Traceability in the Cocoa Supply Chain: An Indonesian Context

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Abstract

The multi – events of food alerts and food risks which occurred in a lengthy period and various locations, grows concern of consumers to question the safety of the food that they consumed. For food producers, occurrences of food alert forced them to review their supply chain to identify what went wrong in their supply chain. To do this, they need a good traceability system capable in revealing the problems occurred along the chains. In general, a typical food supply chain consists of farmers, middlemen, manufactures, retailers and consumers, which can be well represented by the cocoa supply chain. This paper is the initial stage in identifying cocoa supply chain and proposes a conceptual framework of its traceability system. Moreover, this paper aims at linking the traceability to performances of the chains as a driver to reach sustainability

Keywords : *Cocoa, Supply Chain, Traceability, Indonesia*

I. Introduction

Globalization and internationalization of companies led to investments in different parts in the world due to various reasons such as low cost labour, low cost materials, relaxed regulations, strategic locations, partnership and alliance and access to raw materials. For the food industry, that the movement of the products mostly starts from developing countries, where raw materials are usually still abundant, to the developed countries, where most of the processing industries are located. In order to respond this trans-boundaries and trans-national supply chain, companies needs to carefully arrange their supply chain in order to meet the consumers' demand and managing uncertainties. In other words, companies need to outlook carefully their supply chain from the first echelon to the end tier/s, expecting that there will be minimum flaw between echelons that could damage their reputation or even their existence in the competition. This situation may incur to opportunistic behaviour that may lead to falsified of the documentation that must accompany foodstuffs, usually in order to increase profit (Martinez and Friis, 2004). Traceability systems become important to identify what supplier's produce, how they produce and when the products will be delivered among echelons (Deasy, 2002) as well as identification of inputs or raw materials.

Previous researches have demonstrated that traceability has become a major issue in the food chain (e.g. Dabenne and Gay, 2011; Gellynck *et al,* 2006; Jacquet and Pauly, 2008; Monteiro and Caswell, 2009; Opara, 2002; Regattieri *et al*, 2007) and in particular, quality and supply concerns are merging with traceability issues (Kaplinsky, 2004). This particular sector is volatile to the hazardous contaminants that can infect the materials or processed products which will eventually, affected consumer at the end and considering the speed of internationalization of food supply chains, there is a need for faster, cheaper, real – time, more sensitive accurate and validated testing method for food safety and quality assurance (van der Vorst, 2006). This also extends to the need of over viewing what are techniques that are

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common on detecting contamination when food alert occurred where we found that there are limited contributions discussing this across various food industries. Thus, we highlighted some of the content analysis techniques in food industry that available in the literature and presented it in the section 2 as show what techniques related to what industries.

Then, we turn our focus on the traceability for cocoa supply chain. We found that this could be an interesting example due limited discussion on traceability in cocoa supply chain (Gilbert, 2009). It even more interesting if we consider several foods recalls that involved cocoa and cocoa products[2] and it also has been adopted into national policy of food safety in Italy (Sicurelli, 2008). A recent study on traceability in cocoa supply chain was provided by Saltini and Akkerman (2012) focusing on economic simulation if food recalls take place. While providing this information, they concentrate their attention on focal company perspective and not the entire supply chain, in most cases, the initial stage of the chain bear the liability (Pouliot and Sumner, 2008). Furthermore, considering the complications, there is a need to understand what information should be convey in each stage of the supply chain. Thus, this paper proposes a conceptual framework on how traceability should be done in cocoa supply chain in the producing country where the traceability law are not complied (Saltini and Akkerman, 2012).

This paper is comprised onto four sections, where in introduction we discussed some background that enforced our proposed research. In the second section, we briefly discuss what are traceability and its content analysis. We also provided discussion on the extent of technology that used for traceability identification as well as the relationship between traceability and sustainability. Then we move to our core discussion on traceability in cocoa supply chain. In the last section, discussion and further direction are provided.

II. Traceability at a glance

The concept on food traceability started in 1994 followed by some food alerts and food recalls[3] which occurred in a lengthy period and various locations that grow concern of consumers to question the safety of the food that they consumed. An earlier definition was provided by International Standard of Organization (ISO) that defined traceability as *the ability for the retrieval of the history and use or location of an article or an activity through a registered identification* (ISO 8402, 1994). Later, a more concrete description provide by the European Union through Regulation (EC) No. 178 / 2002 defining traceability as *the ability trace and follow a food, feed, food – producing animal or substance intended to be, or expected to be incorporated into food or feed, through all stages of production and distribution*[4]*.* The widely accepted and common methodology employed for food traceability is based on one-up-one-down principle (European Commission, 2002).

There are two type of traceability; backward traceability and forward traceability. Backward traceability implies on tracing products back to requirements to ensure that the requirements have been kept current with design, code or tests. Forward traceability performs tracing activities from the requirements to the products to ensure the completeness of the

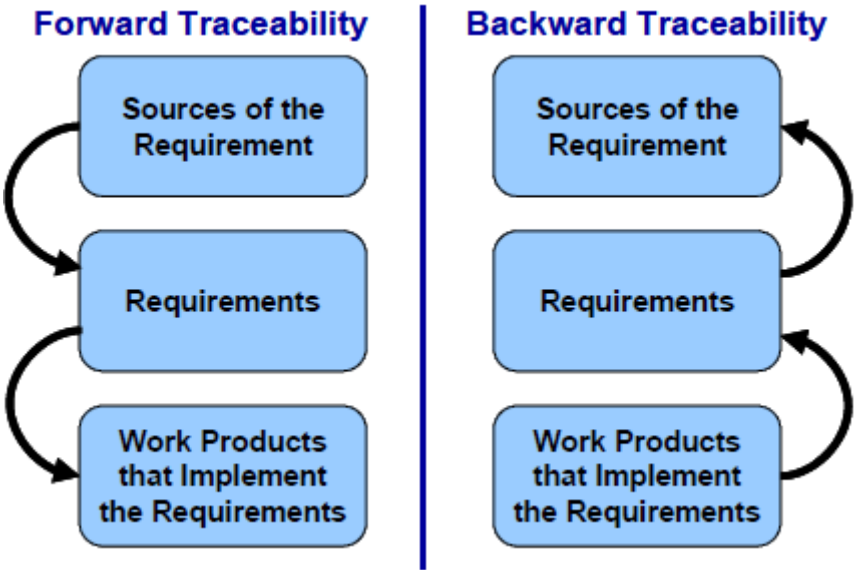
[2] There are several cocoa and chocolate products being recalled from the the market due to various contaminations during 2006 – 2010 (for example *see* http://www.food.gov.uk/enforcement/alerts/2006/jun/cadburychoc; http://www.food.gov.uk/enforcement/alerts/2006/may/choctoffeebites;http://www.food.gov.uk/enforcement/alerts/2009/nov/sainsburyswholenutdarkchocolate)

[3] Food Standard Agency. *http://www.food.gov.uk/enforcement/alerts/*. Accessed on 16th April 2011

[4] European Community. *http://ec.europa.eu/food/food/foodlaw/traceability*. Accessed on 15th April 2011.

product requirement specification. The combination of forward and backward traceability often referred as *bidirectional traceability* (Westfall, 2006) as in figure 1.

Figure 1. Forward and Backward Traceability



Source: Westfall, 2006

Traceability in food chain is nowadays a fundamental requirement, which is becoming mandatory in almost all developed countries. The aim of a traceability system is to collect in a rigorous way all the information related to the displacement of the different products along the supply chain. Understanding traceability's impacts requires shifting perspective in order to encompass the vast array of interests, particularly because how each interest is incorporated into the system will determine how, who and what the human locational database embraces (Popper, 2007). Furthermore, traceability itself offers the promise that the individual can know the full story – the places, people, processes, and practices – of items raised and routed all over the world to end up in one's own mouth.

This information proves essential when facing food safety crisis, and allows efficiently managing the consequent product recall action (Dabenne and Gay, 2011). To ensure the safety and quality of food products, consumers can indentify extrinsic indicators and cues convey information about the products through certification and labelling, which available on the point of purchase (Caswell, 2006) and obtained standard information of the food products (Gellynck *et al*, 2006). One of the biggest challenges with supply chain traceability is the exchange of information in a standardized format between various links in the chain (van der Vorst, 2006; Thakur and Donnelly, 2010).

The context of bidirectional traceability has evolved in recent years and complies with principle of EU traceability, that each chain is able to trace the product at least with their first tier supplier(s) and consumer(s). In the context of agri – food supply chain, consumers gain benefit from increased traceability to the marketers by having better chances of receiving compensation in case of a food safety event and by consuming safer food. Additional traceability from the marketers to the farms does not increase consumer's compensation because it does not change the marketers' liability. However, additional traceability to the farms allows marketers to impose liability costs on farms and thus creates incentives for farms to supply safer food

(Pouliot and Sumner, 2008). Thus, t*raceability must be treated as holistic context compare to partial sight limited to one chain before and after the viewed chain.*

In this way, we stresses on the importance of holistic traceability compare on focusing only on one or two chains. This also in line with Manikas and Manos (2008) stating that the efficiency of a traceability system depends on the ability uniquely *each unit* that is produced and distributed, in a way that enables the continuous tracking, *from the primary production to the retail point of sale*.

2.1. Features of traceability in food chains

2.1.1. Content Analysis in Traceability Measurement

Content analysis in traceability measurements in the food chain comprises of various techniques. It also can be employed for Genetic Modified Organism (GMO) and GM food / feed (*see* Marmiroli *et al,* 2008 for literature review). The application is extended, not only to identify origin of a product, but also to compute the maturity of a food product (e.g. in wine industry). In most of the fishery and aquaculture chains identification techniques (*see* Moretti *et al,* 2003 for literature review), DNA based identification is the most applicable techniques to categorize species identification, production methods and geographical origin of species (e.g. Schröder, 2008; Ardura *et al*, 2010; Maldini *et al*, 2006; Fernández – Tajes *et al*, 2008) as well as in meat (Aslan *et al,* 2009) and wheat industries (Scarafoni *et al,* 2009). In short, traceability is an important feature for offering safe and high qualified food products.

Different methodologies have also being designed to serve different purposes. High – performance Liquid Chromatography (HPLC) is performed to identified nitrate concentrate in several vegetables to see whether the level of concentrate can be acceptable for daily intake (Castanheira *et al,* 2004), carbon and sulphur isotope composition on beef industries (Schmidt *et al,* 2005; Bahar *et al,* 2008). Table 1 presents an overview how content analysis has evolved in the traceability mainstream literature. Overall, fishery and aquaculture industries received high attention in the traceability mainstream followed by the meat and vegetables products. This is due to the fact that scientists are interested in the origin of the consumable fish in the market as well as the treatment received by the fish products before reaching the consumer‘s table.

Table 1. Content Analysis in Traceability Measurement for Food Industries

Industries	Methodology	Literature
Fishery and Aquaculture	DNA Identification	Schröder, 2008; Ardura *et al*, 2010; Maldini *et al*, 2006; Fernández – Tajes *et al*, 2008; Filonzi *et al*, 2010; von der Heyden *et al,* 2010; Ogden, 2008; Pérez *et al,* 2005
	HPLC	Orban *et al*, 2007
	Stable Isotope	Sant’Anna *et al,* 2010
Meat and Cattle	DNA Identification	Aslan *et al,* 2009; Goffaux *et al,* 2005; Losio *et al,* 2004
	Stable Isotope	Schmidt *et al,* 2005; Bahar *et al,* 2008; Guo *et al,* 2010
Soybean	DNA Identification	Bogani *et al, 2009*

Wine	Temperature Monitoring MALDI – TOF Mass Spectometry[5]	Boquete *et al,* 2010 Chamberry *et al,* 2009
Honey	Solid – Phase Microextraction Bottleneck Neural Network	Cajka *et al*, 2009 Novic and Grošejl, 2009
Vegetable Oil and Products	DNA Identification HPLC	Caramante *et al,* 2011; Montemurro *et al,* 2008; Pafundo *et al,* 2010 Castenheira *et al,* 2004; Cserháti *et al,* 2005
Rice and Wheat	DNA Identification	Cirillo *et al,* 2009; Scarafoni *et al,* 2009
Dairy Products	HPLC	Cserháti *et al,* 2005; Fernandez *et al,* 2003
Cocoa	High Temperature Gas Liquid Chromatography HPLC	Buchgraber *et al,* 2003 Cambrai *et al,* 2010

2.1.2. Information Technological Application

Currently, information technology plays an important role for traceability in the food chain, not only for the consumers but also for the producers (Buhr, 2003). There are several methodologies applied to conduct traceability in the food chain led by the recent development in ICT to make traceability more computerized system in implementation (Chrysochou *et al,* 2009). Among them, alphanumerical code, barcoding and radio frequency identification data-RFID (Gandino *et al,* 2009; Regattieri *et al,* 2007; Sahin *et al,* 2002) is the most used techniques in agri – food chain to indentify supplier' products including process system, raw materials, number of batch, etc. In fast moving consumer goods (FMCG) labeling becomes important feature to identify, not only the brand of the product, but also the ingredients contained in the food products (Banterle and Stranieri, 2008), enabling consumer to observe chemical materials inside the food products. Besides that, other approaches conducted are capillary electrophoresis (Vallejo – Cordoba and González – Córdova, 2010) and application of biosensors on food products (Terry *et al,* 2005)

An interesting case study comes from the soybean supply chain showing that only information that will be delivered to the next link is considered important (Thakur and Donnelly, 2010), which means that information only passed to immediate supplier(s) or customer(s) of the echelon. The study also provided evidence of the utilization of Electronic Data Interchange (EDI) and Extensible Markup Language (XML) for standardize data exchange. Other technologies for modelling traceability are EPCIS framework and UML statecharts, which modelled transitions in food production. However, EPCIS specification does not cover all of the events (transitions) described in the previous sections (Thakur *et al*, 2011), thus not revealing all relevant information within the supply chain.

[5] Matrix – assisted laser desorption / ionization – Time of flight mass spectometer

2.2. Traceability and sustainable supply chain management

Of all sustainability elements, traceability has been highlighted (Epstein, 2008) as the driver for transparency (Carter and Roger, 2008) in recent years following recalls of many food products in several countries, leading to higher consumer concerns on food safety and hazardous materials that may be contained in food products. As part of operations, supply chain holds an important position in maintaining the flow of the materials to the processing units up to supplying finished goods to the end consumer (Chopra *et al*, 2001; Chopra and Meindl, 2007). As a consequence of globalization, global supply chains are typically characterized by greater use of transportation with obvious implications on the environment and induce local behaviours that sometimes may not be socially sustainable (e.g., exploitation of low cost labours). These factors are urging stakeholders to take sustainability into account due to both rising concern of national and international regulations and an ever growing attention of end consumers of the implications on sustainability. In the last decade, there have been raising concerns on environmental damage, depleted resources, exploitation of child labour, endangered species, and global warming. Reuter *et al* (2010) state that sustainable supply chain in terms of global supplier management must be managed carefully to reduce risks, which also implies to the globalized food supply chain.

These concerns have shifted the traditional way of manufacturing and operation of most firms in the world so to become more concerned with the triple bottom line (Elkington 1998, 2004), thus guaranteeing both economic, social and environment sustainability of operations. In response to this growing concern, the number of papers that discuss sustainability has increase in the last decade by quintuple-fold (Linton et.al 2007). In the context of performance, traceability provides companies with supporting framework in understanding what practices that been applied by their suppliers. Within this perspective, where the level of trust between suppliers and consumers plays an important role (Barrett *et al*, 1999; Choe *et al,* 2009), traceability also can be extended as ethical approaches and ensures certain consumers to acknowledge information related to the food products that may lead to sustainability[6] (Beekman, 2008).

Similarly, Epstein (2008) pointed out the importance of traceability in identifying sustainability while Kaynak and Montiel (2008), Beamon (2008) and Smith (2008) summarize the relationship between sustainability and supply chain performance, where traceability is identify as one of the key element in the performance for reaching sustainability. This matter also being highlighted by Opara (2002, 2003) and Wognum *et al* (2011) that traceability can actually use to identified the level of social and environmental dimensions whereas traceability overviewed transparency in the food chain (Skilton and Robinson, 2009). However, they also mentioned the difficulties in applying traceability as the major tool to assess sustainability performances in the food chain especially when suppliers have high degree of complexity. Therefore we also adopted the mainstream perspective that *traceability has positive direct impact on supply chain performances.*

[6] Ethical traceability can be functioned as public management tools used to ensure consumer that consumers are provided are provided with food that respect some threshold level of animal welfare, sustainability or fair trade and as public – private tool, used to allow certain consumers to be provided with food products and sufficient information about these products (pp 70 – 71).

III. Traceability Cocoa Supply Chain: An Indonesian Context

3.1. Cocoa industry at a glance

Previously, there was stigma that chocolate is the source of fat, unhealthy product that can cause obesity and heart attack. Yet, it was revealed that chocolate is not causing heart attack, while instead, one type of chocolate (dark chocolate) can strengthen the heart of human and can lower the human blood pressure[7]. This finding indirectly promotes the production of dark chocolate due to shifted preference on healthier products (Knickel *et al* 2002). Similar finding also provided by International Coffee and Cocoa Organization or ICCO (2008) showing that chocolate candies are more dark and high content of cocoa in the recent years. The study was done in US and UK market which can be considered as premium market in chocolate industry. Relevant to that context, market trend shows the consumption of the chocolate in the world is increasing by 14% on average within the period of 1997 – 2006 with USA as the leading country with about 1.600.000 tons in 2006 of chocolate consumption followed by Germany, United Kingdom and France.

The rising demand for chocolate affected the performance in the export of cocoa beans. In the period 2005 / 2006, European region has been accounted for the largest cocoa consumption by 49% followed by American region with 35% and Asian region with 14% of total world consumption. There is significant increase by 728.000 tons in the 2005 / 2006 period compare to the 1995 / 1996 period or equal to 27% increase. Trend showed significant improvement in the organic or sustainable chocolate that comes from sustainable supply chain management due to for example environmental issues and food safety reasons.

In the production side, Ghana, Cote d'Ivoire and Indonesia dominated the cocoa production in the world, accounted for more than 70% of total world production. Market for Indonesian' cocoa beans in European countries still counted as a niche market since only less than 15% of market share is available (Ministry of Agriculture, 2005). Moreover, the challenges for Indonesian' beans are the standard for quality set by European countries and General System of Preferences (GSP) rules in trading, where EU gave zero percent tariff to several beneficiaries (Coté d'Ivoire, Ghana, Brazil, Cameroon and Ecuador), compare to Most Favored Nation (MFN) rules that set 3.5% tariff for Indonesia. In general picture, most of the beans produced in Indonesia are unflavored cocoa beans, which counted for discounted price in the destination countries and subject to importing tariffs (Dradjat *et al*, 2003) and government intervention (Neilson, 2007), while additional fermentation will increase the value added to the beans (Latuhihin *et al,* 2007; Ardhana and Fleet, 2003) Like any other food chain, cocoa also faced sustainability problems such as forest degradation, biodiversity destruction or child labor issue (Neilson, 2007; Schrage and Ewing, 2005) that often occurred in food supply chains.

Approximately there are 400,000 – 500,000 smallholder households engaged in the cocoa production in Indonesia (Panliburton and Lusby, 2006) where most of the plantations are located in Sulawesi Island. Being the 3rd largest cocoa producers in the world, the area of plantations in Indonesia reached 920,000 hectares with the yield reached 630 kg/hectare. The production rate was counted for 600,000 tons/year (Djajusman, 2007). However, only 10% of

[7] WebMD. *http://www.webmd.com/diet/news/20030827/dark-chocolate-is-healthy-chocolate*. Accessed on 16th April 2011.

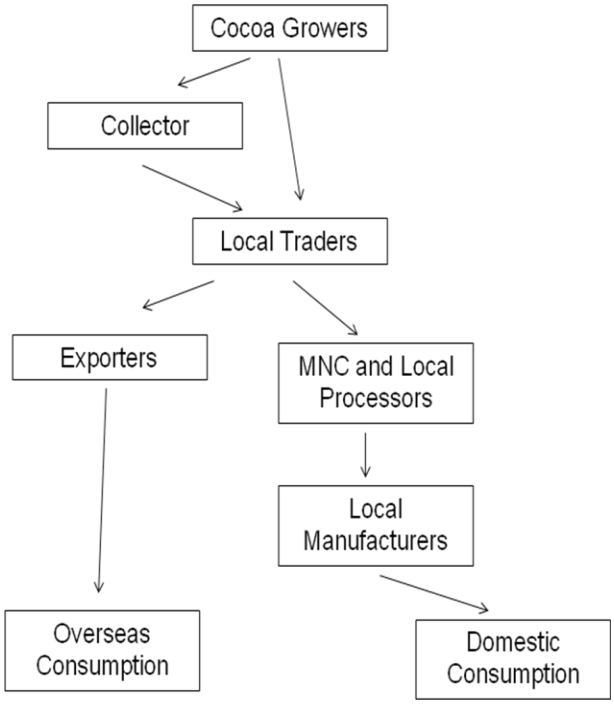
cocoa beans are locally processed, while the rests were exported as raw beans. Approximately 80% of the cocoa beans in Indonesia are sold by the five main multinational affiliate exporters (Panliburton and Lusby, 2006).

3.2. Cocoa Supply Chain in Indonesia

Typical like other food chains, the cocoa supply chain in Indonesia consists of growers, collector, local traders, exporters, multinational (MNC) and local processors and local manufactures (Bedford *et al,* 2002). Farmers cultivate cocoa beans nurture them before finally harvest the beans. The typical characteristics of cocoa growers can be divided into three that are owner farmer, sharecroppers and farm managers where these characteristics were determined by the ownership of the cocoa plantation. Collectors are part of the supply chain that buys and collect cocoa beans from the farmers before sell it to the local traders. They also often referred as *tengkulak*, whereas they usually lend the money to the farmers in the off – farm season (*see* Neilson, 2007 for further detail). Collectors usually operate in the regions where farmers do not have the capability and capital to bring their harvest directly to the local traders.

Later, traders act as the marketing point where cocoa beans marketed to exporters, where the beans then sell to the overseas buyers, and to the local and MNC processors, where the beans processed for the domestic consumption. In the processing stage, beans are extracted into several by – products such as cocoa cake, liquor and butter that are used for confectionaries, cosmetics, chemical and medicines in the manufacturing stage. The cocoa supply chain in Indonesia is detailed in figure 2.

Fig. 2. Cocoa Supply Chain in Indonesia



Source : Adapted from Bedford et. al. 2002

3.3. Traceability in Cocoa Supply Chain in Indonesia

Currently traceability in cocoa supply chain in Indonesia still limited and faces difficulties in the implementation. Not only because the level of adoption is still low among actors in the supply chain, there are also limited technology as well as legal framework that can enforce the practice of traceability for the cocoa supply chain Indonesia. Currently, there exists only voluntary regulations, such as *Standar Nasional Indonesia* (Indonesian National Standard / SNI), that can be used as a guideline to conduct traceability, but there is no regulation such as EC 178 / 2002 that are legitimate and binding.

Table 2 showed the movement of the cocoa beans in different level of supply chain, the transportation and identification modes. As mentioned before in the section 3.2, the product is homogeneous from growers to exporters / processors where in the manufacturing stage, the bean will be extracted into different by – products. Similarly, the transportation of the beans also homogeny for the same stage and will be different in the exporter – consumers stage, where the transportation will change into sea vessel.

Table 2. Traceability on the Indonesian Cocoa Supply Chain

	Growers – Collectors	**Growers – Local Traders**	**Collectors – Local Traders**	**Local Traders – Exporters**	**Local Traders – Local Processors**	**Exporters and Local Processors – Local Manufactures / Consumers**
Product(s)	Bean	Bean	Bean	Bean	Bean	Bean, Cocoa Cake, Cocoa Butter, Cocoa Liquor
Transportation Mode	Truck	Truck	Truck	Truck	Truck	Truck, Sea Vessel
Identification Instrument	Labelling	Labelling	Labelling	Labelling	Labelling	EDI

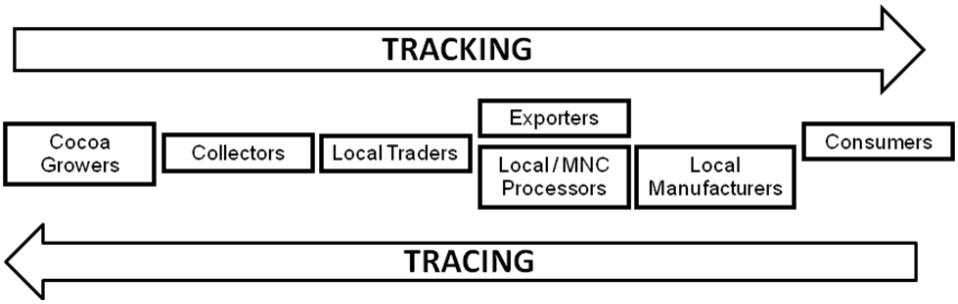
The instrument for identification in cocoa supply chain consists of labelling and EDI systems. Traditionally, growers put cocoa beans into the sacks and then tagged it manually. Most of the tag label in the growers level only mentions the grower‘names and the date of when the beans are harvested. Usually in this stage, problem of quality and traceability usually occurs because collectors usually do not have appropriate recording system. When the beans reaches local traders, it will be labelled that includes the quality of the beans by showing the percentage of moisture and dirt of each sacks received. Finally, when the sacks arrive to exporters or processors warehouses, the manual data are inserted into a personal computer. This entails to the possibility of data mismatch during the supply chain process due to transformation of manual data into automatic data (Thakur and Donnelly, 2010).

3.4. Tracking and Tracing in Cocoa Supply Chain

In this section, we discussed on how traceability that should be employ to cocoa supply chain. In particular, we divide the traceability into two parts; *tracking* and *tracing* that was proposed by Schwägele (2005) enabling each actor in the supply chain recognize the flow of the product even from the initial stage (fig. 3). By this approach, manufacturers can identify not only

their immediate suppliers, but also went back to cocoa growers and *vice versa* and thus, able to identify which stage those are responsible for the food alerts. When the food recall or alerts occurred, farmers or growers as the initial echelon often subjected to the party that is responsible for such occurrence due to, for example, pesticide use or lack of quality control (Pouliot and Sumner, 2008) and subject to economic exploitation where sometimes growers must bear the cost of the recalls. Moreover, we want to highlighted which other information should be inserted in the label including information on sustainability performances.

Fig. 3. Tracking and Tracing in Cocoa Supply Chain



Source: Adapted from Schwägele, 2005

As transparency is the important feature in traceability, in tracing phase, we consider the *flow and openness of information* become the key figures to determine a successful traceability system. This entails on what kind of information should be provided to minimize the occurrence of food alerts. Moreover, information flow can be utilized as the tool to monitor sustainability performances. Taking this into consideration, beside usual information such as number of batch, ingredients and characteristics of the cocoa products, information regarding how focal companies managed their social and environmental performances should be included in the label of the product. On the other hand, the tracking phase meant for tracking the movement of goods downstream and must go as far as the consumer in case of food alert. This mean the information delivered mostly the quality of the product, level of waste and dirt from the growers to at least the processors level. Concerning the point raised by Pouliot and Sumner (2008), we viewed that there is a necessity to growers to track the transmission of the price along the supply chain. This is required to measure the economical performance of the supply chain in complete picture.

IV. Discussion and Further Development

Traceability becomes important figure to identify products, materials, service and processes that had been conducted by the suppliers within the supply chain particularly in the food chain. Traceability also acts as the tool for improving consumer trust towards supplier and product quality (van Rijswijk *et al,* 2008; Verbeke *et al*, 2007) although consumer should pay more for the food product (Xu and Wu; 2010), a counter instrument for misinformation and mislabelling on food products (Jacquet and Pauly, 2008) and by definition, it can be used to measure uncertainty in the supply chain (Bièvre, 2004) as well as a component for controlling and monitoring (Hamprect *et al,* 2004). Moreover, it can provide a significant impact on the pursuant of sustainability (Phillips and Tallontire, 2007). In this context, traceability can provide more detailed information, not limited to the products, but also to the sustainability performance of the supply chain (i.e. social and environmental performances). Thus, traceability must be conducted by all elements in the supply chain and not limited to certain chain.

However, regarding the information' availability, certain chains should possessed complete information regarding the traceability. Nor the consumer nor the farmers, but chains that have better financial performances (i.e. retailers, manufacturers) whereas consumers have strong preferences that other stakeholders, retailers and governments, in the chain possessed information on traceability and available upon request (Gellynck *et al*, 2006). Furthermore, economic incentive can be applied to organizations that employed more stringent traceability (Charlier and Valceschini, 2008; Hirschhauer and Musshoff, 2007) and taking into account all stakeholders concerns (Doluchitz *et al*, 2010, Narrod *et al,* 2009).

This paper also provides a view on how traceability in cocoa supply chain should be done. While taking into account the necessity of having a bidirectional traceability, intelligent transportations for perishable products (Hsueh and Chang, 2010) should also be considered and it can be a prerequisite as prevention against food alert and can be use as a detection tool for pesticide usage (Bateman, 2008; Kaplinsky, 2004). Another possible approach that can be implemented for traceability in cocoa supply chain is the Failure Mode Effect and Critically Analysis (FMECA) proposed by Bertolini, *et al*(2006), which extend the industrial application to food industry. Implementing traceability should not be an economical burden for cocoa supply chain in Indonesia since it only costs 3% of the retail chocolate price (Abbott *et al,* 2005). Furthermore, farmer'acceptance towards also must be taken into account considering that rates of of traceability adoption at the farm level may be lower in regions or countries where the majority of producers market their products independently (Monteiro and Caswell, 2009). Moreover, there is an urgent need for regulation that stresses on the substantial responsibilities of farmers and processing companies for the food quality assurance and therefore, need to prove the diligence and traceability practices in their operations and supply chain (Savov and Kouzmanov, 2009).

Next, it would be interesting to extend the supply chain until the end consumers, not only confectionary industries, but also chemical and pharmaceutical industries that used the fraction of cocoa as one of the ingredients of their products. A cross industries sample selection will provide wider perspective on how traceability works in the cocoa chain.

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