessment studies.

TRACEABILITY SYSTEM:

A reference code is assigned for samples collected and submitted to BFAR laboratory and/or recognized laboratory by the inspectors and/or analyst to determine the

appropriate analysis needed and for the purpose of verifying the products for shipment as requisite for the issuance of Health Certificate (HC).

The code is a combination of letters and numerical numbers representing the following information:

- plant location
- establishment name
- product name
- production code

The code is consistently reflected on the sample collection form, laboratory analysis and on the HC issued to establish product traceability.

For traceability of raw materials, the inspector looks for the Auxiliary Invoice issued by the Local Government Units. This is a certificate given to suppliers prior to transport of raw materials from their point of origin to their point of destination within the Philippines. It bears information on the species of fish, weight, name of shipper/supplier, name of the fishing vessel and the catch area.

PRODUCT RECALL SYSTEM:

Fishery establishments have their own product recall system example of which is:

- First column stands for the supplier of the raw material
- Second column stands for the origin of the raw material
- Third column stands for the product description
- Fourth column stands for the month of production
- Fifth and sixth column stands for the date of production
- Seventh column stands for the year of productions

Product Description	Code	Production	Date	Supplier	Code
Sauteed Tiny Shrimps	C	0	6	ICOR 3 Ent.	I
Salted Tiny Shrimp	D	1	7	LG Inc.	L
Sauteed Tiny Shrimps Paste	F	2	8	Phil-Frost Inc.	P
Salted Anchovies	T				

Origin of Raw Material	Code	Production Year	Code
Manila Bay	1	2005	E
Bataan	2	2006	F
Cavite	9	2007	G
Bicol	3	2008	H

Production Month	Code
January	J
February	F
March	M
April	A
May	Y
June	E
July	L
August	U
September	S
October	O
November	N
December	D

Example: L9CM10H, means:
L - LG Inc.
9 - Cavite
C - Sauteed Tiny Shrimps
M - March
Date - 10
H - 2008

Aquaculture products processed in establishments are advised to source their raw materials from registered farms. These farms are regularly monitored by the Fish Health Officers. BFAR have a total of 223 registered farms in all the regions.

Constraints:

There is difficulty in applying traceability for raw materials sourced from the auction markets. These includes raw materials like tiny shrimps, crabs for crab meat, prawns and milkfish. Owners of auction markets get their supply from several suppliers and the Food Business Operators cannot identify the supplier and the catch area of the commodity.

BFAR's structural mechanism for official control of fishery and aquaculture products to ensure product safety and public health